2024
ANNUAL REPORT
MONITORING PROGRAM
(29th MONITORING YEAR)
at
Hudson National Golf Club
Croton-on-Hudson, New York

Prepared for

The Village of Croton-on-Hudson

Prepared by

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EXECUTIVE SUMMARY

The construction of Hudson National Golf Course (HNGC) was approved conditioned on the design and implementation of a comprehensive, multimedia environmental monitoring program. The Environmental Management Plan (EMP; Turf Science Group [TSG], 2000) contains the protocol for the monitoring program. Baseline sampling began on May 30, 1994. The TSG issued the baseline and the first-year monitoring reports (1996), and Environmental & Turf Services, Inc. (ETS) reviewed these reports. Since then, ETS has directed the monitoring program and issued the annual reports for monitoring years 1997 through the present. In addition, ETS issues letter reports summarizing the results of all sampling events routinely throughout the year. The monitoring results for 2024 (29th operational monitoring year) are summarized in this annual report.

The core five-years of 'official' operational monitoring began with the "satisfactory completion of all drainage systems and water quality basins" (TSG, 2000). The HNGC satisfied the completion of that condition on August 31, 1999 (Ioannou, 2002). Therefore, the core five-years of operational phase monitoring at HNGC ended August 31, 2004 for those parameters (e.g., pesticides) that had not exceeded response thresholds (RTs) as described in the EMP. RTs for two pesticides were exceeded in the early years of monitoring at surface water stations: PCNB in 1997 and chlorothalonil in 1999. The use of those two pesticides stopped following their RT exceedances and monitoring continued for an additional five years. There were no other exceedances of those two pesticides. In addition, no other pesticides' RTs were exceeded during that 5-yr monitoring period. Therefore, monitoring of pesticides ended in 2004, in accordance with the EMP.

Monitoring continues today as the result of RT exceedances in surface water at four stations and for selected parameters, most importantly nitrate-nitrite nitrogen. Nitrate-nitrite nitrogen (N-N) monitoring ended at SW-5 following the completion of monitoring in 2021 because the monitoring requirements were fulfilled at that station. Total phosphorus monitoring ended at the end of 2021 at all stations because the monitoring requirements were fulfilled. Thus monitoring at three on-site surface water stations (SW-1, SW-3A, and SW-4) and the off-site surface water station (SW-6) continue for N-N and turbidity only.

Limited monitoring continued at four remaining surface water stations in 2024: three on-site and one off-site. In accordance with the 2000 EMP (as amended) all monitoring will stop at the HNGC following the completion of the remaining monitoring requirements, currently scheduled for 2027 for stations SW-1 and SW-4, and SW-3A in 2029 based on the condition that there are no nitrogen exceedances. There was one N-N RT exceedance at SW-3A in 2024; however, this was likely the result of the ground disturbance for the work done on the golf course in 2023. Monitoring at the off-site station SW-6 will continue until all on-site monitoring stops, due to the fact that it is the reference (i.e., background) site.

Results and Discussion

Surface water stations were sampled four times during the routine sampling in 2024. There were three base flow (BF) events that occurred in the appropriate seasons: May 21st (spring), July 31st (summer), and October 10th (fall). There was one storm flow (SF) event during

2024: December 16th (fall); however, this was not a qualifying storm event in accordance with the EMP. There were no qualifying storm events during the spring or the summer seasons because there were no opportune times and/or the rain accumulation did not meet the storm criteria for those two seasons. Samples were analyzed for nitrate-nitrite as nitrogen (N-N) and turbidity. Field parameters (pH, temperature, and specific conductance) were measured when samples were collected during each sampling event.

The N-N concentrations ranged from non-detect (ND; <0.1 ppm; SW-4 and SW-6) to 1.31 ppm (average of duplicate samples, SW-3A) in 2024. N-N was not detected at the off-site station SW-6 during any of sampling events in 2024. The N-N concentrations exceeded one on-site stations' response threshold one time during the four sampling events: SW-3A (spring BF).

The average N-N concentration for all on-site surface water monitoring stations in 2024 is 0.38 ppm (std = ± 0.35 ppm; n=12). The overall on-site average N-N concentration was lower than in 2023 (0.56 ppm, n=12) and in 2022 (0.68 ppm, n= 11). This indicates a decreasing N-N trend at the on-site stations. The N-N concentration at the background station SW-6 in 2024 was less than the detection limit (i.e., <0.1 ppm) during all sampling events. Thus, we know that the average concentration was less than 0.1 ppm, but we cannot know the actual number.

Resampling Criteria

The Village Planning Board approved our recommendations to revise the sampling criteria for N-N and TP response threshold (RT) exceedances (ETS, 2012). This was done because of difficulty resampling as defined in the original EMP (2000). All total phosphorus monitoring stopped at the end of 2021. Thus we did not evaluate TP in this report. Below is a summary of the accepted resampling criteria. We have been using these criteria since that time (2012). Additionally, we recommended that no resampling be implemented in 2024 due to the major earth work that was done on the golf course grounds in 2023, which causes nitrogen release in the soil and is transported to the nearby streams via ground water seepage. In addition, we did not resample following the spring base flow event at SW-3A because we did not receive the lab results until August due to the lab's omission to provide them promptly.

List of Resampling Criteria

1. Resampling should be based on an RT exceedance using the corrected RTs and a statistically significant increasing trend for the parameter (i.e., N-N or TP);
2. The resampling event should be done under the same flow conditions under which the original samples were collected (e.g., if original samples were collected during a storm flow event, then the resampling event should also be done during a storm flow event);
3. The resampling event should be completed within the same season (i.e., spring, summer, or fall); otherwise, routine sampling will continue; and
4. A reasonable amount of time for resampling will be 2-3 weeks after receipt of results, otherwise no resampling will be done for that exceedance.

Trends Analyses

Temporal Trends. Quantitative and qualitative statistical tests have been conducted on the cumulative data generated since September 1999 in order to evaluate seasonal and long-term trends. This was done by comparing the results of N-N at each station from year to year (1999-2024) to identify any significant trends for those parameters. Two on-site stations show increasing N-N concentration long-term trends (SW-1 and SW-3A), and one station shows a decreasing trend (SW-4) using the cumulative datasets. In addition, we evaluated each station's N-N concentration for the last 10 years (2015-2024) in order to determine more recent trends (i.e., increasing or decreasing) for the possible cessation of monitoring. Two stations show decreasing N-N concentration 10-year trends (SW-1 and SW-4), SW-3A shows a flat trend (i.e., neither increasing nor decreasing), and reference station SW-6 shows a slight increasing trend.

Although the pH fluctuates at both the on-site and background surface water stations, the fluctuations are not anomalous for this area. Therefore, no statistical analyses were done for pH; however, pH measurements will continue as long as N-N is monitored.

Amended Nutrient Program

We continue to recommend the fertilizer restriction of no more than a 1,000 lb N total be applied after October 15 until early spring to help prevent N-N RT exceedances at the surface water stations. This latter EMP amendment was approved (January 31, 2017). It was implemented and followed by the superintendent in the fall of 2017 and has continued since then. There were no N-fertilizer applications made after September 24, 2024 to any of the turf.

Conclusions

Overall, the course appears to be managed well, from an environmental perspective, with minimal nutrient impacts on surface water. The overall cumulative monitoring results (1997-2024) show that there are increasing long-term N-N trends at two on-site stations compared with SW-6: SW-1 and SW-3A. However, the data over the last 10 years (2015-2024) show decreasing trends at SW-1 and SW-4, neither increasing nor decreasing at SW-3A, and slightly increasing at SW-6.

The N-fertilizer applications are not the only N-source releasing nutrients into the system, which may be causing the N-N increasing trends. The major earthwork in 2023 is also a source of nitrogen release into the system. N-fertilizer applications are very low (i.e., spoon-feeding rates, 0.1 lb N/1,000 sq ft) except for the applications during the reseeding of the greens, tees, and fairways.

There was only one N-N RT exceedance during routine sampling events in 2024. The nitrogen fertilizer applications are very low and below typical industry rates during normal operational periods. It is hard to imagine that the N fertilizer applications could be the only cause of the N-N RT exceedances, especially at the background/reference station, which also has had an RT exceedance. There has been much ground disturbance over the last several years and recently, which provides another reasonable explanation for the N-N RT exceedances. The combination of the two is likely the cause of the N-N RT exceedances. ***In any case, the average N-N concentration for the three remaining on-site stations combined is well below 2.0 ppm (0.44 ppm, std ±0.43, n=370, includes all resampling events).***

Recommendations

We recommend that monitoring for nitrate-nitrogen and turbidity at the Hudson National Golf Course be reduced to monitoring surface water at only one station: SW-3A (see discussion in Section IV.C). In addition, we recommend that the monitoring be done annually during the spring base flow instead of three times a year. The background/reference station SW-6 will be monitored for N-N as long as on-site stations are monitored.

Monitoring for N-N is required under the EMP at two on-site stations (SW-1 and SW-4) through 2027, at one on-site station (SW-3A) through 2029, and at the off-site station SW-6 (as long as monitoring on-site continues) in accordance with the EMP. However, we recommend that monitoring at stations SW-1 and SW-4 be stopped because those stations do not flow to any significant body of water and do not provide any useful information about golf course fertilizer management.

We continue to recommend that no more than 1,000 lb N total be applied between October 15 and early spring (April 1). Appendix C provides the cover letter and the amended "Fertilizing" section of the EMP that was submitted January 17, 2017.

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I. INTRODUCTION

The Environmental Management Plan (EMP; Turf Science Group [TSG], 2000) was developed to establish an environmental management and monitoring program for the Hudson National Golf Club (HNGC). Monitoring over the last 29 years (1996-2024) has included ground water from on-site monitoring wells and off-site residential wells, surface water (on-site and off-site), and pond sediments for pesticides, nutrients, and inorganics. The monitoring program has been reduced over time due to minimal environmental issues, and it currently includes nutrient monitoring at four of the original seven surface water monitoring stations (three on-site and one off-site), as described in this report. All monitoring of ground water, three surface water stations, and the pond sediment stopped because those monitoring requirements have been fulfilled in accordance with the EMP.

Parameters were selected and analyzed prior to golf course operations to provide a water quality baseline. The monitoring program helps ensure that the golf course is being maintained in an environmentally responsible manner and that the surrounding water quality is protected.

Sampling Criteria. Procedures and field methods for Phase III (operational monitoring phase, the current phase) are detailed in the EMP (2000 and as amended). The management plan requires that surface water samples for storm flow be collected by the grab method between 4 and 10 hours following the accumulation of ¼ inch (0.25") of rainfall for the spring and fall sampling events. The summer storm flow event samples are collected between 2 and 8 hours following the accumulation of 0.25" of rainfall (the shorter response time in the summer is due to the higher intensity storms). Base flow samples are also to be collected by the grab method during the spring, summer, and fall when it has not rained for at least 48 hours preceding the sampling event.

Reporting. Individual sampling event reports are issued throughout the year. However, in 2024 only one report was issued for all sampling events because some of the data needed for a proper evaluation was not receive in a timely manner. In addition, the EMP requires comprehensive annual reports. This annual report describes the 2024 monitoring results for the four remaining surface water stations: SW-1, SW-3A, and SW-4 (on-site), and SW-6 (off-site). The data provided in this report include field notes, summary tables of analytical results, and graphical comparisons of results with response thresholds (RTs).

The first year of Phase III (1996) operational monitoring results was presented in a previous report by the Turf Science Group (TSG), and reviewed by Environmental & Turf Services, Inc. (ETS). ETS took over as the study directors after the first year of operational phase monitoring (i.e., Phase III), and has prepared the operational phase annual reports for the last 28 years (1997-2024). The 2000 EMP includes the results of baseline (Phase I) and construction (Phase II) phases of monitoring. This 2024 report represents the 29th year of operational golf course monitoring. However, the ‘official’ operational monitoring program began with the “satisfactory completion of all drainage systems and water quality basins” (TSG, 2000). That condition was satisfied on August 31, 1999 (Gallelli and Ioannou, 2002). Thus, we use data from September 1999 through the current year for statistical analyses of the monitoring data. In addition, we use the seasonal data at station SW-3A from 2004-2024 to evaluate trends for each season for continued monitoring at that station.

Termination of Monitoring. The critical initial five years of operational phase monitoring at HNGC ended on August 31, 2004 for those parameters that had not exceeded the RTs, in accordance with the 2000 EMP at that time. Thus, all pesticide monitoring requirements were fulfilled following the completion of the 2004 summer monitoring events (base flow and storm flow) at all surface water and ground water monitoring stations. Inorganic monitoring requirements were fulfilled for all off-site residential ground water stations following the 2004 summer sampling event, and on-site well monitoring requirements were fulfilled following the 2007 winter sampling event in accordance with the EMP (2011). Consequently, all ground water monitoring stopped following the 2007 winter sampling event. Monitoring at the remaining surface water stations will cease when the monitoring requirements have been fulfilled in accordance with the EMP (2011). In addition, monitoring at surface water stations SW-2 and SW-3B ended in 2009 and 2007, respectively, because their monitoring requirements had been fulfilled. Monitoring at SW-5 stopped following the fall sampling in 2021. In addition, monitoring for total phosphorus (TP) at all surface water stations stopped following the completion of monitoring in 2021.

Access to Results. The results for each of the 2024 sampling events are described in the following sections. All of the lab's analytical results were provided to the Village in one report (ETS, 2025) and will not be reproduced in this annual report except as a summary in the tables. Section II provides information relevant to golf course management and soil/tissue testing. Section III provides the details of the 2024 surface water monitoring program followed by a summary of the results. The surface water trends are described in section IV and the conclusions and recommendations are provided in Section V. The analytical results are also shown graphically in the figures section at the end of this report. The appendices follow the figures section.

2024 Sampling Dates and Compliance with Sampling Criteria. Base flow samples were collected on May 21st (spring), July 31st (summer), and October 10th (fall). Samples were collected on December 16th to represent a fall storm flow event during 2024; however, it was not a qualifying storm (see Section III below) in accordance with the EMP. There were no qualifying storm events during the spring or summer seasons. There was no resampling event following the RT exceedance in the spring because we did not receive the results until August, which is outside of the guidelines for resampling. Samples were analyzed for nitrate-nitrite as nitrogen (N-N) and turbidity. Field parameters (pH, temperature, and specific conductance) were measured when samples were collected.

All results were provided to the Village in our letter report for the spring, summer, and fall sampling events in January 2025 (ETS, 2025) as explained above.

Nutrient Management Amendment. The nutrient management portion of the EMP (2000; i.e., fertilizer applications, soil/tissue sampling) was amended in 2011 (ETS, 2011). This was done in order to update the turf management strategies. The Planning Board-approved amended nutrient management program was implemented in July 2011.

As reported in our 2016 annual monitoring report, the total amount of fertilizer used in 2016 was in accordance with the amended nutrient management program, but the application timing led to water quality exceedances, which resulted in an additional amendment to the EMP. See below for more details. An EMP amendment for fertilizer restrictions was approved in 2017 (ETS, 2017a).

The reduction in fertilizer applications for the fall through the winter months was implemented during the fall of 2017, and has continued through 2024.

Approved Amendments to the EMP – Fertilizer Applications

The superintendent's application records indicate that he complied with the following amendments.

Amendment 2011 – Fertilizer Application Reduction (all areas)

We recommended that fertilizer applications incorporate some of the newer products (e.g., Earthworks™ and Perdue PPM) and that single application rates be reduced to no more than 0.5 lb N/1,000 sq ft in keeping with the EMP (2000)*. Fertilizer applications should be delayed if heavy rainfall is forecast. Total applications should not exceed 3.0 lb N/1000 sq ft during a growing season. This is a reduction of the total N applications allowed (i.e., 4-5.5 N/1,000 sq ft) in Table 3 of the EMP (2000).

Multiple "spoon feeding" applications of 0.1 lb N/1,000 sq ft should be used on greens, tees, and fairways during the optimum growing season (April-October). Fertilizer applications can be tank mixed with fungicide applications on two week intervals. These low nutrient rates have little risk of runoff and can be extremely beneficial to plant health especially with the management of anthracnose disease on putting greens.

Phosphorus and potassium applications should be based on the results of the soil and/or tissue sample results.

Amendment 2017 – Total N – Additional Fertilizer Application Restrictions

No more than 1,000 lb of N may be applied between October 15 and early spring (April 1).

Reason for Additional Fertilizer Application Restrictions of Total N

It appears that the N applications made prior to the fall sampling events in 2016 were the cause of the N-N RT exceedances at all on-site stations and the cause of one TP exceedance in 2016 (see our 2016 fall letter report, ETS, 2017b).

It is important to note that the turfgrass in that region of the country is probably not actively growing after early to mid-November. This means that N that is applied during and after this time is more available to runoff near the soil's surface than N that is applied, e.g., in May. Therefore, applications are not to exceed 1,000 total lb nitrogen after October 15 until early spring to help prevent N-N RT exceedances at the surface water stations.

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* This 0.5 lb N/1000 ft^2 limit should be relaxed in the future; after all N exceedance problems have been resolved. Specifically, we recommend that the future limit on single applications of certain controlled release N fertilizers such as POLYON® be raised to 1.5 lb N/1000 ft^2, if it can be established that such release occurs over a period averaging at least 12-16 weeks. This change should be considered the next time the EMP is modified, but not at this time. Approval provided relief of this restriction in 2020 (see ETS,2021).

II. TURF CHEMICAL APPLICATIONS, SOIL AND TISSUE TESTING

A. 2024 Nutrients and Pesticides Applications

Brett Scales submitted the nutrient and pesticide application schedules and his nutrient management plan for 2024 (Appendix A). Those schedules provide details of the dates and rates of applications for the pesticide and fertilizer products used in 2024, and the specific locations where each product was applied. The NYSDEC now requires that the Superintendent input all pesticide applications into the NYSDEC's online software. Thus, we no longer have a DEC log from the Superintendent. We summarized the fertilizer application schedule below. Although pesticides are no longer part of the monitoring program, we monitor their use to ensure compliance with the EPM, and those used in 2024 are listed below and shown in Appendix A.

1. Fertilizer Applications

Greens and Tees. There were 15 nitrogen fertilizer applications made to the greens using three different formulations April through September: 20-20-20 (9); 7-7-7 (2); and 28-8-18 (4). Additional fertilizer applications that contained only potassium using the formulation 0-0-52 were applied to the greens. [The number in parentheses is the number of applications that was made to the area of turf described using that formulation. The numbering system refers to the percent of nitrogen, phosphorus, and potassium, in that order (N-P-K).] These applications yielded rates of: 2.75 lb N/1,000 sq ft; 2.462 lb P/1,000 sq ft; and 5.262 lb K/1,000 sq ft to the greens. All of the individual applications during the growing season (April-September) were made at relatively low rates (e.g., spoon-feeding at rates of 0.1 - 0.5 lb N/1,000 sq ft). These numbers are relatively low, and they indicate that the superintendent, Mr. Scales, is managing the course in a relatively lean manner.

Nitrogen fertilizers were applied to the tees 12 times using four formulations April through September: 5-7-5 (1) and 28-8-18 (11). Eight additional fertilizer applications that contained only potassium using the formulation 0-0-52 were applied to the tees. These applications to the tees yielded rates of: 1.6 lb N/1,000 sq ft; 1.008 lb P/1,000 sq ft; and 2.713 lb K/1,000 sq ft. Most of the individual nitrogen applications were made at relatively low rates (e.g., spoon-feeding at rates of 0.1-0.5 lb N/1,000 sq ft). The larger application of 0.5 lb N/1,000 sq ft was made to the tees for the spring application in May.

The total N applications to the greens turf was below the 3.0 lb N/1,000 sq ft recommended in the original 2000 EMP. The Superintendent had reported that heading into the 2023 season that the golf course would be closing for a restoration project starting July 5th 2023. The restoration project would include replacing USGA spec greens, replacing the irrigation system, replacing all sand traps, and re-grassing tees, approaches and fairways. That project was completed prior to the start of sampling in 2024.

Fairways and Roughs. There were 19 nitrogen fertilizer applications made to the fairways using four formulations April through September: 28-8-18 (8) and 46-0-0 (11). Six additional fertilizer applications that contained only potassium using the formulation 0-0-52 were applied to the fairways. These applications yielded total rates of: 1.77 lb N/1,000 sq ft, which is very low for fairways; 0.14 lb P/1,000 sq ft; and 0.897 lb K/1,000 sq ft. Individual applications for the fairways of nitrogen (N) were made at low rates (e.g., spoon-feeding at rates of 0.07-0.11 lb N/1,000 sq ft). There were no large spring or fall applications made to the fairways.

One fertilizer application was made to the roughs using formulation: 22-0-5 (1) for total of 1.42 lb N/1,000 sq ft, 0.0 lb P/1,000 sq ft, and 0.4 lb K/1,000 sq ft. This application was made to 35 A of roughs.

2. Pesticide Applications

Approximately 19 different pesticide products containing 23 different active ingredients, which are consistent with the EMP as amended, were applied from April through late November of 2024 to the greens, tees, and fairways, and roughs through September. However, not all products were applied to all types of turf. Some of the products contain more than one active ingredient. Fungicide active ingredients and growth regulator products were applied to the greens, tees, and fairways; herbicides and fungicides were applied to the roughs during 2024 (See Appendix A for details). No insecticides were used in 2024.

B. Soil and Tissue Testing

The soil and tissue analyses help the superintendent maintain healthy turf, which will result in less pesticide use and more efficient nutrient uptake. The soil and tissue results show no excessive nutrients in the soil or tissue samples (i.e., turf). See Appendix B.

III. SELECTION OF ANALYTES, REFERENCE CRITERIA, SUMMARY OF 2024 SURFACE WATER QUALITY RESULTS, AND QA/QC

A. Selection of Analytes

The core five years of operational phase monitoring at HNGC ended August 31, 2004 for those parameters that had not exceeded the response thresholds (RTs) as described in the EMP (e.g., pesticides). Monitoring continues today as a result of RT exceedances (as corrected in 2012) in surface water at selected stations and for selected parameters (e.g., nitrate-nitrite nitrogen). Therefore, all 2024 surface water sampling events consisted of analyses for nitrate-nitrite as nitrogen (N-N), turbidity, and field parameters (pH, temperature, and specific conductance) under base flow conditions during the spring, summer, and fall, and under storm flow conditions during the fall; however, as stated above the fall storm samples did not qualify in accordance with the EMP (see below). There were no qualifying storm flow sampling events during the spring and summer.

Four surface water stations were sampled as part of the 2024 monitoring program at the HNGC: three on-site stations (SW-1, -3A, and -4) and one off-site/background station (SW-6).

B. Reference Concentrations and Response Thresholds

Two important types of reference points are discussed in this report: reference concentrations (RCs) and response thresholds (RTs). RCs refer to spatial background points in space (SW-6) and time (pre-construction). RTs are action/threshold concentrations that require some type of management response, i.e., resampling or use restrictions. [Note: Several houses were constructed upslope from the station that is used as background (i.e., SW-6) after monitoring began. Therefore, station SW-6 is no longer a true background station, i.e., it has been impacted by outside cultural practices. However, it can still be used as a background station relative to golf course management for surface water at the HNGC because golf course management does not affect station SW-6.]

See Table III-1 below for the RTs used to evaluate resampling of N-N only (ETS, 2013). All results 1999 through 2024 and continuing are compared with the corrected RTs to determine whether monitoring should be extended (see section V) and/or resampling is warranted. Station SW-5 was removed from our evaluation since it is no longer monitored in accordance with the EMP.

Table III-1. Corrected Response Thresholds

Monitoring Stations →	**SW-1 (mg/L)**	**SW-3A (mg/L)**	**SW-4 (mg/L)**	**SW-6 (mg/L)**
Parameter →	nitrate-nitrite as nitrogen			
Corrected (2012) RT values*	0.89	0.57[†]	0.38	0.31

* The corrected RT values are based on the original baseline sampling results and recalculated as two standard deviations above the mean.
[†] This value was calculated correctly and remains unchanged.

The EMP provides criteria for management response (i.e., resampling and chemical use restrictions) for RT exceedances of N-N for each monitoring station (ETS, 2012). The resampling triggers (i.e., exceedance of an RT) were revised in order to include an evaluation of additional criteria to determine if resampling is necessary. The additional criteria consisted of a statistically significant increasing trend for TP and/or N-N, sample collection under the same flow condition (e.g., storm or base flow), sampling within the same season, and sampling within a reasonable amount of time (i.e., 2-3 weeks following results; ETS, 2012). A review of management practices (e.g., application of fertilizers), site conditions, and weather conditions, may help determine the reason for the unexpected increased concentrations, which also includes major construction on the turf areas (e.g., removing turf and reseeding certain areas).

C. Results and Summary of 2024 Sampling Events

Four routine surface water sampling events occurred during the spring, summer, and fall of the 2024 calendar year: three were under base flow conditions and one under storm flow conditions. See Table III-2 at the end of this section for results.

Qualifying base flow samples were collected on May 21st (spring), July 31st (summer), and October 10th (fall). Fall storm flow samples were collected on December 16th; however, this was not a true qualifying storm event based on the data from on-site weather station. There were no qualifying storm flow samples during the spring or summer.

Temperature, pH, and specific conductance were measured in the field during each sampling event at each station sampled. Inorganic parameters analyzed in the lab included N-N and turbidity. Those five parameter results are graphically depicted in Figures III-1 through III-5 for 2024. The results tables are presented at the end of this section (Tables III-2 through III-5). All figures are presented at the end of this report.

Table III-2 provides the analytical results and field measurements for 2024 compared with respective reference criteria (i.e., RCs and RTs). Table III-3 provides a list of the stations that exceeded reference criteria. Table III-4 provides the average concentrations, standard deviations (std), and the number of samples (n) that were used to perform the statistical calculations for 2024. Table III-5 shows the combined average concentrations for the on-site stations compared with the background station. Detailed results are described below for each sampling event.

The EMP requires that base flow samples be collected when there has been no rain for 48 hours prior to sampling. This criterion was met during all three base flow sampling events. The EMP requires that spring and fall storm flow samples be collected between 4 and 10 hours following the accumulation of 0.25” of rain (i.e., first flush). The field team determined that there were no opportune times or the rain accumulation did not meet the storm criteria to collect storm flow samples during the spring of 2024. The EMP requires that storm flow samples during the summer be collected 2 to 8 hours following the accumulation of 0.25” of rain. The field team determined that conditions were not met for summer storm flow sampling. Fall storm flow samples were collected; however, they were not collected within the storm criteria as explained below using the on-site weather station data.

1. Spring Sampling Event

Routine Sampling Event – May 21, 2024 (Base Flow)

The results show that nitrate-nitrogen (N-N) was detected at two on-site stations: SW-1 at 0.356 ppm and SW-3A at 1.31 ppm (average of duplicate samples). The N-N response threshold (RT) of 0.57 ppm was exceeded at SW-3A; however, due to the late arrival of the results (i.e., received in August) and the earthwork done in 2023 no resampling was done. We have noted in the past that major earthwork causes release of nutrients in the ground water and to the nearby surface water sampling stations. Thus, no resampling will be done and we will continue to monitor the N-N at all station to determine when the concentrations will return to baseline levels, as recommended by Daniel O'Connor. See Table III-2 for results.

The turbidity ranged from 2.1 NTUs (SW-1) to 6.7 (SW-4). Turbidity was also detected in the field blank sample at 0.175 NTUs and in the trip blank sample at 0.430 NTUs (LOQ = 0.1 NTUs). The sample water for the field blank is lab water sent with the samples and poured into a bottle on-site and the trip blank sample is filled at the lab and the bottle is not opened in the field.

The pH was measured at all stations: 6.8 (SW-1), 7.07 (SW-3A), 6.86 (SW-4), and 7.01 (SW-6; Table III-2). The pH values are within the desirable range (6.5-8.5) at all three on-site stations and the off-site station. Thus, these values are acceptable.

2. Summer Sampling Events

Routine Sampling Event – July 31, 2024 (Base Flow)

The results show that N-N was detected at three on-site stations: SW-1 at 0.489 ppm, SW-3A at 0.343 ppm, and 0.195 ppm at SW-4 (average of duplicate samples). The N-N RT was not exceeded at any station. In addition, the N-N concentration at SW-3A was lower during this event than during the spring. Thus, no resampling is warranted. See Table III-2 for results.

The turbidity ranged from 1.6 NTUs (SW-1) to 11.25 (SW-4). Turbidity was not detected in the field blank sample; however, the trip blank sample showed a concentration of 0.130 NTUs (LOQ = 0.1 NTUs). The detection of turbidity in the trip blank is of little consequence to the results.

The pH was measured at all stations: 6.26 (SW-1), 7.04 (SW-3A), 6.64 (SW-4), and 7.24 (SW-6; Table 2). The pH values are within the desirable range (6.5-8.5) at two on-site stations and the off-site station; however, it was slightly below the lower range at SW-1. These values are acceptable.

3. Fall Sampling Events

Routine Sampling Event - October 10, 2024 (Base Flow)

The results show that N-N was detected at two on-site stations: SW-1 at 0.713 ppm and SW-3A at 0.218 ppm (average of duplicate samples). The N-N RT ppm was not exceeded at any station. Thus, no resampling is warranted. See Table III-2 for results.

The turbidity ranged from 2.3 NTUs (SW-1) to 17.0 (SW-4). Turbidity was not detected in the field blank sample or the trip blank samples. A value of 17.0 NTUs at SW-4 cannot be seen visually. Thus, this concentration is likely of no consequence to the results.

The pH was measured at all stations: 6.90 (SW-1), 7.07 (SW-3A), 6.67 (SW-4), and 6.9 (SW-6; Table III-2). The pH values are within the desirable range (6.5-8.5) at all on-site stations and the off-site station. These values are acceptable.

Routine Sampling Event – December 16, 2024 (Storm Flow)

Although this was not a qualify storm event in the strictest sense, we will use the results because there was rain in the area. This is not considered a qualifying storm event because rain was not recorded at the on-site weather station. In any case, the results show that N-N was detected at low concentrations at the three on-site stations: SW-1 at 0.425 ppm, SW-3A at 0.241 ppm, and SW-4 at 0.155 ppm (ave. of duplicate samples). The N-N RT was not exceeded at any station. Thus, no resampling is warranted. See Table III-2 for results. Sampling results are used for this event

The turbidity ranged from 2.9 NTUs (SW-1) to 9.0 (SW-4, ave. of duplicate samples). Turbidity was detected in both the field blank (0.71 NTUs) and the trip blank (0.35 NTUs) samples. These values do not affect the results.

The pH was measured at all stations: 7.04 (SW-1), 6.89 (SW-3A), 6.91 (SW-4), and 6.21 (SW-6; Table III-2). The pH values are within the desirable range (6.5-8.5) at all on-site stations, however, the pH is slightly below the lower end of the range at the off-site station. These values are acceptable.

D. Trends and Comparison of the 2024 Surface Water Results with Reference Criteria

Table III-3 shows the number of times a station exceeded its response threshold (RT) and its reference concentration (RC) for each parameter. Comparisons of the average concentrations for the relevant parameters are presented in Table III-4. Table III-5 shows the comparisons of the 2024 mean concentrations for four parameters described below: average of all of the combined on-site stations' mean concentrations compared with SW-6, the background station. In addition, Table III-5 shows whether the mean concentrations of the combined on-site stations' mean concentrations are statistically significantly different or the same as SW-6 for the parameters.

The 2024 surface water monitoring results are presented in Figures III-1 through III-5. The lines connecting each data point may not truly represent a continuous increase or decrease over time for any parameter at a particular point in time. Rather, each point should be viewed as a "snapshot" in time, and any possible change in a parameter should be viewed over the entire dataset. In addition, any station that was not sampled or an analyte not analyzed during a particular sampling event is not represented by a data point on the figures, and non-detects are represented by one-half the quantitation limit/method reporting limit.

Comparisons of results with response thresholds for pH, N-N, specific conductance and turbidity are discussed below.

pH. The pH is measured in the field at the time of sampling at each sampled station. The RT for pH is any value outside the 6.5 to 8.5 desirable ranges. However, the pH range is not an enforceable one because acidic rain in this area affects all of the stations, including the background station SW-6 (i.e., acid rain is most likely the cause of the lower pH: <6.5). The 2024 pH results are depicted in Figure III-1.

The pH at all four stations ranged from 6.21 (SW-6) to 7.24 (SW-6) during the four routine sampling events. Note that the pH minimum and maximum range were both at the off-site station. The average pH at the background station (SW-6) for 2024 was 6.84 (std = ± 0.44, n = 4). This is about the same as the overall average pH at the three on-site stations combined during the 2024 sampling events (6.85, std = ± 0.23, n = 12; Table III-4).

The value range for pH (6.5-8.5) is a desirable range and not an enforceable parameter. Therefore, we only make a comparison with previous years and show trends.

Temperature and Specific Conductance. Temperature and specific conductance (SC) data are measured field parameters along with pH (Table III-2). Figures III-2 and III-3 illustrate temperature and specific conductance, respectively for 2024. Temperature is directly related to seasonal variations of air temperature, and SC is, generally, directly related to fluctuations of total dissolved solids (TDS; i.e., if TDS increases, then SC should increase). TDS is not measured in surface water, but the SC can still be used as a general guide for dissolved solids in the water.

Figure III-3 shows that specific conductance fluctuates seasonally at the three on-site stations and the trend at SW-6 shows a decreasing trend from spring to fall. Neither of these parameters (temperature and specific conductance) is used for responding to exceedances of water quality standards; however, they are measured and reported as a general practice to enhance our understanding of the hydrologic system.

Turbidity. Turbidity is a measure of cloudiness or the amount of undissolved particles/sediment in the water (Table III-2). Figure III-4 depicts the turbidity at all surface water monitoring stations for 2024. The values ranged from 1.6 to 17 NTUs during the routine sampling events. These values are not likely visible to the eye. The 2024 average for all on-site surface water stations was low: 5.7 NTUs (std = ± 4.7 NTUs, n=12). The average turbidity at the background station SW-6 was slightly lower than the on-site stations: 5.2 NTUs (std = ± 2.1 NTUs, n=4). None of the stations exceeded their RTs during 2024 (Table III-2). Turbidity trends over the course of the year varied. There are no management responses to RC or RT exceedances of turbidity.

Nitrate/Nitrite-Nitrogen (N-N). The 2024 N-N results are illustrated in Figure III-5 and listed in Tables III-2 through III-5. The on-site concentrations ranged from ND (<0.1 ppm) to 1.3 ppm (SW-3A) during the four monitoring events. Only one station exceeded its N-N RTs during the four sampling events (SW-3A, Table III-2). The background station SW-6 had no detectable N-N concentrations during any event.

The average N-N concentration for all on-site surface water monitoring stations in 2024 is 0.38 ppm (std = ± 0.35 ppm; n=12). The overall on-site average N-N concentration was lower than in 2023 (0.56 ppm, n=12) and in 2022 (0.68 ppm, n= 11). This indicates a decreasing N-N trend at the on-site stations. The N-N concentration at the background station SW-6 in 2024 was less than the detection limit (i.e., <0.1 ppm) during all sampling events. Thus, showing an average concentration has little meaning. The difference in the mean concentrations between the on-site stations and SW-6 is significantly different ($p = 0.008$) for 2024 (see Table III-5), which is not surprising since N-N was not detected at SW-6 during 2024.

E. Quality Assurance/Quality Control

The HNGC monitoring study was designed and is conducted with high standards of quality control. As such, a comprehensive quality assurance/quality control (QA/QC) program has been established to ensure the integrity of the data gathered. The QA/QC program established for this monitoring study is in the spirit of EPA's Good Laboratory Practice Standards (GLPs; 40 CFR Part 160). GLPs were developed to create uniformity from study to study and to help ensure the quality of data collected. Listed below are the most important parts of the QA/QC program that field and lab personnel must follow. Pages 65-72 of the EMP (2000) describe the requirements of the QA/QC program for this monitoring study.

1. Field Personnel and 2024 QC

WSP USA (WSP, White Plains, NY), collects all of the surface water samples for the monitoring program. WSP (formerly known as LBG) has been collecting water samples at HNGC since December 1997. A major advantage of having the same field team associated with this project for so many years is that the same competent personnel typically collect and/or manage collection of the samples. Therefore, field personnel are familiar with the project site, the EMP (and amendments as they pertain to sampling), and the sample collection procedures. This helps to ensure that quality control is being maintained at every event.

The most important QC procedures that field personnel must follow include calibrating field instruments, using properly cleaned sample collection devices at each station, taking field notes during the time of collection that state where the sample was collected, and noting the time and date of collection. In addition, icing and shipping samples to the laboratory without delay and accurately completing the chain-of-custody forms are important. Pages 68 and 69 of the EMP provide additional field QC procedures to prevent sample contamination during the time of collection and to help ensure the overall integrity of the study (e.g., the inner portion of the sample bottles and caps should not be touched with bare hands, gloves or mitts, etc.). In addition, since we started using a local lab, samples are delivered the same day they are collected or the following morning, which eliminates holding time violations or lost in transit samples.

The field notes/sheets for 2024 were good. The sample bottles were delivered to the lab by WSP immediately after sampling or the following morning for each event. The samples were delivered to the lab in good condition and properly preserved on ice for all sampling events.

Fall storm samples should not have been collected (December 16, 2024) based on the data from the on-site weather station. However, the WSP field team did not have access to the on-site weather station that morning, but was conscientious enough to access the local weather station to determine if there was sufficient rain to qualify for a fall storm event since it was raining in the area. In any event, the results can be used.

2. Laboratory

Overall, the lab QC was good throughout 2024. We changed labs in 2022 from Eurofins Eaton Analytical, Inc. (Eaton, South Bend, IN), to York Analytical Laboratory (York; CT) because of reduced analyses and on-time delivery issues. The lab QA/QC is perhaps the most important part of this comprehensive QA/QC program.

The lab is required to run several QC sample analyses that help identify sources of sample contamination during the collection and analysis process. This process includes lab equipment, field sample bottles, etc., to ensure that the lab equipment is properly calibrated and that chemical analytes are correctly identified and quantified. The lab results would be less meaningful, and the concentrations of detections would be in doubt, without these additional analyses. The following QA/QC samples are required by the EMP and analyzed by the lab: lab blanks, field blanks, and duplicate samples. For an explanation of each sample type, refer to page 70 of the EMP (TSG, 2000). Additionally, matrix spike (MS) and MS duplicate (MSD) samples are collected in the field to help identify poor lab equipment performance due to matrix interference (e.g., sediment in the water). The field team rotates these samples between stations and events; however, it is sometimes necessary to collect duplicate samples at the same station from the previous event due to low or no flow. The lab also performs continuing calibration checks on lab equipment to guarantee equipment accuracy.

York labs uses the term limit of quantitation (LOQ), which is comparable to the method reporting limit (MRL) used by Eaton labs, which is virtually the same as a detection limit. It is the minimum concentration of a target analyte that can be reported within a specified degree of confidence.

The lab was negligent in submitting the May (spring base flow) results in a timely manner; however, samples at SW-3A for the N-N RT exceedance would not have been resampled due to the major earth work done on the golf course in 2023.

The duplicate samples collected during all four of the sampling events compared well for N-N. The matrix spike (MS) and MS duplicate recoveries for the N-N data compared well for the base flow sampling events and were within the acceptable recovery ranges. However, the MS/MSD recoveries for N-N during the fall storm flow showed slightly high biased recoveries at 112% for the range of 90-110% for both MS and MSD, which indicates that the N-N concentrations could be slightly lower than reported.

Table III-2. Water Quality Results for the Surface Water Monitoring Stations – 2024

SW-1	RCs	RTs	MRLs	Spring		Summer		Fall	
Parameters				**5/21/24 BF**	**No SF**	**7/31/24 BF**	**No SF**	**10/10/24 BF**	**12/16/24 SF****
Flow rate (GPM)	--	--	--	5		3		4	5
pH (s.u.)	--	<6.5,>8.5	--	6.8		**6.26**		6.9	7.04
Water temp. (°C)	--	--	--	17.2		21.8		12.1	6.7
Sp. Cond. (µS/cm)	117	--	--	204		707		284	251
NO_3/NO_2-N (mg/L)	0.30	0.89	0.1	0.356		0.489		0.713	0.425
Turbidity (NTU)	7.3	21.4	1.0	2.1		1.6		2.3	6.2
SW-3A	**RCs**	**RTs**	**MRLs**	**Spring**		**Summer**		**Fall**	
Parameters				**5/21/24* BF**	**No SF**	**7/31/24 BF**	**No SF**	**10/10/24* BF**	**12/16/24 SF****
Flow rate (GPM)	--	--	--	8		5		4	10
pH (s.u.)	--	<6.5,>8.5	--	7.07		7.04		7.07	6.89
Water temp. (°C)	--	--	--	17.6		23.3		10.9	7.21
Sp. Cond. (µS/cm)	121	--	--	349		525		293	401
NO_3/NO_2-N (mg/L)	0.21	0.57	0.1	**1.31**†		0.343		0.218	0.241
Turbidity (NTU)	7.2	19.4	1.0	2.7		2.3		4.75	2.9
SW-4	**RCs**	**RTs**	**MRLs**	**Spring**		**Summer**		**Fall**	
Parameters				**5/21/24 BF**	**No SF**	**7/31/24* BF**	**No SF**	**10/10/24 BF**	**12/16/24 SF****
Flow rate (GPM)	--	--	--	5		5		3	10
pH (s.u.)	--	<6.5,>8.5	--	6.86		6.64		6.67	6.91
Water temp. (°C)	--	--	--	20.0		23.2		11.4	5.75
Sp. Cond. (µS/cm)	80	--	--	220		825		572	321
NO_3/NO_2-N (mg/L)	0.18	0.38	0.1	<0.1		0.195		<0.1	0.155
Turbidity (NTU)	7.2	19.4	1.0	6.7		11.3		17.0	9.0
SW-6	**RCs**	**RTs**	**MRLs**	**Spring**		**Summer**		**Fall**	
Parameters				**5/21/24 BF**	**No SF**	**7/31/24 BF**	**No SF**	**10/10/24 BF**	**12/16/24 SF****
Flow rate (GPM)	--	--	--	3		4		5	8
pH (s.u.)	--	<6.5,>8.5	--	7.01		7.24		6.9	**6.21**
Water temp. (°C)	--	--	--	18.0		23.5		11.6	6.82
Sp. Cond. (µS/cm)	121	--	--	320		225		204	242
NO_3/NO_2-N (mg/L)	0.21	0.57	0.1	<0.1		<0.1		<0.1	<0.1
Turbidity (NTU)	7.2	19.4	1.0	2.5		4.8		7.5	6.1

RCs = reference concentrations
RTs = Revised Response Thresholds
MRLs = Method Reporting Limits, also LOQ = limit of quantitation
BF = base flow; SF = storm flow; NS = no sample due to insufficient flow or dry.
Red Bold = concentration exceeded or was the same as the RT. As for the pH, **bold** = was below or above the desired values, no bold on values exceeding the turbidity RT because no action is required.
* Duplicate samples were collected at this station. An average for the duplicate sample results is shown above. These values were averaged for one concentration to perform the statistical calculations.
† No resampling was not done for this RT exceedance because the results were received well past the season (see the text above).
** Samples were not collected within the strictest sense of the storm criteria; however, the elevated flow indicates that the site received rain. Thus this sampling event is acceptable.

Table III-3. Exceedance of the Response Thresholds for Surface Water Stations – 2024

Parameters	Exceedance of RTs[1]
pH	SW-1 (1), SW-6 (1)
NO_3/NO_2-N	SW-3A (1)

[1] number in parentheses = the number of times the station exceeded its RT in 2023, or for the case of pH the measurements were outside of the desirable range of ≥6.5 - ≤8.5.
Turbidity was not included because no action is required.

Table III-4. Mean Concentrations - Surface Water Monitoring Stations Compared with RCs, RTs, and EPA Ecoregional Criteria (US EPA, 2001) – 2024

SW-1	Ecoregional Criteria	Response Thresholds††	Reference Concentration†	2024 Data		
Parameters				**Mean**	**SD**	**N**
pH (s.u.)	--	< 6.5, >8.5	7.1±0.1	6.75	0.34	4
Sp. Cond. (µS/cm)	--	None	117±36	362	233	4
NO_3/NO_2-N (mg/L)	0.42*	0.89	0.30±0.27	0.50	0.15	4
Turbidity (NTU)	0.80	21.4	7.3±7.1	3.1	2.1	4
SW-3A	**Ecoregional Criteria**	**Response Thresholds††**	**Reference Concentration†**	**2024 Data**		
Parameters				**Mean**	**SD**	**N**
pH (s.u.)	--	< 6.5, >8.5	6.9±0.2	7.02	0.09	4
Sp. Cond. (µS/cm)	--	None	121±86	392	99	4
NO_3/NO_2-N (mg/L)	0.42*	0.57	0.21±0.18	0.53	0.52	4
Turbidity (NTU)	0.80	19.4	7.2±6.1	3.2	1.1	4
SW-4	**Ecoregional Criteria**	**Response Thresholds††**	**Reference Concentration†**	**2024 Data**		
Parameters				**Mean**	**SD**	**N**
pH (s.u.)	--	< 6.5, >8.5	7.2±0.0	6.77	0.13	4
Sp. Cond. (µS/cm)	--	None	80±78	485	271	4
NO_3/NO_2-N (mg/L)	0.42*	0.38	0.18±0.08	0.11	0.07	4
Turbidity (NTU)	0.80	19.4	7.2±6.1	11.0	4.4	4
SW-6√	**Ecoregional Criteria**	**Response Thresholds††**	**Reference Concentration†**	**2024 Data**		
Parameters				**Mean**	**SD**	**N**
pH (s.u.)	--	< 6.5, >8.5	7.3±0.2	6.84	0.44	4
Sp. Cond. (µS/cm)	--	None	138±18	248	51	4
NO_3/NO_2-N (mg/L)	0.42*	0.31	0.17±0.06	<0.1	0	4
Turbidity (NTU)	0.80	54.3	16.1±19.1	5.2	2.1	4

††Baseline Mean + 2 Std. Dev. The values presented in the table are the corrected RTs (ETS, 2012).
†The RC is the baseline mean for the appropriate reference station.
*The 0.42 mg/L ecoregional criterion (EPA, 2001) is for total nitrogen (TN) and NO_3/NO_2-N is only one component of TN.
√ There were no detections of N-N at this station in 2024. Therefore no statistical analyses can be run to compare with the on-site stations.

Table III-5. Comparison of the On-site Stations' Mean Concentrations (Combined) with the Background Station - 2024

Parameters	Background Station SW-6			Three On-site Stations*			p-values SW-6 vs. On-Site‡	Are the Means Different? ($p<0.05$)
	Mean	**SD**	**N**	**Mean**	**SD**	**N**		**Yes or No**
pH (s.u.)	6.84	0.44	4	6.85	0.23	12	0.97	No
Sp. Conduct. (µS/cm)	248	51	4	413	201	12	0.022	Yes
NO_3/NO_2-N (mg/L)	0.05*	0	4	0.38	0.35	12	0.008	Yes
Turbidity (NTU)	5.2	2.1	4	5.7	4.7	12	0.84	No

*These averages are for the three remaining on-site stations during 2024 routine sampling events: SW-1, -3A, and -4.

*There was no detectable N-N concentration at SW-6 in 2024.

‡ If p <0.05, then the datasets (SW-6 vs. on-site stations) are statistically significantly different from each other for the parameter shown.

IV. TRENDS AND STATISTICAL ANALYSES

The Environmental Management Plan (TSG, 2000) requires that the data be analyzed to determine trends over time. This section describes the time trends for relevant inorganic parameters in the surface water samples.

A. Methods

We created graphs of concentration vs. time since the beginning of monitoring and visually inspected them for obvious trends for pH and nitrate-nitrogen (N-N): pH - Figure IV-1; N-N - Figures IV-2a (cumulative). These graphs represent the cumulative results from the 'official' start of monitoring (i.e., Sept. 1999) through the end of 2024. In addition, we created a graph (Figure IV-2b) for the last 10 years (2015-2024, inclusive) to evaluate trends. Non-detectable concentrations for N-N are depicted by an entry of half the MRL (method reporting limit) or the LOQ (limit of quantitation). Note that the N-N MRL was 0.5 mg/L from 1999 through the June 2001 sampling event, and it was reduced to 0.1 mg/L in August 2001 (see Figure IV-2a). This likely skews the trends. However, the graphs are intended to highlight the overall trends at the four remaining sampled stations (SW-1, -3A, -4, and -6). Although it is also important to note peak concentrations in the graphs, it is equally important to realize each peak represents a single sampling date, not a longer-term average. Therefore, the cumulative results should be analyzed based on the overall trends.

Test for Significant Differences. The Student's t-test is a statistical method used for comparing two groups of data. If the p-value is less than (<) 0.05, then it can be said that the two groups of data are statistically significantly different from each other. This test is used for the N-N results only.

Linear Regression Analyses. We used the coefficient of determination for linear regression analyses, r^2, to determine if there are any increasing or decreasing trends for N-N. The coefficient of determination, when multiplied times 100, yields the percent variation in the data that can be explained by the equation/relationship; in this case, concentration vs. time.

B. Parameter Trends and Statistical Comparisons

The discussion below summarizes the trends analysis for surface water from 1999 ('official' start of monitoring) through 2024. Figure IV-1 compares the pH of the three remaining on-site stations with the background station SW-6. Similarly, Figure IV-2a compares the N-N concentrations with the background station. The trends for these parameters are discussed below.

1. pH

A visual inspection of Figure IV-1 shows that the pH at all surface water stations have been fluctuating between ~5 and ~8.5 (except for a few outliers) over the last 10 years (i.e., 2015-2024), including the background station SW-6. The highest pH over the last 10 years was observed at SW-1 (8.45; 2019) and the lowest pH also at SW-1 (4.48; 2017).

The average pH at the background stations for that 10-year period (2015-2024) is 7.02, and the average pH at the three remaining on-site stations combined is 6.78. In addition, the overall averages (1999-2024) of the three remaining on-site stations (6.65) and SW-6 (6.70) shows that the background station's pH is slightly less acidic than the on-site stations for the official monitoring period (1999-2024). Although we can assume that acid rain can account for lower pH values some of the time, it likely does not account for all of the lower pH values (i.e., some of the lower pH values may be the result of golf course management). Keep in mind that slightly lower pH values (i.e., acidic) helps to maintain healthy turf, which means less pesticides are needed. In any case, pH monitoring will continue as long as N-N is monitored. In addition, the overall and the 10-yr average pH values for both the on-site and the background stations are within the desirable range 6.5-8.5.

2. Nitrate-Nitrite Nitrogen

Figure IV-2a illustrates the nitrate-nitrite nitrogen (N-N) concentrations at the four remaining surface water stations: three on-site stations (SW-1, SW-3A, and SW-4) and one off-site station (i.e., SW-6, background). A visual inspection of the figure with the trend lines shows that the N-N concentration fluctuates at all stations. Figure IV-2a shows that there have been many N-N concentration spikes and there appears to be slightly increasing trends at stations SW-1 and SW-3A and slightly decreasing trends at SW-4 and SW-6. Therefore, statistical evaluations were done to determine if there are any statistically significant differences ($p<0.05$) in the N-N concentrations and/or concentration trends when compared with the background station for the whole dataset.

Figure IV-2b shows the last 10 years of monitoring (2015-2024) for the remaining four stations (SW-1, SW-3A, SW-4, and SW-6). Two on-site stations show slight decreasing N-N concentration trends (SW-1 and SW-4). Station SW-3A shows a flat trend (i.e., neither increasing nor decreasing). The background station SW-6 shows a very slight increasing trend. The 10 year data at each station was compared with SW-6 to determine if the means are significantly different. The Student's t-test shows that there is a significant difference (i.e., $p<0.05$) in the means at all of the on-site stations compared with SW-6. Table IV-1 shows the p-values of each station compared with SW-6.

Table IV-1. Test of Significance (p-values): SW-1, SW-3A, and SW-4 Compared With SW-6 (20215-2024)

p-values	SW-1	SW-3A	SW-4
SW-6	3.69 E-11	7.28 E-9	0.001

A p-value less than 0.05 = means are significantly different from each other.

The average N-N concentration in 2024 for the three remaining on-site stations combined (0.38 ppm, std ± 0.35 ppm; n=12) is lower than in 2023 (0.56 ppm, std ± 0.69 ppm; n=12) and lower than in 2022 (0.68 ppm, std 0.43, n=11). ***A comparison of the on-site stations' 2023 and 2024 data using the two-tailed Student's t-test and a confidence level (CL) of 95% concluded the difference in means between the datasets is not significant (p=0.43; see Table IV-2 below).***

A statistical comparison of the 2024 on-site stations' combined N-N average concentration (0.38 ppm) and the average N-N concentration at the background station SW-6 (0.05 ppm, ½ the

LOQ) shows there is a statistically significant difference in the datasets (p=0.008; Table IV-2). However, since there were no detections at SW-6 in 2024 the statistical comparison is skewed.

We will continue to use the complete dataset beginning in September 1999 ('official' start of monitoring) for our statistical analyses to compare the remaining on-site stations vs. SW-6 (background) results because past comparisons between the years 1999-2024 vs. 2001-2024 (updated to include the 2022-2024 data) when the MRL changed was not statistically significant (p-value = 0.7, this did not change when we added the additional 2002-2024 data). Therefore, eliminating the earlier data does not affect the statistical analytical test for significance.

Time vs. concentration is represented by the regression analysis. A regression analysis (r^2) trend line for the cumulative datasets (1999-2024) at each station shows that the overall N-N concentrations at stations SW-1 and SW-3 are increasing (Figure IV-2a). However, the trend at those two stations over the last 10 years (2015-2024; Figure IV-2b) shows that the N-N concentration at SW-1 is decreasing and the trend at SW-3A is flat (i.e., neither increasing nor decreasing). The cumulative datasets (1999-2024) trend lines for stations SW-4 and SW-6 show a slightly decreasing trend at both stations (Figure IV-2a). The trend over the last 10 years (Figure IV-2b) for SW-4 is decreasing and is slightly increasing at SW-6. All r^2 values are low, which suggests that there is no apparent correlation between time and the N-N concentrations (i.e., time does not have an effect on the N-N concentrations). Thus, there is another influence on the N-N concentration (e.g., fertilizer applications, earth work, and/or residential influence for SW-6).

In summary, there are concentration spikes and occasional RT exceedances for N-N at some of the on-site stations. However, the N-N concentration trends appear to be decreasing at all on-site stations and the cumulative average (includes only the three remaining on-site stations) N-N concentrations are very low (see Table IV-2 below). Additionally, we observe that the overall mean N-N concentration is lower in 2024 (0.38 ppm) than in 2023 (0.56 ppm) and in 2022 (0.68 ppm; ETS 2023).

Table IV-2. Comparison of the Average N-N Concentrations - 2023 vs. 2024 On-Site Stations, Cumulative and 2024 On-Site Stations vs. SW-6

	Mean N-N Concentrations On-Site Stations§ (ppm)			On-site t-test p-value	Mean N-N Concentration SW-6 (ppm)		Two tailed t-test On-Site Mean vs. SW-6 p-value†	
	1999-2024*	2023	2024	2023 vs. 2024	1999-2024	2024‡	1999-2024	2024
Nitrate-N	0.44	0.56	0.38		0.10	0.05		
Std (±)	0.43	0.69	0.35	0.43	0.14	0	3.5E-37	0.008
N	370	12	12		109	4		

§ We only compared the three remaining stations for the 2024 data set and the cumulative data.
*This average is for the three remaining on-site stations. The MRL between 1999 and August 2001 was 0.5 ppm, then it changed to 0.1 ppm, which impacts the results because non-detects are entered as ½ of the MRL, i.e., 0.25 vs. 0.05. There was no difference in the means for the datasets (See text above).
†A p-value <0.05 = a statistically significant difference in the datasets. A p-value >0.05 indicates that the mean N-N concentrations are the same.
Std = standard deviation; N = number of samples
‡ There were no N-N detections at SW-6 in 2024. Thus, a statistical comparison with the on-site stations is skewed.

C. Station SW-3A Nitrate-Nitrogen Concentration Trends

We compared the results of the remaining three stations' nitrate-nitrogen concentrations to determine if there is a significant difference in the means (i.e., average concentration). A statistical comparison was made using the Student's t-test of the dataset for the time frame 2002-2024 (inclusive). This dataset was selected because the detection limit (0.1 ppm) is the same for the complete 23 years of monitoring. As previously discussed, the detection limit from 1999 through a portion of the 2001 year was 0.5 ppm. A change in detection limits may skew this analysis. Thus, we did not use the data prior to 2002 (i.e., 1999-2001).

The test for significance shows that there is no significant difference (p-value > 0.05) between the means of station SW-1 and SW-3A. However, there is a significant difference between the means of SW-1 and SW-3A compared with SW-4 (Table IV-3).

Figure IV-3. Test for Significance (p-values) - Average Nitrate-Nitrogen Concentrations Between the On-site Stations (2002-2024)

Stations	SW-1	**SW-3A**	**SW-4**	**Two tailed t-test On-Site Mean p-values[†]**		
	(2002-2024)			SW-1 vs. SW-3A	SW-1 vs. SW-4	SW-3A vs. SW-4
Nitrate-N	0.56	0.52	0.29	0.57	6.48E-8	1.11E-4
Std (±)	0.42	0.55	0.28			
n	116	112	106			

[†]p-values < 0.05 = significant difference between the means
n = number of samples

Based on the results above, we selected station SW-3A for further evaluation for seasonal comparison of results. We also selected station SW-3A because it has had the most RT exceedances for the 1999-2024 dataset (n=34, 27%, see the next section Table V-1). In addition, station SW-3A is upgradient and discharges into the arboretum area. Neither station SW-1 nor SW-4 has flow to any significant body of water.

We reviewed the nitrate-nitrogen (N-N) results at station SW-3A to determine which season and flow type (i.e., base flow and storm flow) would provide the most valuable information when reviewing golf course fertilizer management and its possible affect on surface water. A comparison was made between the seasons and flow types for the last 23 years (2002-2024, inclusive). Table IV-4 below shows the average N-N concentrations for each season and flow type at SW-3A. The results show that the most RT exceedances occurred during spring base flow sampling events for the 23 year data (Table IV-4; N-N>RT = 9). In addition, the spring base flow event's 23-yr average N-N concentration is the only season and flow type where the average N-N concentration exceeded its RT of 0.57 ppm (average = 0.74 ppm). The results below show that the best time to collect samples at this station is during the spring base flow (April-June, following the first application of fertilizers). None of the other season's average N-N concentration exceeds the 0.57 ppm RT.

A statistical analysis was also done using the Student's t-test (a test for significance) between the seasons (spring, summer, and fall) and flow types (i.e., base flow or storm flow). This was done to determine if there is a significant difference between the mean N-N concentrations for the seasons and flow types. There are data gaps because sampling was not done during all seasons or all flow types (see Table IV-3 above; number of samples (n)). However, there is enough data to produce reliable results. Table IV-5 below shows the p-values for the seasons and flow types compared with each other. A p-value less than (<) 0.05 indicate that there is a significant difference between the means. There are no p-values less than (<) 0.05 (i.e., all the means are the same). The closest significant difference (p<0.05) between the means is the spring BF compared with the fall BF (p=0.056), which indicates that spring and fall base flows mean N-N concentrations are almost significantly different from each other.

Figure IV-4. Comparison of the Average Nitrate-Nitrogen Concentrations of the Seasons and Flow Types at SW-3a (2002-2024)

SW-3a	Spring-BF	Spring-SF	Summer-BF	Summer-SF	Fall-BF	Fall-SF
Mean (ppm)	0.74	0.45	0.43	0.46	0.44	0.51
Std (ppm)	0.67	0.55	0.51	0.53	0.43	0.58
n	22	12	20	20	22	11
N-N>RT	9	3	4	5	7	3

Mean = seasonal average of the data for the years 2004-2024
Std = standard deviation
n = number of data points, i.e., the number of samples collected between 2002 and 2024 for that season and flow type.
N-N>RT = number of times that the nitrate-nitrogen concentration is greater than (>) the response threshold (RT) of 0.57 ppm during the sampling event.

Figure IV-5. Station SW-3A Student's T-test (p-values) for Significance Between the Seasons and Flow Types for the Nitrate-Nitrogen Concentrations (2002-2024)

Seasons and Flow types	Spring BF	Spring SF	Summer BF	Summer SF	Fall BF	Fall SF
Spring BF	--	0.254	0.099	0.124	**0.056**	0.369
Spring SF	0.254	--	0.878	0.928	0.747	0.812
Summer BF	0.099	0.878	--	0.940	0.846	0.649
Summer SF	0.124	0.928	0.940	--	0.788	0.704
Fall BF	**0.056**	0.747	0.846	0.788	--	0.513
Fall SF	0.369	0.812	0.649	0.704	0.513	--

BF = base flow
SF = storm flow

V. CONCLUSIONS AND RECOMMENDATIONS

Overall, the course appears to be managed well, from an environmental perspective, with minimal nutrient impacts to surface water. The overall cumulative monitoring results (1999-2024) show statistically significant increasing N-N concentration trends at two on-site stations (SW-1 and -3A) compared with the background station SW-6. However, the data over the last 10 years (2015-2024) show decreasing trends at SW-1 and SW-4, neither increasing nor decreasing at SW-3A, and slightly increasing at SW-6. The overall N-N concentrations at the three remaining on-site stations range from non-detect (<0.1 ppm) to 2.3 ppm (see Table V-1 below).

Table V-1. Nitrate-Nitrite Nitrogen RT Exceedances (1999-2024)

Surface Water Stations	N-N RTs (ppm)	N-N Concentration Ranges (ppm; latest yr highest concentration)	Most Recent RT* Exceedance (ppm, year)	Number of Times RT Exceeded Overall (% Exceeded†)
SW-1	0.89	ND - 2.3 (2017)	0.89 (2022)	18 (15%, n=123)
SW-3A	0.57	ND - 2.15 (2023)	1.31 (2024)	34 (27%, n=125)
SW-4	0.38	ND - 1.6 (2004)	0.71 (2022)	28 (24%, n=118)
SW-6	0.31	ND - 1.36 (2022)	1.36 (2022)	2 (2%, n=109)

* The most recent year that a N-N concentration exceeded its corrected RTs for monitoring years 1999-2024.
† The value in parentheses is the percent that the RT was exceeded at that station between monitoring years 1999-2024.
ND = not detected above the MRL of 0.1 ppm (the MRL changed in 2001 from 0.25 ppm to 0.1 ppm)

Our recommendation to reduce the total amount of N that can be applied between October 15 and April 1 to 1,000 lb (Appendix C) was implemented in 2017. The last fertilizer applications were made in late September 2024. No additional fertilization applications will be made until late April or early May 2025 for the spring applications. Thus, the amended EMP was followed for reduced fertilizer applications.

Golf Course Reconstruction

A new irrigation system installation and construction of turf at the HNGC began in 2023 (see Appendix A). According to Brett Scales, Superintendent, the golf course closed in 2023 to replace all greens and sand traps. While the golf course was closed, re-seeding the greens, tees, and fairways was done to improve the bentgrass. This type of major construction produces N-rich ground water, is likely the cause of the one N-N concentration spike observed in 2024 at station SW-3A.

The rigorous schedule of soil and tissue testing was suspended in 2023 due to the nature of the reconstruction of the turf. Soil and tissue testing resumed in 2024 to determine the nutrient needs of the turf.

A. Nitrate-Nitrite Nitrogen

There was one N-N RT exceedances in 2024 during routine sampling events at one station: SW-3A (see Table III-2 above). There was no resampling event for the RT exceedance because we did not receive the results in a timely manner as discussed above.

There is a statistically significant difference between the cumulative (1999-2024) average N-N concentrations for the on-site stations (0.44 ppm; Table IV-1) compared with the background station SW-6 cumulative N-N concentration (0.1 ppm; Table IV-1 above). A visual analysis (i.e., trend line) of each station's cumulative results shows that the N-N concentrations appear to be slightly increasing at two stations: SW-1 and SW-3A (Figures IV-2a). However, the N-N trend at SW-4 and SW-6 shows decreasing trends.

In the past, we stated that N-N increasing trends were likely caused by two factors: 1. Ground disturbance in 2012-2014 and recently in 2023 and 2. Too much N fertilization applied in the fall of 2016. It appears that the recent 2023 ground disturbance contributed to N-rich surface water at station SW-3A during the spring of 2024.

Figure V-1 below graphical shows the cumulative (2001-2024) average N-N concentration of the on-site stations' sampling events compared with the background station SW-6. A trend line was superimposed on each of the datasets to show the trend for each dataset's average N-N concentration. The trend line for the SW-6 background station shows a decreasing trend and the trend line for the on-site stations' cumulative average N-N concentration shows a slightly increasing trend, which is expected since nitrogen fertilizer is applied to the turf and there have been RT exceedances at all on-site stations at some point during the monitoring period. A test for significance for the cumulative average N-N concentrations of the on-site stations vs. SW-6 shows that there is a significant difference between the means (i.e., p-value = 3.5 E-37; Table IV-1).

Figure V-1 (below) also shows that the ground disturbance produced N-N concentration spikes beginning in 2013 and 2014 at the on-site stations and the N-N spike in 2017, which was likely caused by the fall fertilization at the end of 2016. The figure shows that the average N-N concentration at the on-site locations is slightly increasing. In addition, we may see a spike in the near future due to the ground disturbance from 2023. ***In any case, average N-N concentration for the on-site stations combined is well below 2.0 ppm (0.44 ppm, std ± 0.43, n=370, includes all resampling events at the three remaining stations).***

B. Turf Management

The superintendent (Brett Scales) applied fungicides and herbicides allowed under the EMP. In addition, fertilizer applications for 2024 totaled less than the maximum allowed under the EMP and less than industry standards for a high-end golf course. See Appendix A for the Superintendent's report.

C. Continued Monitoring

Our recommendation (Section V.D below) for continued monitoring is based on the discussion in Section IV.C above and the N-N concentration trends for the last 10 years.

In accordance with the EMP, monitoring is extended five years from the date of any sampling event during which an analyte is found to occur at a concentration exceeding a station's respective RTs (TSG, 2000). This determination is made on a station-specific basis. Table V-1 (above) show the surface water stations and the most recent years that the response threshold

(RT) exceedances occurred for N-N. Table V-1 shows the most recent years that an RT was exceeded at each station.

Table V-2 below shows all of the years that N-N concentrations exceeded the corrected RTs at each station since monitoring began. Monitoring is required for N-N at three remaining on-site surface water stations for the time specified in Table V-3 below in accordance with the amended EMP. Table V-3 shows the projected end of monitoring for N-N through 2027 at two of the on-site stations (SW-1 and SW-4) and through 2029 at SW-3A. Samples will be collected from the background station SW-6 as long as any on-site surface water station is sampled.

Table V-2. Years N-N Exceeded Corrected Response Thresholds

SW-1	SW-3A	SW-4	SW-6
2002, 2006, 2007, 2010, 2015, 2016, 2017, 2018, 2019, 2020, 2021. 2022	2002, 2007, 2008, 2010, 2011, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024	2000–2009*, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2021, 2022	2007, 2022

* There was at least one RT exceedance each year between 2000 and 2009.

Table V-3. Projected End of N-N Monitoring Period for Remaining Stations*

SW-1	SW-3A	SW-4	SW-6
2027	2029	2027	**

* Turbidity will be analyzed at all stations during all monitoring events.

**Samples will be collected from the background station SW-6 as long as any on-site surface water station is sampled.

D. Monitoring Recommendations

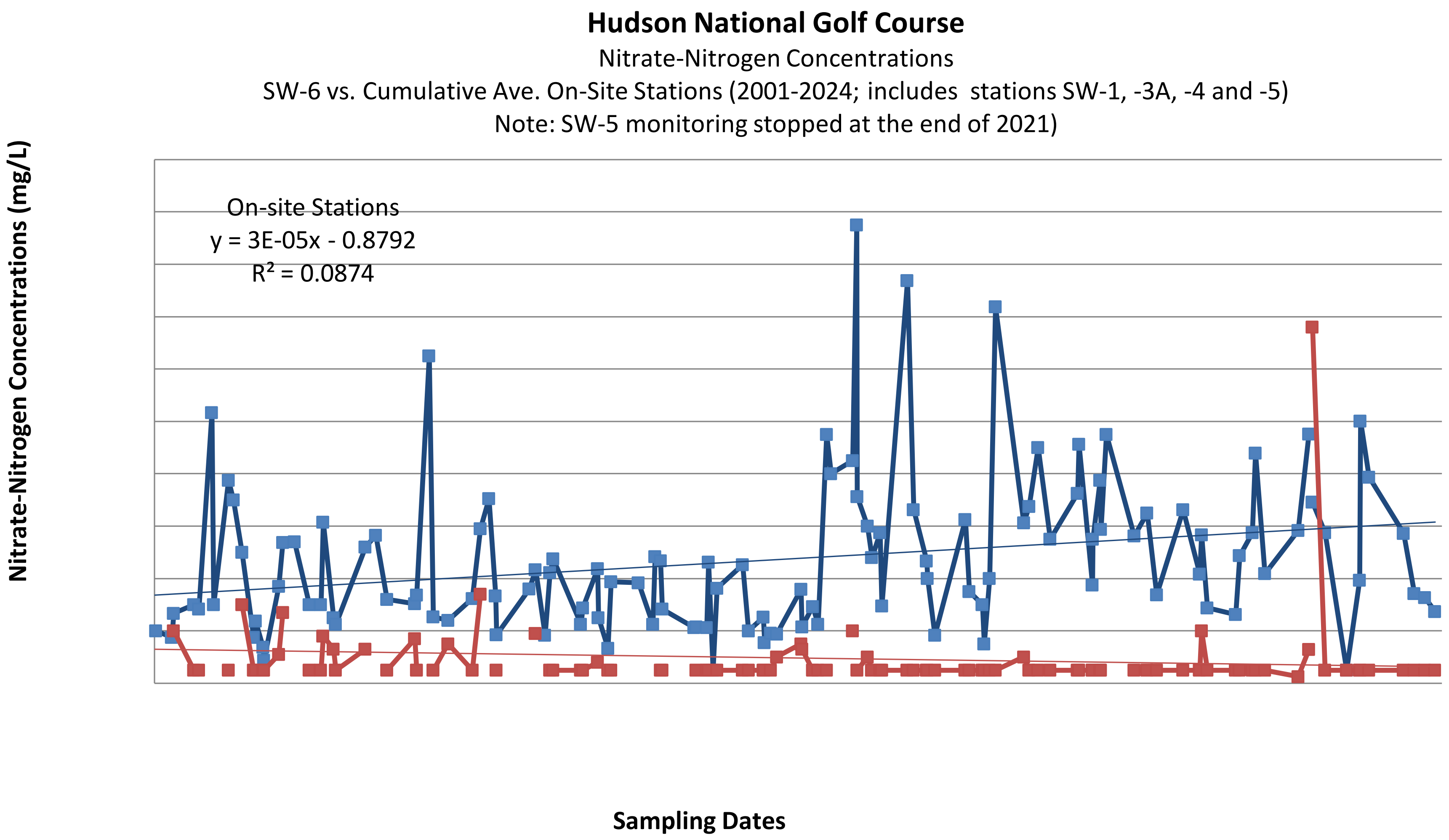
We recommend that monitoring for N-N and turbidity at the Hudson National Golf Course be reduced to monitoring surface water at only one station: SW-3A (see Section IV.C above). In addition, we recommend that the monitoring be done annually during the spring base flow. See our discussion in section IV.C above. Monitoring at SW-6 will be done as long as any on-site station is sampled.

Monitoring for N-N is required under the EMP at two on-site stations (SW-1 and SW-4) through 2027, at one on-site station (SW-3A) through 2029, and at the off-site station SW-6 (as long as monitoring on-site continues) in accordance with the EMP. However, we recommend that monitoring at stations SW-1 and SW-4 be stopped because those stations do not flow to any significant body of water and do not provide any useful information about golf course fertilizer management.

E. EMP Amendment Recommendation

We continue to recommend that no more than 1,000 lb N total be applied between October 15 and early spring (April 1). Appendix C provides the cover letter and the amended "Fertilizing" section of the EMP that was submitted January 17, 2017.

Figure V-1. N-N Average Concentration Trends - On-Site Average vs. SW-6



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FIGURES

APPENDICES

FIGURES

The plots in some graphs are discontinuous due to the inability to collect samples. Samples were not collected because the flow was too low on those dates. Keep in mind the lines connecting the points represent a point in time and not a continuation from one point to the next.

Figure III-1. HNGC Surface Water – pH – 2024

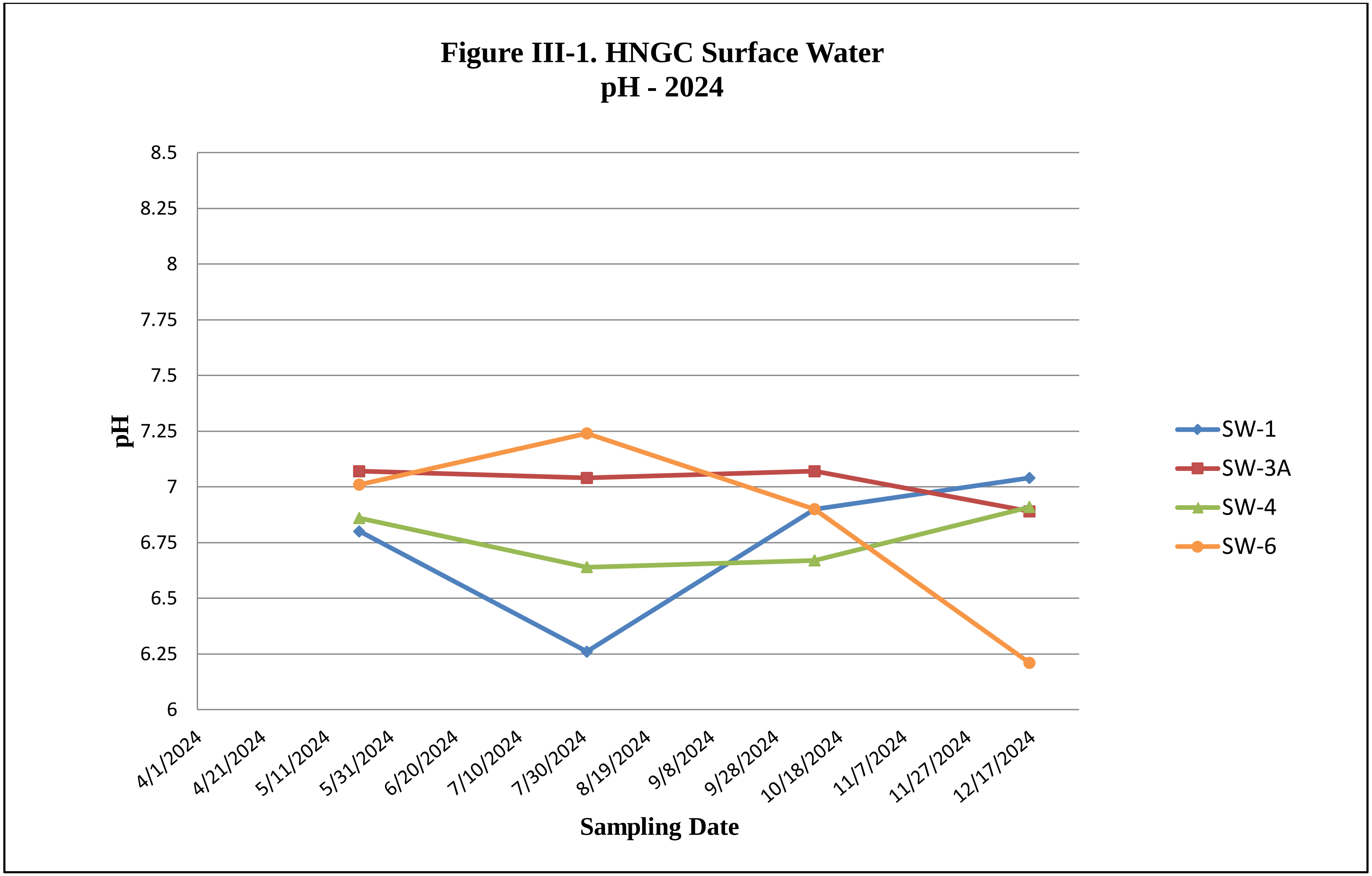


Figure III-2. HNGC Surface Water – Temperature – 2024

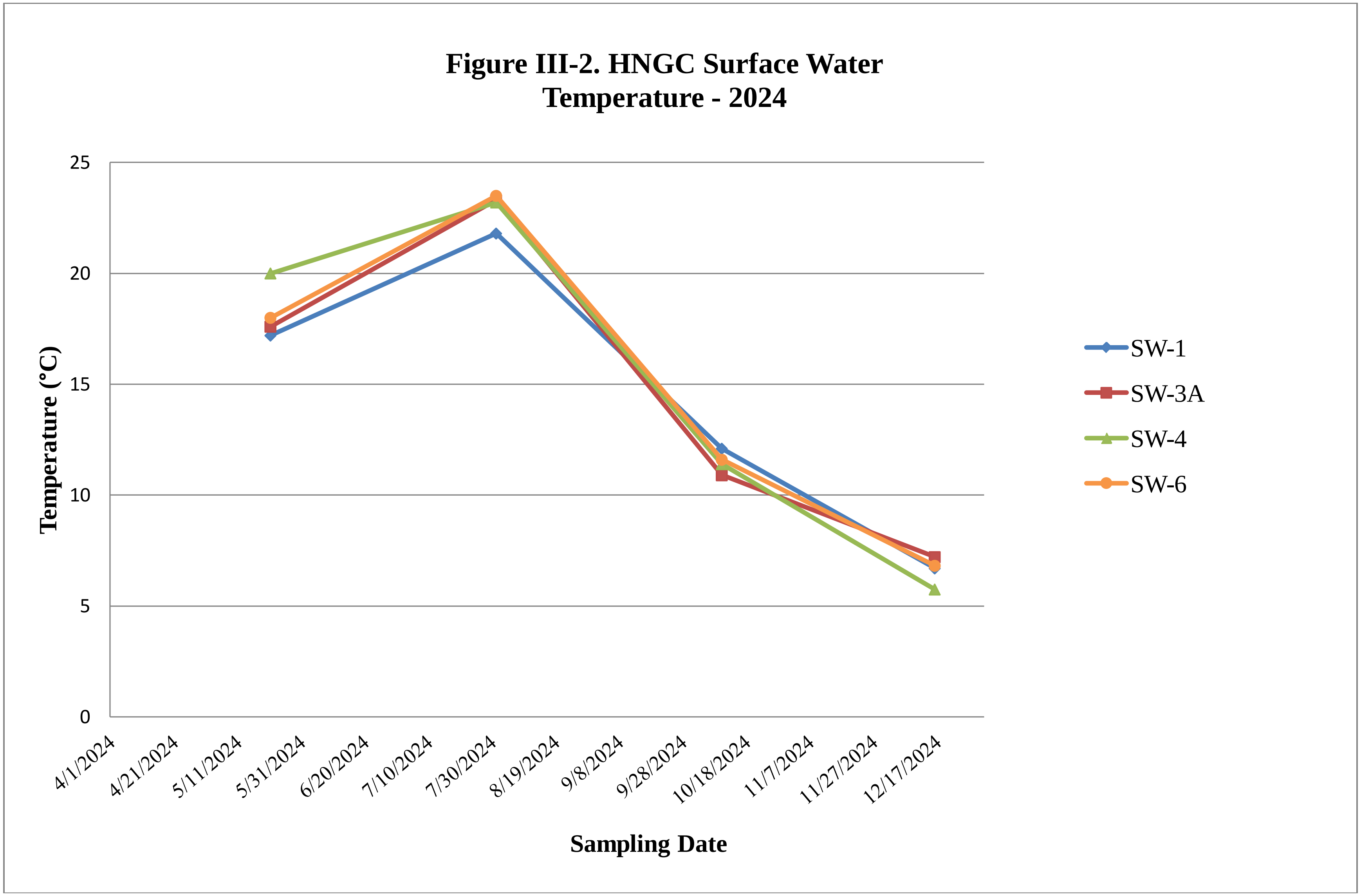


Figure III-3. HNGC Surface Water – Specific Conductance – 2024

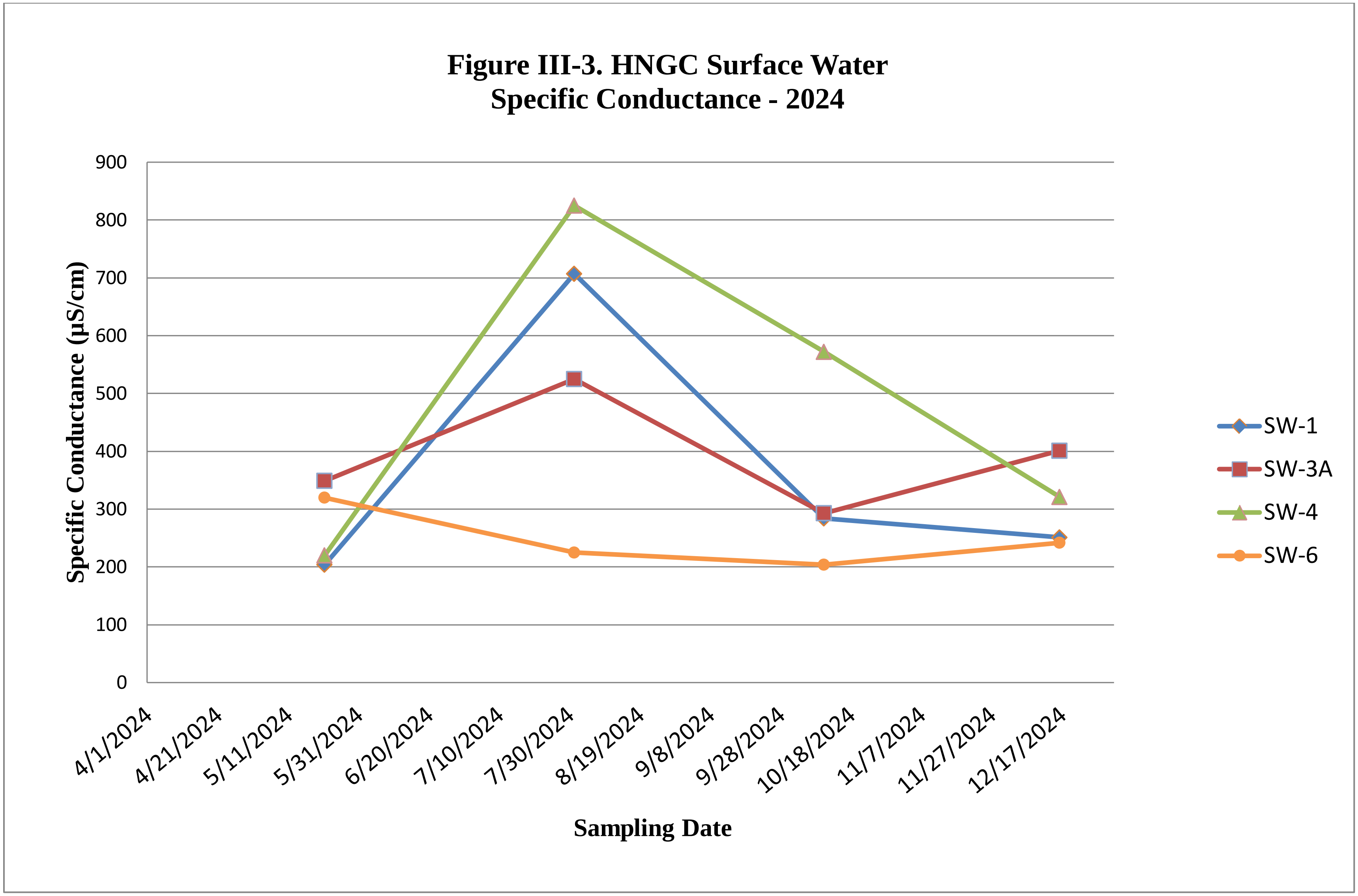


Figure III-4. HNGC Surface Water – Turbidity – 2024

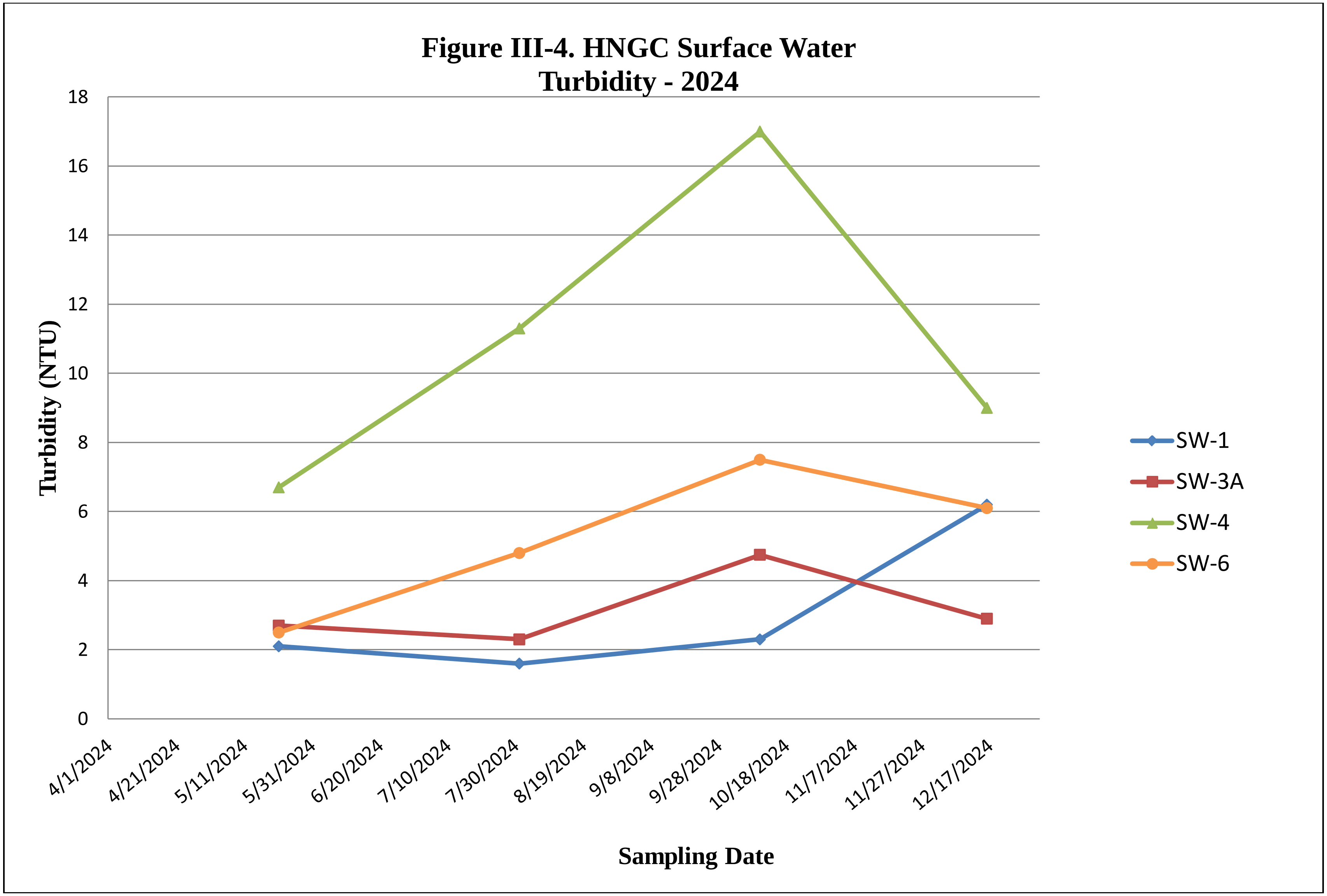
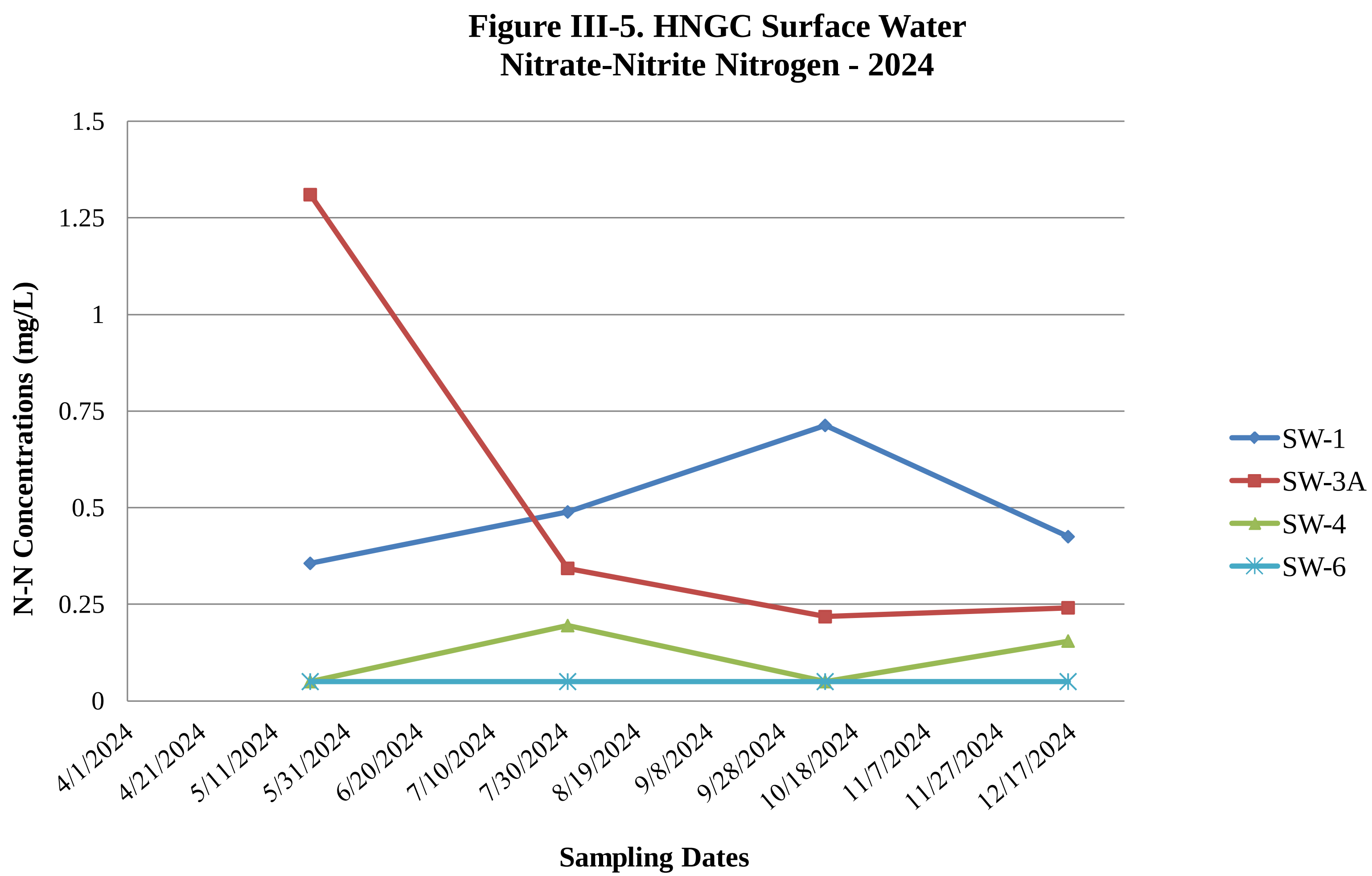


Figure III-5. HNGC Surface Water – Nitrate-Nitrite Nitrogen – 2024



Non detect are shown as 0.05 mg/L, 1/2 of the 0.1 MRL Response thresholds in ppm are shown in parenthesis, e.g., SW-1 (0.89).

Figure IV-1. HNGC Surface Water – pH – Cumulative 1999-2024

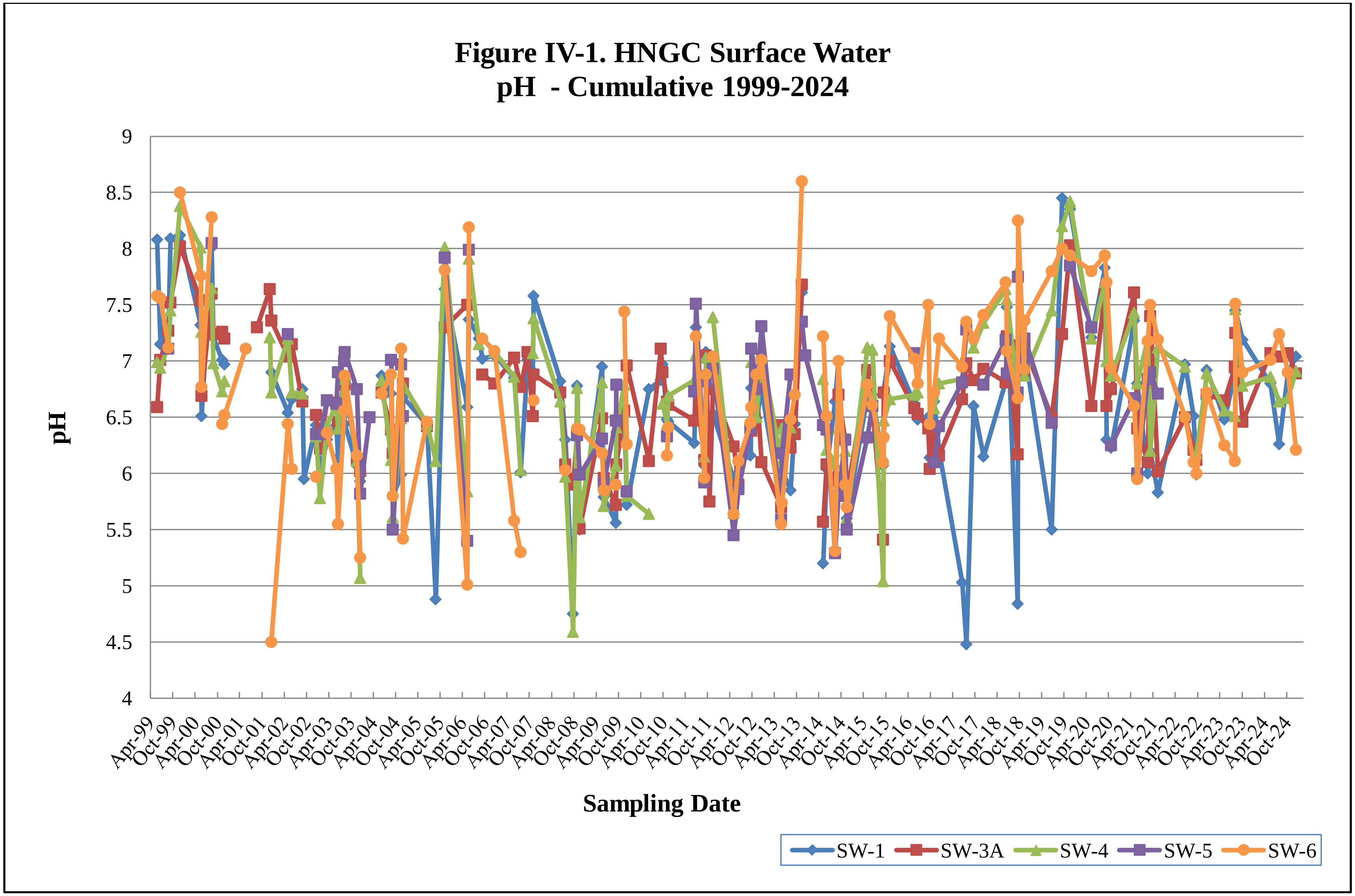


Figure IV-2a. HNGC Surface Water – Nitrate-Nitrite as Nitrogen – Cumulative 1999-2024 SW-1, SW-3A, and SW-4 vs. SW-6

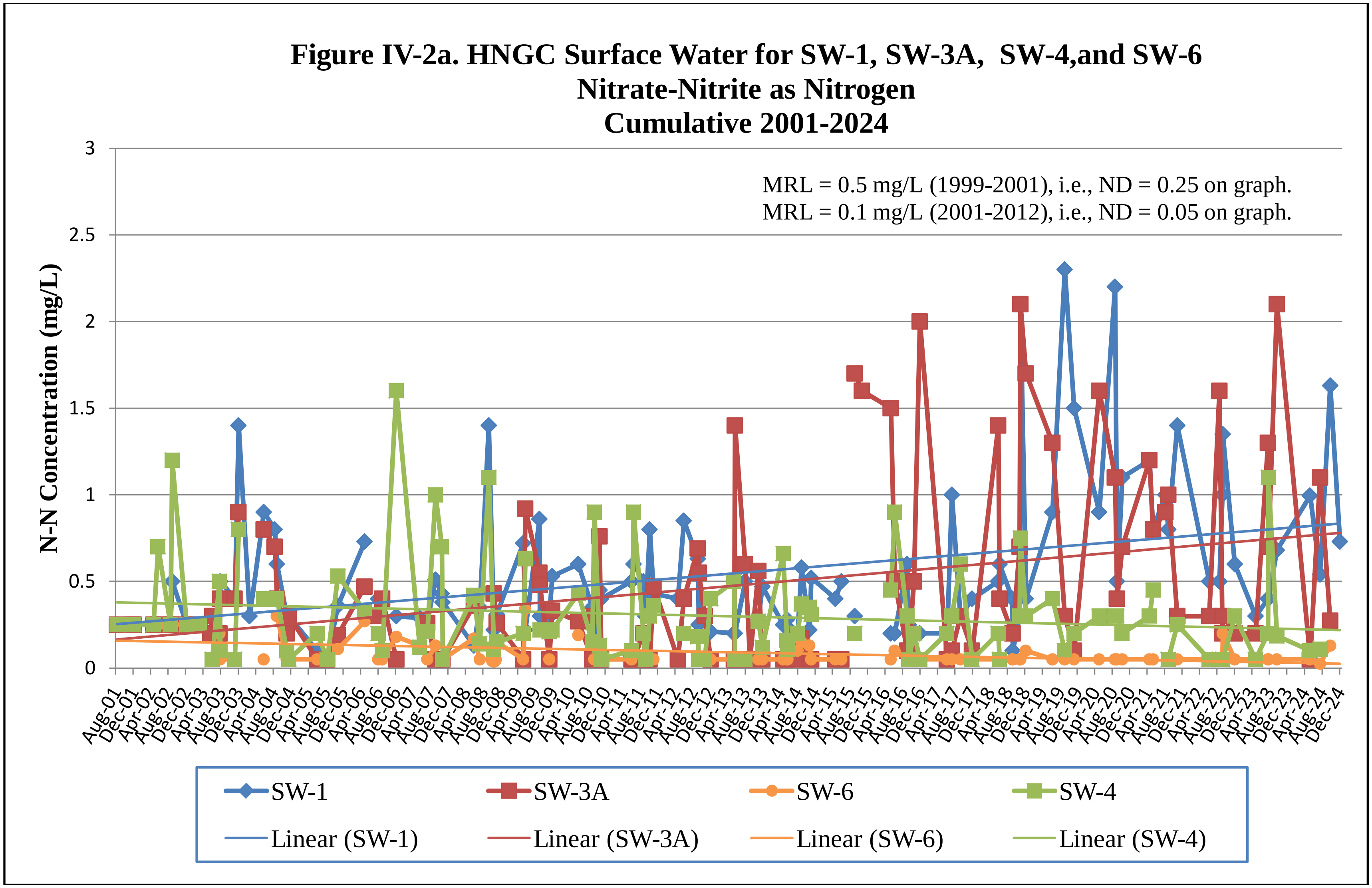
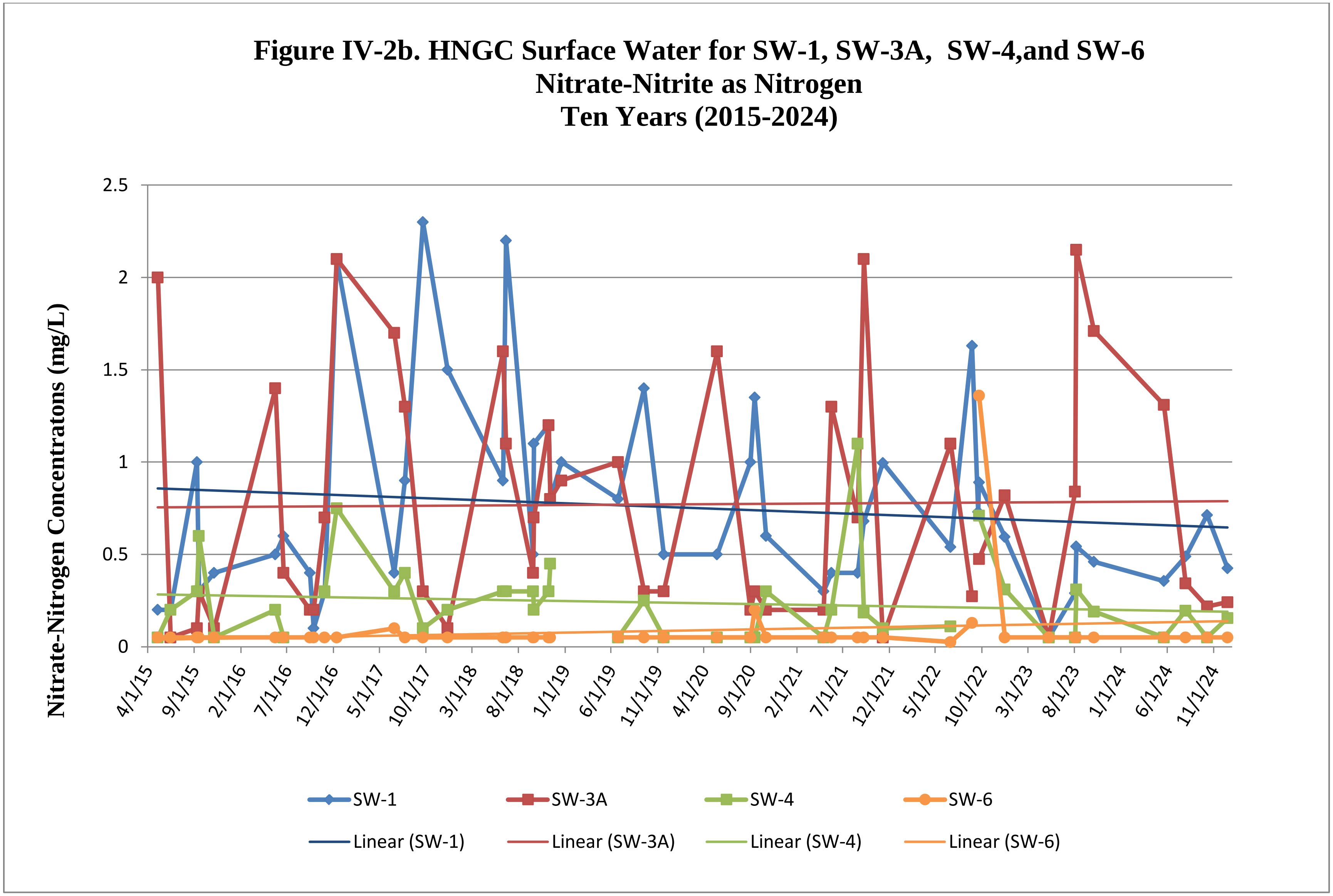


Figure IV-2b. HNGC Surface Water – Nitrate-Nitrite as Nitrogen – 10 Yr Monitoring Trends (2015-2024)



APPENDICES

APPENDIX A. Superintendent's 2024 Report

Report summary, and fertilizer and pesticide application schedules

Hudson National Golf Club
2024 Turfgrass Nutrient Management Plan
Prepared by: Brett Scales, Golf Course Superintendent
(Typographical edits were made by LaJan Barnes)

This report will summarize how and why nutrients were applied to the golf course during the 2024 season. Fertilizer application decisions have been based on the EMP guidelines, turfgrass health/growth, annual soil samples, tissue samples and weather.

Soil samples from greens, tees, fairways, and rough were taken in March and sent to Brookside Laboratories Inc., for analysis. Upon receiving the results of the soil samples, REP Consulting Inc. helped me create a plan to balance soil chemistry and improve turf health.

The 2024 golf season began later than normal as we were finalizing a restoration project of the entire golf course. The restoration project included replacing USGA spec greens, irrigation system, sand traps, re-grassing tees, approaches and fairways. 2024 proved to be a very challenging year with weather extremes.

Greens and tees at Hudson National are sand based root zones. The approach going into the 2024 season was to be conservative with green speeds and have elevated mowing heights on all playing surfaces to allow the new turf to mature. It generally takes 2-3 growing seasons for new bentgrass to reach its genetic maturity. Many of the fertilizer applications contained more phosphorus than typical to encourage rooting and expedite establishment of the young turf. I applied two applications of 7-7-7, an organic fertilizer to encourage microbial activity on the new sterile greens. The 7-7-7 fertilizer also provided a great nutrient base and was supplemented through the growing season with light, frequent "spoon feeding" applications of 20-20-20. I monitor turf grass health weekly through visual observations, color, growth rate, and with tissue samples to help identify deficiencies or surpluses within the tissue. In July, following a period of pro-longed heat, fertilizer applications consisted only of 0-0-52 to limit turf growth and reduce plant stress. The fertility program on tees remained similar to previous seasons even though they were re-grassed. The existing root zone mix on tees was not removed or modified and did not require additional nutritional inputs. Tees were fertilized using the "spoon feeding" method with two different fertilizers, 28-8-18 and 0-0-52. Applications varied between 7 and 14 days through the growing season depending on turf health, growth rate, and recovery.

Fairways were fertilized on a two-week schedule once the turf began actively growing. Fertilizer application totals were relatively low on fairways for growing in new turf. I believe the built up organic matter and decaying old bentgrass provided the new bentgrass with additional nitrogen reducing inputs. Tissue samples were used to monitor plant needs and when necessary adjustments were made.

Primary roughs on the golf course are treated a little bit differently than greens, tees, and fairways. The singular fertilizer application this season was 22-0-5 natural fertilizer, which contains 40% biosolids and 40% Uflexx. Both the Uflexx and biosolid fertilizer are released in a predictable manor from microbial degradation. The 22-0-5 fertilizer benefits the property by having an improved environmental profile by reducing the opportunity of nitrogen leaching. Previous seasons I have added a 2nd rough application approximately 8 weeks after the first application. With the new fertilizer a second application was not needed this year (2024).

All fertilizer applications have been made in an environmentally conscious manner. Weather conditions play an important role of when fertilizer applications are made. All efforts are made to avoid making fertilizer applications when rain or high winds are forecasted. Soil reports, tissue samples and the Environmental Management Plan again will be used to determine rates and timing of fertilizer applications in 2025. The goal will remain to apply the least amount of fertilizer while still maintaining sustainable healthy turfgrass.

2024 Fertilizer Applications

2024 Hudson National Golf Club Fertilizer Applications

Greens

Date	Material	Area	Rate (A) LB	LB N/1000	LB P/1000	LB K/1000	LB N/4A	LB P/4A	LB K/4A	greens	
4/1/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
4/8/24	7-7-7	Greens (4A)	21	0.5	0.5	0.5	87	87	87		
4/20/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
4/25/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
5/2/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
5/3/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
5/6/24	7-7-7	Greens (4A)	21	0.5	0.5	0.5	87	87	87		
5/15/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
5/16/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		1.75
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33	May 21 spring BF	
5/27/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
5/28/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
6/3/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
6/17/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
6/24/24	20-20-20	Greens (4A)	30	0.15	0.15	0.15	26	26	26		
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
7/1/24	28-8-18	Greens (4A)	15.5	0.1	0.028	0.063	17.4	4.9	11		
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
7/8/24	28-8-18	Greens (4A)	15.5	0.1	0.028	0.063	17.4	4.9	11		
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
7/15/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
7/29/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		0.8
8/19/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33	July 31 summer BF	
8/26/24	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
9/2/24	28-8-18	Greens (4A)	15.5	0.1	0.028	0.063	17.4	4.9	11		
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		
9/24/24	28-8-18	Greens (4A)	15.5	0.1	0.028	0.063	17.4	4.9	11	Oct 10 Fall BF	
	0-0-52	Greens (4A)	16	0	0	0.19	0	0	33		0.2
		Green Total		2.75	2.462	5.262	477.6	427.6	914		
										Dec 17 fall SF	

2024 Hudson National Golf Club Fertilizer Applications

Tees

	Material	Area	Rate (A) LB	LB N/1000	LB P/1000	LB K/1000	LB N/3A	LB P/3A	LB K/3A	tees	
4/1/24	5-7-5	Tees (3A)	435	0.5	0.7	0.5	65	91	65		
5/4/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
5/15/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		0.7
5/27/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23	May 21 spring BF	
	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
5/30/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
6/11/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
6/18/24	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
6/25/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
7/3/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
7/10/24	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
7/17/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		
	0-0-52	Tees (3A)	8	0	0	0.19	0	0	24.8		
8/13/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23		0.6
9/3/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23	July 31 summer BF	
9/24/24	28-8-18	Tees (3A)	16	0.1	0.028	0.063	13.03	3.66	8.23	Oct 10 Fall BF	
		Tee Total		1.6	1.008	2.713	208.33	131.26	353.93		0.3
										Dec 17 fall SF	

Fairways

	Material	Area	Rate A	LB N/1000	LB P/1000	LB K/1000	LB N/25A	LB P/25A	LB K/25A	fairways	
4/15/24	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		
	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
5/1/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
5/16/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		0.47
5/27/24	0-0-52	Fairways (25A)	8	0	0	0.097	0	0	12.7	May 21 spring BF	
5/28/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		
6/12/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		

2024 Hudson National Golf Club Fertilizer Applications

	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		
6/25/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		
6/18/24	0-0-52	Fairways (25A)	8	0	0	0.097	0	0	12.7		
7/3/24	0-0-52	Fairways (25A)	8	0	0	0.097	0	0	12.7		
7/11/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		
	0-0-52	Fairways (25A)	8	0	0	0.097	0	0	12.7		
7/25/24	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		0.79
8/6/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0	July 31 summer BF	
8/20/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
	0-0-52	Fairways (25A)	8	0	0	0.097	0	0	12.7		
9/3/24	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0		
	0-0-52	Fairways (25A)	8	0	0	0.097	0	0	12.7		
9/19/24	28-8-18	Fairways (25A)	10.9	0.07	0.02	0.045	76	21	49		
	46-0-0	Fairways (25A)	11.3	0.11	0	0	115	0	0	Oct 10 Fall BF	
		Fairway Total		1.77	0.14	0.897	1682	147	419.2		0.51
										Dec 17 fall SF	

Rough	Material	Area	Rate (A)	LB N/1000	LB P/1000	LB K/1000	LB N/35A	LB P/35A	LB K/35A
5/20/24	22-0-5	Rough (35A)	1.5	1.42	0	0.4	2164	0	609
		Rough Total		1.42	0	0.4	2164	0	609

Location	LB N/m	LB/P/m	LB K/m
Greens	2.75	2.462	5.262
Tees	1.6	1.008	2.713
Fairways	1.77	0.14	0.897
Roughs	1.42	0	0.4
	7.54	3.61	9.272

2024 Pesticide Applications

2024 HNGC Pesticide Applications

Greens

Date	Material	Active Ingredient	Rate	Acres Treated	Total Used	Pest
5/3/24	Insignia	Pyraclostrobin	.7 oz/M	4	592	Take-All Patch/Pythium Root Rot
5/15/24	Strobe L	Azoxystrobin	.4 oz/M	4	70 oz	Take-All Patch/Pythium Root Rot
5/28/24	Posterity	Pydifleten	5oz/A	4	20 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
6/3/24	Tebu 3.6F	Tebuconazole	.6 oz/M	4	104 oz	Take-All Patch/Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
6/10/24	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
6/17/24	Segway	Cyazofamid	.45 oz/M	4	78 oz	Pythium Root Rot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
6/24/24	Secure	Fluazinam	.5 oz/M	4	87 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
7/1/24	Signature	Aluminum Tris	4.4 ibs/A	4	48 ibs	Pythium
7/8/24	Mancozeb DG	Mancozeb	6 oz/M	4	1045 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
7/15/24	Signature	Aluminum Tris	4.4 ibs/A	4	48 ibs	Pythium
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
7/22/24	Mancozeb DG	Mancozeb	6 oz/M	4	1045 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
7/29/24	Signature	Aluminum Tris	4.4 ibs/A	4	48 ibs	Pythium
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
8/5/24	Mancozeb DG	Mancozeb	6 oz/M	4	1045 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
8/12/24	Signature	Aluminum Tris	4.4 ibs/A	4	48 ibs	Pythium
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
8/19/24	Subdue	Mefonoxim	1 oz/M	4	173 oz	Pythium
8/26/24	Tebu 3.6F	Tebuconazole	.6 oz/M	4	104 oz	Take-All Patch/Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
9/9/24	Xzemplar	Fluxapyroxad	.21 oz/M	4	36 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	4	16 oz	Growth
9/17/24	Insignia	Pyraclostrobin	.7 oz/M	4	121 oz	Take all patch
11/26/24	Tebu 3.6F	Tebuconazole	.6 0z/M		104 oz	Snow Mold
	Secure	Fluazinam	.5 oz/M	4	87 oz	Snow Mold

2024 HNGC Pesticide Applications

	Ipro 2	Iprodione	6 oz/M	4	8 gal	Snow Mold

Tees

Date	Material	Active Ingredient	Rate	Acres Treated	Total Used	Pest
5/4/24	Tebu 3.6F	Tebuconazole	.6 oz/M	3	78 oz	Summer Patch/Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
5/15/24	Strobe L	Azoxystrobin	.4 oz/M	3	52 oz	Take-All Patch/Pythium Root Rot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
5/27/24	Maxtima	Mefentrifluconazole	.6 oz/M	3	78 oz	Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
6/11/24	Fluazinam	Fluazinam	.5 oz/M	3	67 oz	Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
6/25/24	Posterity XT	Azoxystrobin, Propiconazole, Pydifluetofen	1.5 oz/M	3	1568 oz	Dollar Spot, Pythium, Brown patch
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
7/10/24	Fore	Mancozeb	6 oz/M	3	784 oz	Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
7/17/24	Strobe L	Azoxystrobin	.4 oz/M	3	52 oz	Take-All Patch/Pythium Root Rot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
7/24/24	Segway	Cyazofamid	.9 oz/M	3	39 oz	Pythium Root Rot
7/31/24	Tebu 3.6F	Tebuconazole	.6 oz/M	3	78 oz	Summer Patch/Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
8/13/24	Maxtima	Mefentrifluconazole	.6 oz/M	3	78 oz	Dollar Spot/ Take all patch
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
9/3/24	xzemplar		.26 oz/M	3	40 oz	Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
9/24/24	Tebu 3.6F	Tebuconazole	.6 oz/M	3	78 oz	Summer Patch/Dollar Spot
	Clarelle	Paclobutrazol	6 oz/A	3	18 oz	Growth
11/26/24	Tebu 3.6F	Tebuconazole	.6 oz/M	3	78 oz	Snow Mold
	Fluazinam	Fluazinam	.5 oz/M	3	67 oz	Snow Mold
	Ipro 2	Iprodione	6 oz/M	3	783 oz	Snow Mold

Fairways

Date	Material	Active Ingredient	Rate	Acres Treated	Total Used	Pest

2024 HNGC Pesticide Applications

5/1/24	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
5/16/24	Tebu 3.6F	Tebuconazole	.6 oz/M	24	653 oz	Summer Patch/Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
5/27/25	Tourney	Metconazole	.37 oz/M	24	386 oz	Dollar Spot, Fairy Ring
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
5/28/24	Secure	Fluazinam	.5 oz/M	24	523 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
6/12/24	Maxtima	Mefentrifluconazole	.6 oz/M	24	627 oz	Dollar Spot, Pythium, Brown patch
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
7/11/24	Posterity XT	Azoxystrobin, Propiconazole, Pydifluetofen	1.5 oz/M	24	1568 oz	Dollar Spot, Pythium, Brown patch
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
7/25/24	Strobe L	Azoxystrobin	.4 oz/M	24	418 oz	Take-All Patch/Pythium Root Rot
	subdue	Mefonoxim	1 0z/m	24	1089 oz	Pythium blight
8/6/24	Secure	Fluazinam	.5 oz/M	24	523 oz	Dollar Spot
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
8/20/24	Posterity XT	Azoxystrobin, Propiconazole, Pydifluetofen	1.5 oz/M	24	1568 oz	Dollar Spot, Pythium, Brown patch
	Anuew	Prohexadione Calcium	4 oz/A	24	100 oz	Growth
9/3/24	Maxtima	Mefentrifluconazole	.6 oz/M	24	627 oz	Dollar Spot, Pythium, Brown patch
11/26/24	Tebu 3.6F	Tebuconazole	.6 oz/M	24	653 oz	Snow Mold
	Secure	Fluazinam	.5 oz/M	24	523 oz	Snow Mold
	Ipro 2	Iprodione	6 oz/M	24	49 gal	Snow Mold

Rough

Date	Material	Active Ingredient	Rate	Acres Treated	Total Used	Pest
4/9/24	Baricade	Prodiamine	.7 oz/M	35	1067 oz	Crabgrass Control
	Triplit	24-D,Mccp, Dicamba	1.5 oz/M	3	196 oz	Broadleaf weeds, Spot Spray
7/9/24	Secure	Fluazinam	0.5	35	763	Dollar Spot, Grey Leaf Spot
7/30/24	Strobe	Azoxystrobin	0.77	35	1173 oz	Dollar Spot, Grey Leaf Spot
8/17/24	Tebu 3.6F	Tebuconazole	.6 oz/M	35	914 oz	Dollar Spot, Grey Leaf Spot
9/12/24	Rodeo	Glyphosate	10%	300 stems	30 oz	Phrags
9/13/24	Rodeo	Glyphosate	10%	300 stems	30 oz	Phrags

APPENDIX B. 2024 Soil and Tissue Results

REP Consulting, Inc.

Started in 1959, serving Sports Turf & Agriculture Worldwide

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DATE: 5/15/2024 | **Corrective Treatment For : Hudson National** | **FILE #: 59118**

Sampled Area: GREENS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	PG	
Mg Lime (dolomite) 22-28% Ca, 12% Mg		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall		5# x 2 appl spring, fall	5# x 2 appl spring, fall	5# x 2 appl spring, fall	
Gypsum (> 85% calcium sulfate dihydrate)	5#/every 4-6 weeks once you start heavily relying on irrigation water as the principle source of moisture - all the greens >>																				
		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP		5# x 1 appl ASAP	5# x 1 appl ASAP	5# x 1 appl ASAP	
Nitrogen/Organic matter:	Continually monitor the condition of the organic in the top 1" of the profile. Adjust maintenance programs (topdressing rates/intervals, venting, verticutting, aerification) to help maintain its optimal condition and health. Total available N at sampling was quite good for 2, 4, 14, 16, 18 & PG - they look like the youngest greens and you're still pushing them. Picked up a little fertilizer (ammonium sulfate) affecting the test results a little on 2 & 4 and more so on 18 & PG. The ammoniacal N is spiked and the pH is temporarily lower. The younger greens also have lower P ranges and so a starter is still very useful so long as the night time temps stay low to moderate. The oldest greens had lower N levels and needed a pick me up on N. And the older one's P levels are better/higher, but still could use some additional P.																				
Potassium:	At spring and fall aerification make sure to incorporate a coated, slow release K. Spring rate should be 2-3# actual K/1000 and fall should be 1-2# actual K/1000																				
0-0-50 (sulfate) or Andersons DG 0-0-25		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1		2# x 1 or 4# x 1	
Pro Mag 36, or Andersons DG 0-0-12-24Mg, or Plant Food KMS 0-0-28-14		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP		4# x 1 ASAP OR 4# x 1 ASAP	
Phosphorus: mono - potassium phosphate (0-52-34)	The most accurate phosphorus reading on the soil report is the Mehlich III phosphorus, >100#/acre is adequate for some situations. There is enough P here, that supplying more is unnecessary under normal conditions. They will respond well to a starter application to help heal aerification and in the shoulder seasons when soils are wet/cold & days are short/cloudy & there is excessive wear from play. To help strengthen the turf when it's shallow rooted & night time temps aren't dropping under 70^{o} and/or soil temps are $>75^{o}$, drop foliar N and replace it with weekly foliar P & K sprays using mono-potassium phosphate (0-52-34 - MKP, 5-7oz material/M)																				
MAP 11-55-0		2# x 3 appls spring,fall		2# x 3 appls spring,fall		2# x 2 appls spring,fall		2# x 1 appl anytime		2# x 2 appls spring,fall		2# x 1 appl anytime		2# x 3 appls spring,fall		2# x 3 appls spring,fall		2# x 3 appls spring,fall	2# x 3 appls spring,fall	2# x 2 appls spring,fall	
Epsom Salts (magnesium sulfate, 11% Mg)	4 ounces material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the greens >>> Keep it simple - the rate can vary between 2 - 6 ounces/M and be fine drying on the leaf. It's likely you can add half or a whole bag/tank and hit somewhere in that range.																				
Manganese Sulfate (32% Mn)	2 ounces material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the greens >>> You can go as high as 8oz material/1000 if the threat of or conditions exist to bring on take-all.																				
Ferrous Sulfate (24% Fe)	1 - 2 ounces material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the greens >>>																				
Sol-U-Bor (21% B)	1/4 ounce material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the greens >>>																				

Recommendations for greens, tees, lawns, and fields are pounds or ounces of *material* to be applied per 1000 ft^2 multiplied by the number of applications. Fairways are pounds or tons of material per *acre*.

Review

Being so new and having a range of fertility levels is going to make this first year a little harder as you try to get them all on the same footing while making it look like they already are. Keep a wary eye out for wear patterns from play and maintenance and adjust the traffic patterns where/when you can and use some surgical fertility applications to those areas to help with maintaining and recovery if it gets that far. I'm trying to keep some Ca and Mg in soil solution with the lime and gypsum and then added Mg as a rider along with some K. Get the higher Mg materials down now and then follow up with the DG 0-0-25 later in the summer. In place of the monthly gypsum there are materials that have Ca, Mg and K in them - covering a spectrum of elements that should stay in soil solution on a consistent basis. Plant Food has Phusion KMS Plus, Harrells has a 0-0-11 & 0-0-7, AQUA-AID has Verde-Cal K plus 0-0-15, Andersons DG line has Kal-Tec 0-0-13, and Solu-Cal has a 0-0-16 K-Cal Plus. Any of these could be used in a monthly 4-7#/M material application to help sustain the soil solution Ca, Mg and K on these high perc rate sand based greens. Trace minerals are another challenge. While I have Mg, Mn, Fe and B itemized, you could use one or two broader spectrum materials to save on individual items going in the tank. Simplot has a material called Rapture that covers several elements, Harrells has an IronMn Mg, Floratine similar with MnMag. You should always have some Tecmangam (manganese sulfate) on hand to ramp up the Mn when take-all is a threat, and it always is in the first two years on new greens.

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DATE: 5/15/2024 | **Corrective Treatment For : Hudson National** | **FILE #: 59118**

Sampled Area: TEES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
Mg Lime (dolomite) 22-28% Ca, 12% Mg			10# x 1 appl asap		5# x 1 appl asap		10# x 1 appl asap		10# x 1 appl asap		10# x 1 appl asap		10# x 1 appl asap		5# x 1 appl asap		10# x 1 appl asap				
Gypsum (> 85% calcium sulfate dihydrate)																					
Nitrogen/Organic matter:	Very modest N levels at sampling and they'll want a shot in the arm to help push divots shut from the side. There seems to be a little more N & P on 11, 13(?) & 17 versus the others. Are you pushing these harder because of their environment? Or are they too small/high play? That's fine, there is plenty of room to increase fertility levels and improve.																				
Potassium: 0-0-50 (sulfate)																					
Sul-Po-Mag or K-Mag (0-0-22-11Mg)	One this spring yet and then again in mid to late summer, and the final one in mid to late fall		5-7# x 3 appls		5-7# x 3 appls		5-7# x 3 appls		5-7# x 3 appls		5-7# x 3 appls		5-7# x 3 appls		5-7# x 3 appls		5-7# x 3 appls				
Phosphorus: MAP 11-55-0	The most accurate phosphorus reading on the soil report is the Mehlich III phosphorus. A number over 100 is adequate for some circumstances.		2# x 1-2 spring, fall		2# x 1-2 spring, fall		2# x 1-2 spring, fall		2# x 1-2 spring, fall		2# x 1-2 spring, fall		2# x 1-2 spring, fall		2# x 1-2 spring, fall		2# x 1-2 spring, fall				
Manganese Sulfate (32% Mn)	2 - 4 ounces material/1000 ft^2 x as often as weekly, but no less than monthly - all the tees >>>																				
Ferrous Sulfate (24% Fe)	1 - 2 ounces material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the tees >>>																				
Sol-U-Bor (21% B)	1/4 ounce material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the tees >>>																				

Recommendations for greens, tees, lawns, and fields are pounds or ounces of *material* to be applied per 1000 ft^2 multiplied by the number of applications. Fairways are pounds or tons of material per *acre*.

Review

Get the lime down and then start chasing the K and Mg. While the K-Mag/Sul-Po-Mag is a less expensive material, the Andersons DG 0-0-12-24Mg or the Plant Food KMS 0-0-28-14Mg both have higher Mg levels than the K-Mag/Sul-Po-Mag and either of those would be a good first application, and then keep that 8-10 week interval through the rest of the year with the K-Mag/Sul-Po-Mag. The P levels are just OK. Use the MAP to your greatest advantage like healing after aerification, early spring to jump start the system, or late fall to extend the season if the play continues at a moderate pace into November/December.

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DATE: 5/15/2024 | **Corrective Treatment For : Hudson National** | **FILE #: 59118**

Sampled Area: ROUGH & FAIRWAYS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		Rough 1/18	Rough 10/12
High Calcium Lime 32- 38% Ca, <5% Mg				OK		OK				OK		OK		OK				OK		500#/ac x 1 appl anytime	1000#/ac x 1 appl anytime
Mg Lime (dolomite) 22-28% Ca, 12% Mg				500# x 1 appl anytime		500# x 1 appl anytime				500# x 1 appl anytime		500# x 1 appl anytime		500# x 1 appl anytime				500# x 1 appl anytime		OK	OK
Nitrogen/Organic matter:	Fairways had very modest N levels to start the spring - no carry-over from fall. Roughs are rocking with some carry-over (or a spring application?) and should still be pushing good growth and color.																				
Potassium: 0-0-50 (sulfate)	100-150#/acre x 1 application - all the fairways >>																			OK	OK
Sul-Po-Mag or K-Mag (0-0-22-11Mg)	250 - 300#/acre x 1 application - late fall/dormant - all the fairways >>																				
Phosphorus: MAP 11-55-0 or DAP 18-46-0	The most accurate phosphorus reading on the soil report is the Mehlich III phosphorus. A number over 100 is adequate for some circumstances. 100-150#/acre x 1 application - all the fairways and roughs >>>																				
Manganese Sulfate (32% Mn)	2 - 4 ounces material/1000 ft^2 x every 14-28 days in season (June through September) - all the fairways >>>																				
Ferrous Sulfate (24% Fe)	1 - 2 ounces material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the fairways >>>																				
Sol-U-Bor (21% B)	1/4 ounce material/1000 ft^2 x every time that you spray (as often as weekly, no less than monthly) - all the fairways >>																				

Recommendations for greens, tees, lawns, and fields are pounds or ounces of _material_ to be applied per 1000 ft^2 multiplied by the number of applications. Fairways are pounds or tons of material per _acre_.

Review

Need to get the K levels back above 100#/acre with a 0-0-50 application. The lime is not critical, but essential to work into this year's program by the end of the season. The P levels are just ok and could use a boost if traffic is going to be heavy. Walkers aren't a concern, but if cart and maintenance traffic is heavy, it could easily show. So if you wanted to save a trip with the spreader around the course, you could have the 0-0-50 and MAP/DAP blended half and half yielding a 5-27-25 with MAP or a 9-23-25 with DAP. Spread the blend at 200-300#/acre. This could be an annual application. Second possibility is to make the potash portion coated so it's less likely to quickly leach on your sand capped fairways and carry through most of the growing season with a spring application. And a third option is to add some manganese to that blend so the Mn levels can get moving faster.

BROOKSIDE LABORATORIES, INC.

Account of : Hudson National Golf Club   City: Croton-on-Hudso   ID#: 59118

Consultant: REP Consulting, Inc.   State: NY   Date: 03/27/24

Field: GREENS				2	4	6
	Sample:			G	G	G
	Lab # :			876	877	878
	Total Exchange Capacity (M.E./100g):			2.68	2.20	2.62
	pH: (H2O 1:1)			6.7	6.8	7.2
	Organic Matter [360° C LOI (humus)] %:			< 0.10	< 0.10	< 0.10
ANIONS	Estimated Nitrogen Release (lbs/acre)			4	4	4
	Soluble Sulfur (p.p.m.)		*(IDEAL 20 - 40ppm)*	18	13	20
		MEHLICH III	*Desired Value	100	100	100
	Phosphates:	Easily Extractable	Value Found	92	92	183
	as P2O5		Deficit	-8	-8	
	lbs/acre	BRAY II	*Desired Value	350	350	350
			Value Found	92	115	183
			Deficit	-258	-235	-167
		OLSEN Phosphorus				
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value		729	650	713
	lbs/acre	Value Found		654	496	624
		Deficit		-75	-154	-89
	Magnesium:	*Desired Value		180	180	180
	lbs/acre	Value Found		126	108	130
		Deficit		-54	-72	-50
	Potassium:	*Desired Value		140	140	140
	lbs/acre	Value Found		166	214	244
		Deficit				
	Sodium:	*Maximum Desired Value		37	30	36
	lbs/acre	Value Found		26	30	42
			Excess			6
BASE SATURATION PERCENT			***IDEAL** (for TEC >5)			
	Calcium	%	68	61.01	56.36	59.54
	Magnesium	%	15	19.59	20.45	20.67
	Potassium	%	4.5	7.94	12.47	11.94
	Sodium	%	< 3	2.11	2.96	3.48
	Other Bases	%	4 - 8	4.70	4.60	4.20
	Hydrogen	%	5 - 10	4.50	3.00	0.00
EXTRACTABLE MINORS:			***DESIRED**			
	Boron (p.p.m.)		1.2 - 1.4	< 0.20	< 0.20	< 0.20
	Iron (p.p.m.)		100 - 300	88	70	75
	Manganese (p.p.m.)		25 - 80	28	9	48
	Copper (p.p.m.)		0.5 - 3.0	0.20	< 0.2	< 0.2
	Zinc (p.p.m.)		5 - 17	2.08	0.62	1.14
	Aluminum (p.p.m.)		< 900	285	218	241
	Molybdenum (p.p.m.)					
OTHER TESTS	Soluble Salts (mmhos/cm)					
	Chloride (p.p.m.)					
	NO3·N (p.p.m.)			0.8	0.8	< 0.5
	NH3·N (p.p.m.)			7.9	5.5	1.0

*desired values provided by REP Consulting, Inc.

BROOKSIDE LABORATORIES, INC.

Account of : Hudson National Golf Club   City: Croton-on-Hudso   ID#: 59118

Consultant: REP Consulting, Inc.   State: NY   Date: 03/27/24

Field: GREENS				8	10	12
	Sample:			G	G	G
	Lab # :			879	880	881
	Total Exchange Capacity (M.E./100g):			2.81	2.41	2.87
	pH: (H2O 1:1)			7.1	7.2	7.1
	Organic Matter [360° C LOI (humus)] %:			0.13	< 0.10	0.13
ANIONS	Estimated Nitrogen Release (lbs/acre)			5	4	5
	Soluble Sulfur (p.p.m.)		*(IDEAL 20 - 40ppm)*	14	13	18
		MEHLICH III	*Desired Value	100	100	100
	Phosphates:	Easily Extractable	Value Found	165	128	156
	as P2O5		Deficit			
	lbs/acre	BRAY II	*Desired Value	350	350	350
			Value Found	179	151	147
			Deficit	-171	-199	-203
		OLSEN Phosphorus				
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value		764	650	781
	lbs/acre	Value Found		664	566	732
		Deficit		-100	-84	-49
	Magnesium:	*Desired Value		180	180	180
	lbs/acre	Value Found		144	120	134
		Deficit		-36	-60	-46
	Potassium:	*Desired Value		140	140	140
	lbs/acre	Value Found		286	258	226
		Deficit				
	Sodium:	*Maximum Desired Value		39	33	40
	lbs/acre	Value Found		28	28	32
			Excess			
BASE SATURATION PERCENT			***IDEAL** (for TEC >5)			
	Calcium	%	68	59.07	58.71	63.76
	Magnesium	%	15	21.35	20.75	19.45
	Potassium	%	4.5	13.05	13.72	10.10
	Sodium	%	< 3	2.17	2.53	2.42
	Other Bases	%	4 - 8	4.30	4.20	4.30
	Hydrogen	%	5 - 10	0.00	0.00	0.00
EXTRACTABLE MINORS:			***DESIRED**			
	Boron (p.p.m.)		1.2 - 1.4	< 0.20	< 0.20	< 0.20
	Iron (p.p.m.)		100 - 300	88	67	70
	Manganese (p.p.m.)		25 - 80	41	55	45
	Copper (p.p.m.)		0.5 - 3.0	0.22	< 0.2	< 0.2
	Zinc (p.p.m.)		5 - 17	1.20	0.77	4.58
	Aluminum (p.p.m.)		< 900	274	223	245
	Molybdenum (p.p.m.)					
OTHERS TESTS	Soluble Salts (mmhos/cm)					
	Chloride (p.p.m.)					
	NO3·N (p.p.m.)			< 0.5	< 0.5	< 0.5
	NH3·N (p.p.m.)			1.4	1.9	1.7

*desired values provided by REP Consulting, Inc.

BROOKSIDE LABORATORIES, INC.

Account of : Hudson National Golf Club   City: Croton-on-Hudso   ID#: 59118

Consultant: REP Consulting, Inc.   State: NY   Date: 03/27/24

Field: GREENS			14	16	18
	Sample:		G	G	G
	Lab # :		882	883	884
	Total Exchange Capacity (M.E./100g):		2.42	3.57	2.08
	pH: (H2O 1:1)		7.0	7.3	6.5
	Organic Matter [360º C LOI (humus)] %:		< 0.10	< 0.10	< 0.10
ANIONS	Estimated Nitrogen Release (lbs/acre)		4	4	4
	Soluble Sulfur (p.p.m.) *(IDEAL 20 - 40ppm)*		16	13	23
	Phosphates: as P2O5 lbs/acre	MEHLICH III *Desired Value	100	100	100
		Easily Extractable Value Found	101	101	115
		Deficit			
		BRAY II *Desired Value	350	350	350
		Value Found	101	119	119
		Deficit	-249	-231	-231
		OLSEN Phosphorus			
EXCHANGEABLE CATIONS	**Calcium:** lbs/acre	*Desired Value	650	971	650
		Value Found	588	884	400
		Deficit	-62	-87	-250
	Magnesium: lbs/acre	*Desired Value	180	180	180
		Value Found	120	154	112
		Deficit	-60	-26	-68
	Potassium: lbs/acre	*Desired Value	140	140	140
		Value Found	214	354	224
		Deficit			
	Sodium: lbs/acre	*Maximum Desired Value	33	49	29
		Value Found	32	54	30
		Excess		5	1
BASE SATURATION PERCENT		***IDEAL** (for TEC >5)			
	Calcium %	68	60.74	61.90	48.08
	Magnesium %	15	20.66	17.97	22.44
	Potassium %	4.5	11.34	12.71	13.81
	Sodium %	< 3	2.87	3.29	3.14
	Other Bases %	4 - 8	4.40	4.10	4.90
	Hydrogen %	5 - 10	0.00	0.00	7.50
EXTRACTABLE MINORS:		***DESIRED**			
	Boron (p.p.m.)	1.2 - 1.4	< 0.20	< 0.20	< 0.20
	Iron (p.p.m.)	100 - 300	79	67	73
	Manganese (p.p.m.)	25 - 80	44	49	29
	Copper (p.p.m.)	0.5 - 3.0	0.28	< 0.2	1.15
	Zinc (p.p.m.)	5 - 17	0.85	1.76	0.75
	Aluminum (p.p.m.)	< 900	234	269	211
	Molybdenum (p.p.m.)				
OTHERS TESTS	Soluble Salts (mmhos/cm)				
	Chloride (p.p.m.)				
	NO3·N (p.p.m.)		4.3	3.0	3.5
	NH3·N (p.p.m.)		1.9	2.9	24.1

*desired values provided by REP Consulting, Inc.

BROOKSIDE LABORATORIES, INC.

Account of : Hudson National Golf Club | City: Croton-on-Hudso | ID#: 59118

Consultant: REP Consulting, Inc. | State: NY | Date: 03/27/24

Field: GREENS			20	PG	
	Sample:		G	G	
	Lab # :		885	886	
	Total Exchange Capacity (M.E./100g):		3.09	2.84	
	pH: (H2O 1:1)		6.8	6.5	
	Organic Matter [360° C LOI (humus)] %:		0.84	0.13	
ANIONS	Estimated Nitrogen Release (lbs/acre)		34	5	
	Soluble Sulfur (p.p.m.)	*(IDEAL 20 - 40ppm)*	25	27	
	Phosphates: as P2O5 lbs/acre — MEHLICH III	*Desired Value	100	100	
	Easily Extractable	Value Found	105	142	
		Deficit			
	BRAY II	*Desired Value	350	350	
		Value Found	69	137	
		Deficit	-281	-213	
	OLSEN Phosphorus				
EXCHANGEABLE CATIONS	**Calcium:** lbs/acre	*Desired Value	840	772	
		Value Found	974	612	
		Deficit		-160	
	Magnesium: lbs/acre	*Desired Value	180	180	
		Value Found	74	118	
		Deficit	-106	-62	
	Potassium: lbs/acre	*Desired Value	140	140	
		Value Found	38	322	
		Deficit	-102		
	Sodium: lbs/acre	*Maximum Desired Value	43	39	
		Value Found	28	24	
		Excess			
BASE SATURATION PERCENT		***IDEAL** (for TEC >5)			
	Calcium %	68	78.80	53.87	
	Magnesium %	15	9.98	17.31	
	Potassium %	4.5	1.58	14.54	
	Sodium %	< 3	1.97	1.84	
	Other Bases %	4 - 8	4.60	4.90	
	Hydrogen %	5 - 10	3.00	7.50	
EXTRACTABLE MINORS:		***DESIRED**			
	Boron (p.p.m.)	1.2 - 1.4	< 0.20	< 0.20	
	Iron (p.p.m.)	100 - 300	79	66	
	Manganese (p.p.m.)	25 - 80	26	26	
	Copper (p.p.m.)	0.5 - 3.0	1.17	0.22	
	Zinc (p.p.m.)	5 - 17	4.67	0.95	
	Aluminum (p.p.m.)	< 900	97	236	
	Molybdenum (p.p.m.)				
OTHERS TESTS	Soluble Salts (mmhos/cm)				
	Chloride (p.p.m.)				
	NO3·N (p.p.m.)		< 0.5	2.8	
	NH3·N (p.p.m.)		< 0.5	11.0	

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Consultant: REP Consulting, Inc. | State: NY | Date: 03/27/24

Field: TEES			3	5	7
Sample:			T	T	T
Lab # :			888	889	890
Total Exchange Capacity (M.E./100g):			1.82	3.52	2.42
pH: (H2O 1:1)			6.4	6.4	6.1
Organic Matter [360° C LOI (humus)] %:			0.52	0.85	1.21
ANIONS	Estimated Nitrogen Release (lbs/acre)		21	34	44
	Soluble Sulfur (p.p.m.)	*(IDEAL 20 - 40ppm)*	10	10	10
	MEHLICH III	*Desired Value	100	100	100
	Phosphates: Easily Extractable	Value Found	137	165	174
	as P2O5	Deficit			
	lbs/acre BRAY II	*Desired Value	350	350	350
		Value Found	78	96	137
		Deficit	-272	-254	-213
	OLSEN Phosphorus				
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value	650	957	650
	lbs/acre	Value Found	468	974	586
		Deficit	-182		-64
	Magnesium:	*Desired Value	180	180	180
	lbs/acre	Value Found	74	124	98
		Deficit	-106	-56	-82
	Potassium:	*Desired Value	140	140	140
	lbs/acre	Value Found	20	24	28
		Deficit	-120	-116	-112
	Sodium:	*Maximum Desired Value	25	49	33
	lbs/acre	Value Found	30	22	28
		Excess	5		
BASE SATURATION PERCENT		***IDEAL** (for TEC >5)			
	Calcium %	68	64.29	69.18	60.54
	Magnesium %	15	16.94	14.68	16.87
	Potassium %	4.5	1.41	0.87	1.48
	Sodium %	< 3	3.58	1.36	2.52
	Other Bases %	4 - 8	5.00	5.00	5.20
	Hydrogen %	5 - 10	9.00	9.00	13.50
EXTRACTABLE MINORS:		***DESIRED**			
	Boron (p.p.m.)	1.2 - 1.4	< 0.20	< 0.20	< 0.20
	Iron (p.p.m.)	100 - 300	100	122	126
	Manganese (p.p.m.)	25 - 80	8	26	18
	Copper (p.p.m.)	0.5 - 3.0	0.64	0.88	1.17
	Zinc (p.p.m.)	5 - 17	2.66	2.67	4.14
	Aluminum (p.p.m.)	< 900	74	131	124
	Molybdenum (p.p.m.)				
OTHERS TESTS	Soluble Salts (mmhos/cm)				
	Chloride (p.p.m.)				
	NO3·N (p.p.m.)		0.9	0.9	1.4
	NH3·N (p.p.m.)		1.3	1.9	1.6

*desired values provided by REP Consulting, Inc.

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Account of : Hudson National Golf Club | City: Croton-on-Hudso | ID#: 59118

Consultant: REP Consulting, Inc. | State: NY | Date: 03/27/24

Field: TEES			9	11	13
	Sample:		T	T	T
	Lab # :		891	892	893
	Total Exchange Capacity (M.E./100g):		2.00	2.48	2.07
	pH: (H2O 1:1)		5.7	5.7	6.0
	Organic Matter [360° C LOI (humus)] %:		0.81	0.88	0.83
ANIONS	Estimated Nitrogen Release (lbs/acre)		32	35	33
	Soluble Sulfur (p.p.m.)	*(IDEAL 20 - 40ppm)*	9	23	13
		MEHLICH III *Desired Value	100	100	100
	Phosphates:	Easily Extractable Value Found	169	238	179
	as P2O5	Deficit			
	lbs/acre	BRAY II *Desired Value	350	350	350
		Value Found	119	183	142
		Deficit	-231	-167	-208
		OLSEN Phosphorus			
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value	650	650	650
	lbs/acre	Value Found	420	516	488
		Deficit	-230	-134	-162
	Magnesium:	*Desired Value	180	180	180
	lbs/acre	Value Found	66	82	76
		Deficit	-114	-98	-104
	Potassium:	*Desired Value	140	140	140
	lbs/acre	Value Found	20	30	24
		Deficit	-120	-110	-116
	Sodium:	*Maximum Desired Value	28	34	29
	lbs/acre	Value Found	22	30	36
		Excess			7
BASE SATURATION PERCENT		***IDEAL** (for TEC >5)			
	Calcium %	68	52.50	52.02	58.94
	Magnesium %	15	13.75	13.78	15.30
	Potassium %	4.5	1.28	1.55	1.49
	Sodium %	< 3	2.39	2.63	3.78
	Other Bases %	4 - 8	6.00	6.00	5.40
	Hydrogen %	5 - 10	24.00	24.00	15.00
EXTRACTABLE MINORS:		***DESIRED**			
	Boron (p.p.m.)	1.2 - 1.4	< 0.20	0.21	< 0.20
	Iron (p.p.m.)	100 - 300	123	174	150
	Manganese (p.p.m.)	25 - 80	21	28	16
	Copper (p.p.m.)	0.5 - 3.0	0.95	1.26	0.67
	Zinc (p.p.m.)	5 - 17	4.56	5.26	3.16
	Aluminum (p.p.m.)	< 900	122	153	110
	Molybdenum (p.p.m.)				
OTHER TESTS	Soluble Salts (mmhos/cm)				
	Chloride (p.p.m.)				
	NO3·N (p.p.m.)		0.5	1.8	0.6
	NH3·N (p.p.m.)		1.6	5.6	2.4

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Account of : Hudson National Golf Club | City: Croton-on-Hudso | ID#: 59118

Consultant: REP Consulting, Inc. | State: NY | Date: 03/27/24

					15	17	
Field: TEES					15	17	
	Sample:				T	T	
	Lab # :				894	895	
	Total Exchange Capacity (M.E./100g):				2.33	2.30	
	pH: (H2O 1:1)				6.8	6.0	
	Organic Matter [360º C LOI (humus)] %:				0.68	0.93	
ANIONS	Estimated Nitrogen Release (lbs/acre)				27	37	
	Soluble Sulfur (p.p.m.)			*(IDEAL 20 - 40ppm)*	7	20	
		MEHLICH III		*Desired Value	100	100	
	Phosphates:	Easily Extractable		Value Found	151	179	
	as P2O5			Deficit			
	lbs/acre	BRAY II		*Desired Value	350	350	
				Value Found	92	156	
				Deficit	-258	-194	
		OLSEN Phosphorus					
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value			650	650	
	lbs/acre	Value Found			696	554	
		Deficit				-96	
	Magnesium:	*Desired Value			180	180	
	lbs/acre	Value Found			76	84	
		Deficit			-104	-96	
	Potassium:	*Desired Value			140	140	
	lbs/acre	Value Found			32	26	
		Deficit			-108	-114	
	Sodium:	*Maximum Desired Value			32	32	
	lbs/acre	Value Found			26	30	
				Excess			
BASE SATURATION PERCENT			***IDEAL** (for TEC >5)				
	Calcium	%	68		74.68	60.22	
	Magnesium	%	15		13.59	15.22	
	Potassium	%	4.5		1.76	1.45	
	Sodium	%	< 3		2.43	2.84	
	Other Bases	%	4 - 8		4.60	5.40	
	Hydrogen	%	5 - 10		3.00	15.00	
EXTRACTABLE MINORS:			***DESIRED**				
	Boron (p.p.m.)		1.2 - 1.4		< 0.20	< 0.20	
	Iron (p.p.m.)		100 - 300		93	144	
	Manganese (p.p.m.)		25 - 80		25	21	
	Copper (p.p.m.)		0.5 - 3.0		1.20	0.99	
	Zinc (p.p.m.)		5 - 17		4.13	3.43	
	Aluminum (p.p.m.)		< 900		103	115	
	Molybdenum (p.p.m.)						
OTHER TESTS	Soluble Salts (mmhos/cm)						
	Chloride (p.p.m.)						
	NO3·N (p.p.m.)				0.7	1.4	
	NH3·N (p.p.m.)				0.9	2.9	

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Account of : Hudson National Golf Club | City: Croton-on-Hudso | ID#: 59118

Consultant: REP Consulting, Inc. | State: NY | Date: 03/27/24

Field: FAIRWAYS				4	6	10
	Sample:			F	F	F
	Lab # :			896	897	898
	Total Exchange Capacity (M.E./100g):			3.89	2.77	2.90
	pH: (H2O 1:1)			5.9	6.0	5.8
	Organic Matter [360° C LOI (humus)] %:			1.62	1.48	1.80
ANIONS	Estimated Nitrogen Release (lbs/acre)			52	50	56
	Soluble Sulfur (p.p.m.)		*(IDEAL 20 - 40ppm)*	11	8	6
		MEHLICH III	*Desired Value	100	100	100
	Phosphates:	Easily Extractable	Value Found	188	137	151
	as P2O5		Deficit			
	lbs/acre	BRAY II	*Desired Value	350	350	350
			Value Found	174	69	82
			Deficit	-176	-281	-268
		OLSEN Phosphorus				
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value		1058	753	789
	lbs/acre	Value Found		932	688	668
		Deficit		-126	-65	-121
	Magnesium:	*Desired Value		180	180	180
	lbs/acre	Value Found		114	90	80
		Deficit		-66	-90	-100
	Potassium:	*Desired Value		140	140	140
	lbs/acre	Value Found		74	48	54
		Deficit		-66	-92	-86
	Sodium:	*Maximum Desired Value		54	38	40
	lbs/acre	Value Found		34	24	24
			Excess			
BASE SATURATION PERCENT			***IDEAL** (for TEC >5)			
	Calcium	%	68	59.90	62.09	57.59
	Magnesium	%	15	12.21	13.54	11.49
	Potassium	%	4.5	2.44	2.22	2.39
	Sodium	%	< 3	1.90	1.88	1.80
	Other Bases	%	4 - 8	5.60	5.40	5.80
	Hydrogen	%	5 - 10	18.00	15.00	21.00
EXTRACTABLE MINORS:			***DESIRED**			
	Boron (p.p.m.)		1.2 - 1.4	0.28	0.21	< 0.20
	Iron (p.p.m.)		100 - 300	298	189	207
	Manganese (p.p.m.)		25 - 80	12	21	18
	Copper (p.p.m.)		0.5 - 3.0	1.17	0.93	0.48
	Zinc (p.p.m.)		5 - 17	2.59	2.41	2.28
	Aluminum (p.p.m.)		< 900	499	221	232
	Molybdenum (p.p.m.)					
OTHERS TESTS	Soluble Salts (mmhos/cm)					
	Chloride (p.p.m.)					
	NO3·N (p.p.m.)			< 0.5	< 0.5	< 0.5
	NH3·N (p.p.m.)			2.8	2.3	1.9

*desired values provided by REP Consulting, Inc.

BROOKSIDE LABORATORIES, INC.

Account of : Hudson National Golf Club   City: Croton-on-Hudso   ID#: 59118

Consultant: REP Consulting, Inc.   State: NY   Date: 03/27/24

Field: FAIRWAYS		12	14	18
Sample:		F	F	F
Lab # :		899	900	901
Total Exchange Capacity (M.E./100g):		2.62	2.11	3.23
pH: (H2O 1:1)		6.0	5.9	6.2
Organic Matter [360º C LOI (humus)] %:		1.60	1.67	2.66
ANIONS	Estimated Nitrogen Release (lbs/acre)	52	53	73
	Soluble Sulfur (p.p.m.) *(IDEAL 20 - 40ppm)*	9	9	12
	MEHLICH III *Desired Value	100	100	100
	Phosphates: Easily Extractable Value Found	133	124	215
	as P2O5 Deficit			
	lbs/acre BRAY II *Desired Value	350	350	350
	Value Found	69	69	142
	Deficit	-281	-281	-208
	OLSEN Phosphorus			
EXCHANGEABLE CATIONS	**Calcium:** *Desired Value	713	650	879
	lbs/acre Value Found	632	464	782
	Deficit	-81	-186	-97
	Magnesium: *Desired Value	180	180	180
	lbs/acre Value Found	90	82	130
	Deficit	-90	-98	-50
	Potassium: *Desired Value	140	140	140
	lbs/acre Value Found	52	40	76
	Deficit	-88	-100	-64
	Sodium: *Maximum Desired Value	36	29	45
	lbs/acre Value Found	30	28	36
	Excess			

BASE SATURATION PERCENT		*IDEAL (for TEC >5)			
Calcium	%	68	60.31	54.98	60.53
Magnesium	%	15	14.31	16.19	16.77
Potassium	%	4.5	2.54	2.43	3.02
Sodium	%	< 3	2.49	2.88	2.42
Other Bases	%	4 - 8	5.40	5.60	5.20
Hydrogen	%	5 - 10	15.00	18.00	12.00

EXTRACTABLE MINORS:	*DESIRED			
Boron (p.p.m.)	1.2 - 1.4	0.24	0.24	0.36
Iron (p.p.m.)	100 - 300	237	252	296
Manganese (p.p.m.)	25 - 80	26	24	33
Copper (p.p.m.)	0.5 - 3.0	0.66	1.03	1.46
Zinc (p.p.m.)	5 - 17	2.39	2.76	3.52
Aluminum (p.p.m.)	< 900	177	127	385
Molybdenum (p.p.m.)				

OTHER TESTS				
	Soluble Salts (mmhos/cm)			
	Chloride (p.p.m.)			
	NO3·N (p.p.m.)	< 0.5	< 0.5	0.5
	NH3·N (p.p.m.)	1.6	2.2	2.2

*desired values provided by REP Consulting, Inc.

BROOKSIDE LABORATORIES, INC.

Account of : Hudson National Golf Club | City: Croton-on-Hudso | ID#: 59118

Consultant: REP Consulting, Inc. | State: NY | Date: 03/27/24

Field: ROUGH				01/18	10/12	
	Sample:			R	R	
	Lab # :			902	903	
	Total Exchange Capacity (M.E./100g):			9.97	8.66	
	pH: (H2O 1:1)			6.1	5.8	
	Organic Matter [360º C LOI (humus)] %:			6.42	7.83	
ANIONS	Estimated Nitrogen Release (lbs/acre)			107	114	
	Soluble Sulfur (p.p.m.)		*(IDEAL 20 - 40ppm)*	16	17	
		MEHLICH III	*Desired Value	100	100	
	Phosphates:	Easily Extractable	Value Found	234	147	
	as P2O5		Deficit			
	lbs/acre	BRAY II	*Desired Value	350	350	
			Value Found	275	142	
			Deficit	-75	-208	
		OLSEN Phosphorus				
EXCHANGEABLE CATIONS	**Calcium:**	*Desired Value		2712	2356	
	lbs/acre	Value Found		2450	1826	
		Deficit		-262	-530	
	Magnesium:	*Desired Value		359	312	
	lbs/acre	Value Found		360	300	
		Deficit			-12	
	Potassium:	*Desired Value		350	304	
	lbs/acre	Value Found		276	322	
		Deficit		-74		
	Sodium:	*Maximum Desired Value		138	120	
	lbs/acre	Value Found		58	50	
			Excess			
BASE SATURATION PERCENT			***IDEAL** (for TEC >5)			
	Calcium	%	68	61.43	52.71	
	Magnesium	%	15	15.05	14.43	
	Potassium	%	4.5	3.55	4.77	
	Sodium	%	< 3	1.26	1.26	
	Other Bases	%	4 - 8	5.20	5.80	
	Hydrogen	%	5 - 10	13.50	21.00	
EXTRACTABLE MINORS:			***DESIRED**			
	Boron (p.p.m.)		1.2 - 1.4	0.48	0.39	
	Iron (p.p.m.)		100 - 300	225	188	
	Manganese (p.p.m.)		25 - 80	45	33	
	Copper (p.p.m.)		0.5 - 3.0	3.19	2.24	
	Zinc (p.p.m.)		5 - 17	2.53	1.63	
	Aluminum (p.p.m.)		< 900	965	1077	
	Molybdenum (p.p.m.)					
OTHERS TESTS	Soluble Salts (mmhos/cm)					
	Chloride (p.p.m.)					
	NO3·N (p.p.m.)			7.5	7.0	
	NH3·N (p.p.m.)			7.3	4.1	

*desired values provided by REP Consulting, Inc.

Nutra Turf
AGRONOMIC SALES & SERVICE

Account
Hudson National

Tissue Analysis Chart

nutrient management
diagnostic testing

		nutrient percentage							ppm				
		N %	P %	K %	Ca %	Mg %	S %	Na %	Fe	Mn	Zn	B	Cu
Target Range		4.5 - 5.25	.45 - .60	2.25 - 3.0	.45 - .60	.25 - .35	.25 - .40	.01 - .04	200 - 400	80 - 150	45.0 - 65.0	10.0 -15.0	10.0 - 15.0
Green / Hole #	Sample Date												
Gr 6	21-Jun	4.27	0.35	1.12	0.71	0.25	0.50	0.05	294.30	106.76	58.98	15.53	18.34
Gr 13		4.40	0.36	1.11	0.67	0.25	0.51	0.06	299.46	108.10	61.00	14.23	19.00
9 fwy		4.52	0.37	1.11	0.61	0.24	0.47	0.04	270.50	100.20	59.70	13.51	18.47
	Sample Ave	**4.40**	**0.36**	**1.11**	**0.66**	**0.25**	**0.49**	**0.05**	**288.09**	**105.02**	**59.89**	**14.42**	**18.60**
		D - L	D-L	D-L	Ex-H	D - L	Ex-H	Ex-H	S-Opt	s-opt	S-Opt	S-Opt	Ex-H

Ratio Index	
N : K	3.9
N : S	8.9
Fe : Mn	2.7
Protein	27%

Notes:

Turfgrass nutrient index value **14.5%** of optimum

Key	
Ex - H	Excessive - High
D - L	Deficient - Low
S - Opt	Sufficient - Optimal

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Hudson National

Tissue Analysis Chart

nutrient management
diagnostic testing

		nutrient percentage							ppm				
		N %	P %	K %	Ca %	Mg %	S %	Na %	Fe	Mn	Zn	B	Cu
Target Range		4.5 - 5.25	.45 - .60	2.25 - 3.0	.45 - .60	.25 - .35	.25 - .40	.01 - .04	200 - 400	80 - 150	45.0 - 65.0	10.0 -15.0	10.0 - 15.0
Green / Hole #	**Sample Date**												
11T	17-Jul	5.27	0.39	0.96	0.73	0.27	0.52	0.04	562.13	109.58	72.81	14.18	26.64
14G	17-Jul	5.86	0.38	1.16	0.60	0.25	0.55	0.05	7.31	116.90	75.41	10.40	17.62
14Fwy	17-Jul	5.74	0.49	1.71	0.56	0.24	0.57	0.06	111.97	120.60	69.76	9.59	19.11
10G	17-Jul	4.69	0.29	0.59	0.75	0.29	0.52	0.07	120.54	110.17	76.92	16.77	18.75
18G	17-Jul	6.65	3.42	0.08	0.04	0.16	0.48	0.42	3.84	90.69	43.81	0.77	54.32
	Sample Ave	**5.64**	**0.99**	**0.90**	**0.54**	**0.24**	**0.53**	**0.13**	**161.16**	**109.59**	**67.74**	**10.34**	**27.29**
		Ex-H	Ex-H	D-L	S-Opt	D - L	Ex-H	Ex-H	D-L	S-Opt	Ex-H	SOpt	Ex-H

Ratio Index	
N : K	6.3
N : S	10.7
Fe : Mn	1.5
Protein	35%

Ex - H	Excessive - High
D - L	Deficient - Low
S - Opt	Sufficient - Optimal

Notes:

Turfgrass nutrient index value of optimum

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Tissue Analysis Chart

nutrient management
diagnostic testing

		nutrient percentage							ppm				
		N %	P %	K %	Ca %	Mg %	S %	Na %	Fe	Mn	Zn	B	Cu
Target Range		4.5 - 5.25	.45 - .60	2.25 - 3.0	.45 - .60	.25 - .35	.25 - .40	.01 - .04	200 - 400	80 - 150	45.0 - 65.0	10.0 -15.0	10.0 - 15.0
Green / Hole #	**Sample Date**												
10FWY	31-Jul	5.24	0.56	2.05	0.52	0.24	0.54	0.05	316.04	114.38	67.81	7.88	23.64
14G	31-Jul	5.45	0.33	1.00	0.64	0.28	0.49	0.05	186.18	101.39	81.97	14.00	20.68
18G	31-Jul	5.30	0.45	1.59	0.59	0.24	0.54	0.08	318.21	111.23	72.54	9.44	23.93
7T	31-Jul	5.89	0.40	0.99	0.56	0.27	0.51	0.04	276.28	107.80	81.36	11.80	23.62
	Sample Ave	**5.47**	**0.44**	**1.41**	**0.58**	**0.26**	**0.52**	**0.06**	**274.18**	**108.70**	**75.92**	**10.78**	**22.97**
		Ex-H	D-L	D-L	S-Opt	S-Opt	Ex-H	Ex-H	S-Opt	S-Opt	Ex-H	S-Opt	Ex-H

Ratio Index	
N : K	3.9
N : S	10.5
Fe : Mn	2.5
Protein	34%

Notes:

Turfgrass nutrient index value of optimum

Ex - H	Excessive - High
D - L	Deficient - Low
S - Opt	Sufficient - Optimal

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Hudson National

Tissue Analysis Chart

nutrient management
diagnostic testing

		nutrient percentage							ppm				
		N %	P %	K %	Ca %	Mg %	S %	Na %	Fe	Mn	Zn	B	Cu
Target Range		4.5 - 5.25	.45 - .60	2.25 - 3.0	.45 - .60	.25 - .35	.25 - .40	.01 - .04	200 - 400	80 - 150	45.0 - 65.0	10.0 -15.0	10.0 - 15.0
Green / Hole #	Sample Date												
12FWY	5-Sep	5.00	0.47	1.73	0.60	0.24	0.54	0.03	303.29	115.32	61.29	11.26	19.75
12G	5-Sep	4.47	0.35	1.16	0.74	0.25	0.53	0.04	308.74	112.61	63.03	14.36	20.31
Sample Ave		4.74	0.41	1.45	0.67	0.25	0.54	0.04	306.02	113.97	62.16	12.81	20.03
		S-Opt	D-L	D-L	Ex-H	D - L	Ex-H	S - Opt	S-Opt	S-Opt	S-Opt	S-Opt	Ex-H

Ratio Index	
N : K	3.3
N : S	8.9
Fe : Mn	2.7
Protein	30%

Notes: Turfgrass nutrient index value of optimum

Ex - H	Excessive - High
D - L	Deficient - Low
S - Opt	Sufficient - Optimal

APPENDIX C. 2000 EMP Fertilizing Section with 2011 and 2017 Amendments

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January 17, 2017

Mr. Daniel O'Connor
1 Van Wyck Street
Croton-on-Hudson, NY 10520

RE: The Combined HNGC's EMP (2000)
Nutrient Management Amendments
(2000, 2011, and 2017)

Dear Mr. O'Connor:

The nutrient management portion of the Environmental Management Plan (EMP; i.e., fertilizer applications, soil/tissue sampling) has been reviewed several times since 2000, in order to update the turf management strategies. A golf course EMP should be a living document (i.e., changes should be made as newer and/or safer products become available and as nutrient strategies evolve).

We are recommending amendments to the fertilizer program at the Hudson National Golf Club (HNGC) because the nitrogen response thresholds were exceeded at four on-site surface water stations during the fall of 2016 storm flow sampling event. In addition, we submitted nutrient management recommendations in 2011, which were subsequently approved and have been incorporated into the operation of the golf course by the superintendents, as stated in the attachment following each amendment (e.g., the soil testing frequency was reduced because it was excessive).

The attachment provides the extracted "Fertilizing" section pages 3-8 from the EMP (2000), as well as the 2011 approved amendments and our 2017 recommendation for nutrient management at the HNGC.

The amended nutrient management program, if approved, should be implemented immediately. The 2011 and 2017 amendments will supersede the 2000 EMP where a change or recommendation is shown. Otherwise, the 2000 EMP will remain in effect.

The original EMP (2000) tables are presented at the end of the attachment for continuity of text. Tables 2 and 3 were corrected to show the 2011 and 2017 amended applications. The 2000 EMP, the 2011 amendments, and our 2017 recommendations are attached.

Thank you for the opportunity to provide our recommendations for EMP amendments. If you have any questions, please let us know.

Sincerely,

N. LaJan Barnes, M.S., P.G.

Project Manager, Sr. Hydrogeologist

Stuart Z. Cohen, Ph.D., CGWP
President

Ken Ingram, CGCS, MG
Turf Agronomist

Attachment: “Fertilizing” Section: EMP 2000 (pages 3-8), 2011 Amendments, and 2017 recommended amendment

cc: Ryan Oliver, HNGC Superintendent

ATTACHMENT: Amended Fertilizing Section - Environmental Management Plan

EMP 2000
FERTILIZING

The most important aspect of a sound fertilizer program is to ensure that the nutrients applied do not end up in surface and/or ground water and do not drift off-site. Nitrogen and phosphorus are the elements most often associated with eutrophication of lakes and streams. Other nutrients do not seem to pose a problem to surface waters.

Excessive nitrate concentrations in ground water represent a health hazard where ground water is tapped for drinking water supplies. Much of the nitrogen applied to golf courses is in the ammonium and nitrate forms. The results of research on nitrogen fertilizers applied to turf grasses (Petrovic; 1990) reveal that nitrate-nitrogen concentrations in soil water leaching through the surface soil exceeds drinking water standards of 10 ppm only where soils are sandy and one of the following conditions exist: 1) high levels of soluble nitrogen life applied, greater than 3 lbs. N/1000 sq.ft. at one time; or 2) very frequent (daily) irrigation is practiced coupled with application of water soluble nitrogen sources. Accordingly, nitrate movement may be minimized by addressing efficiency in rate and timing of nitrogen inputs, through choice of materials, and efficiency in rate and timing of irrigation. Reports by Walker and Branham (1992) concluded that several management actions effectively minimize or eliminate nitrate movement: 1) limit irrigation to replacement of soil moisture; 2) use slow release nitrogen sources; 3) time fertilizer applications in relation to active uptake; and 4) use realistic nitrogen application rates.

When a fertilizer is applied in excess of what the plant can use or when the turf is not actively growing due to temperature, water, light, lack of an individual nutrient, etc., much of the application could be lost. For these reasons, before a fertilizer is applied, the limiting growth factors must be considered. In addition, only a fertilizer containing the nutrients in the right form needed by the plant should be used and applied at the appropriate rate and frequency. Plants will respond favorably to fertilizer applications only if the application contains a nutrient that is deficient.

To ensure that fertilizer applications address actual deficiencies, soils must be analyzed to determine pH, calcium, magnesium, phosphorus and potassium availability and balance. From this information a valid lime and fertilizer program can be developed with the assurance that excess nutrients will not be applied. Soils are to be sampled at all greens, tees, and fairway areas. Data from these analyses will be used to adjust fertilizer rates based on soil residual levels, thereby avoiding excess application of materials which could become nonpoint sources of pollution.

Amendment 2011 – Soil Testing

We recommend that soil testing be done once annually, during the winter months (December/January). These results should be used to determine fertilizer requirements for the upcoming growing season.

Reason for Soil Testing Change

Samples were not being collected in accordance with the current EMP (2000), and the EMP (2000) sampling frequency requirement was excessive for a well-established golf course. In addition, soil testing is the most reliable method for determining fertilizer applications. Annual testing is now sufficient given the several years of experience that has been accumulated. More frequent testing was needed when the golf course was young.

EMP 2000

Nitrogen is the nutrient used by grasses in the largest quantities. Its function is to stimulate vegetative growth and provide the grass with green color. Nitrogen fertilization needs are to be determined by color, density and rate of growth (clipping yields) of grass, and plant tissue analysis. Plant tissue analysis is to be conducted on selected locations every three to four weeks during the growing season. This will serve as a guide for determining if nutrients are in a sufficiency range or if fertilization is needed to balance the nutrition. Freshly harvested tissue is to be collected and dried in a microwave oven. The dried plant material is to be sent to a lab and analyzed for a standard compliment of analytes, including nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, and manganese.

<u>Amendment 2011 - Tissue Testing</u>

We recommend that tissue testing be conducted bimonthly in May, July, and September on selected greens and fairways. These samples should be rotated to incorporate underperforming greens and fairways. The rotation of tissue sample collection locations should provide optimum information for nutrient management. The best results may be obtained by comparing underperforming greens and fairways to those in good condition and adjusting fertilizer applications to those “weaker” areas, which will allow fertilizer application adjustments to the “weaker” areas.

Reason for Tissue Testing Change

The original tissue testing schedule appeared to be excessive and it was not being done in accordance with the EMP (2000). In addition, the EMP (2000; pg. 16) states that tissue samples should be collected periodically as determined by the Superintendent, which had been done. Tissue testing using the 2011 bimonthly schedule has mostly been followed, with a few missed sampling dates.

<u>Amendment 2011 – Reporting</u>

The fertilizer applications and the soil and tissue sample results should be submitted with the Superintendent’s annual report. In addition, the report should include a section that briefly explains how the results from the soil and tissue analyses were incorporated into the fertilizer program.

Reason for Reporting Change

The soil and tissue testing results have always been included in the Superintendent’s report. However, there was no explanation about how those results were being used to develop the fertilizer program.

EMP 2000

Leaching of nitrate nitrogen can be minimized by making controlled applications (spoon feeding), by using controlled materials (slow-release) or by using a combination of these approaches. The superintendent will personally control applications by either using soluble fertilizers and applying the materials with a sprayer that has been calibrated to put out an accurate amount of material per acre, or through fertigation. Under either approach, the superintendent can personally control the rate and frequency of fertilizer application; thereby reducing the tendency to apply excessive amounts of nitrate and ammonium forms of nitrogen on an infrequent basis.

Controlled materials, such as natural organic sources (Milorgranite, Ringer, Sustane, etc.), isobutylidene diurea (IBDU), methylene ureas (MU) and coated ureas (SCU, Polyon, Poly-S, Sulfurkote-ll and others) are all slow-release (SR) nitrogen sources. They have the advantage of supplying a longer more uniform source of nitrogen, a lower salt index and reduced nitrogen leaching.

Amendment 2011 – Other Product Uses

The products mentioned in the original EMP (Milorganite, Sustain, Ringer) are still available; however, some of the newer products (e.g., Earthworks™ and Perdue PPM) need to be incorporated, especially the “poly” coated ureas.

Reason for Other Product Uses Change

This was done in order to help keep the EMP a living document as nutrient strategies evolve and as newer and/or safer products become available.

EMP 2000

By combining soluble nitrogen sources with the slow-release nitrogen products, availability can be extended to the grass without prompting nitrogen leaching into the groundwater. Also, the use of fertigation will allow the superintendent to apply small amounts of fertilizer to locations where it is needed and thus reduce the likelihood of off-site contamination.

Note 2017: Fertigation is not used at the HNGC.

EMP 2000

BASIC FERTILIZER PROGRAM

Creeping bentgrass and Kentucky bluegrass grow within a wide soil pH range. However, for optimum soil microbial activity and improved nutrient availability it is preferred to keep the pH in the 5.5 to 6.5 range. Also important is the maintenance of a calcium to magnesium ratio of 10:1.

The basic turfgrass fertilization program for the Hudson National Golf Club is presented in Tables 2 through 5. Additional, location specific provisions are presented below.

Greens. If soil test results indicate that either dolomite for soil pH correction and/or phosphorus are needed, they shall be applied during aerifying operations so that they can be worked into the root zone. The addition of potassium shall be made in three to four applications per year and applied at the rate of ½ to 1 pound per 1000 square feet. Slow release sources of nitrogen shall be applied at the rate of 0.5 to 1.0 pound per 1000 square feet.

Tees. If phosphorus and dolomite are needed, the tee surfaces shall be treated the same as the greens. Nitrogen and potassium lire to be applied at about the same rate as for the putting greens.

Fairways. Dolomite and phosphorus applications arc to be based on soil test results. No individual application of nitrogen or potassium is to exceed 40 pounds per acre and ½ the nitrogen is to be from a slow release source.
Roughs. Roughs are to be fertilized two times per year. Dolomite and phosphorus applications are to be based on soil test results. Individual applications of nitrogen and potassium are not to exceed 40 pounds per acre and ½ the nitrogen is to be from a slow release source.

Amendment 2011 – Fertilizer Application Reduction (all areas)

We recommend that fertilizer applications incorporate some of the newer products (e.g., Earthworks™ and Perdue PPM) and that single application rates be reduced to no more than 0.5 lb N/1,000 sq ft in keeping with the EMP (2000)[2]. Fertilizer applications should be delayed if heavy rainfall is forecast. Total applications should not exceed 3.0 lb N/1000 sq ft during a growing season. This is a reduction of the total N applications currently allowed (i.e., 4-5.5 N/1,000 sq ft) in Table 3 of the EMP (2000).

Multiple “spoon feeding” applications of 0.1 lb N/1,000 sq ft should be used on greens, tees, and fairways during the optimum growing season (April-October). Fertilizer applications can be tank mixed with fungicide applications on two-week intervals. These low nutrient rates have little risk of runoff and can be extremely beneficial to plant health especially with the management of anthracnose disease on putting greens.

Phosphorus and potassium applications should be based on the results of the soil and/or tissue sample results.

2017 Recommendation – Total N – Additional Fertilizer Application Restrictions

Further, no more than 1,000 lb of N may be applied between October 15 and early spring (April 1).

Reason for Additional Fertilizer Application Restrictions of Total N

It appears that the N applications made prior to the fall sampling events in 2016 were the cause of the N-N RT exceedances at all on-site stations and the cause of one exceedance in 2016 (see our fall letter report, ETS, 2017).

We have carefully considered the formulations of the nitrogen fertilizers, the amounts that have been applied, and the timing of the applications. Regarding the latter, it is important to

[2] This 0.5 lb N/1000 ft^2 limit should be relaxed in the future, after all N exceedance problems have been resolved. Specifically, we recommend that the future limit on single applications of certain controlled release N fertilizers such as POLYON® be raised to 1.5 lb N/1000 ft^2, if it can be established that such release occurs over a period averaging at least 12-16 weeks. This change should be considered the next time the EMP is modified, but not now.

note that the turfgrass in that region of the country is probably not actively growing after early to mid-November. This means that N that is applied during and after this time is more available to runoff near the soil's surface than N that is applied, e.g., in May. Therefore, we recommend that applications not exceed 1,000 total lb nitrogen after October 15 until early spring to help prevent N-N RT exceedances at the surface water stations.

References:

Dahlgren, R.A. and C.T. Driscoll. 1994. The Effects of Whole-Tree Clear-cutting on Soil Processes at the Hubbard Brook Experimental Forest, New Hampshire, USA. Plant and Soil158:239-262.

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Table 2. General Fertilizer Applications on Greens and Tees (Pounds per 1000 square feet per year). †

Areas	Nitrogen	Phosphorus	Potassium
Greens	3.0 (2011)	1 to3	4 to 6
Tees	3.0 (2011)	1 to3	4 to 6

† Adjustments are to be made based upon testing results and turf response.

Table 3. Fertilizer Schedule for Greens and Tees (Pounds per 1000 square feet per application). †

Greens & Tees	Apr*	May	June	July	Aug	Sep*	Oct	Nov	Total
Nitrogen	WS 0.25	WS 0.25	NO 0.5	NO 0.5	NO 0.5	SR 0.5	WS 0.5	‡(2017)	3.0 (2011)
	SR 0.25	SR 0.25							
Phosphorus	0.25		0.4	0.4	0.4				1.45
Potassium	0.5	0.5	0.8	0.8	0.8	0.5	0.5	0.5-1	4.9-5.4

† Adjustments are to be made based upon testing results and turf response. May be modified by the fertigation schedule.
* application may be reduced or eliminated after first several years.
WS = Water soluble; SR = Slow release; NO = Natural organic.
‡ Applications not exceed 1,000 total lb N between October 15 and early spring (April 1; see text above).

Table 4. General Fertilizer Applications on Fairways, Intermediate Rough and Rough (Pounds per acre per year). †			
Area	**Nitrogen**	**Phosphorus**	**Potassium**
Fairways	90 to 180	45 to135	90 to 225
Intermediate Rough	60 to 120	22 to 66	60 to 120
Rough	40 to 80	0 to 45	40 to 80
Vegetative Filter Strip	40	20	40
† Adjustments are to be made based upon testing results and turf response. May be modified by the fertigation schedule.			

Table 5. Fertilizer Schedule for Fairways and Roughs (Pounds per acre per application).						
Fairways	**May**	**June**	**July**	**Aug**	**Sep**	**Total**
Nitrogen	WS 22.5	NO 45		NO 45	WS 22.5	180
	SR 22.5				SR 22.5	
Phosphorus	22.5	18		18		58.5
Potassium	45	36		36	45	162
Roughs	**May**	**June**	**July**	**Aug**	**Sep**	**Total**
Nitrogen	WS 20				WS 20	80
	SR 20				SR 20	
Phosphorus	22.5					22.5
Potassium	40				40	80
Intermediate Roughs	**May**	**June**	**July**	**Aug**	**Sep**	**Total**
Nitrogen	WS 20	WS 10			WS 20	100
	SR 20	SR 10			SR 20	
Phosphorus	22				22	44
Potassium	20	20			20	60
Vegetative Filter Strip	**May**	**June**	**July**	**Aug**	**Sep**	**Total**
Complete N-P-K	40-20-40					40-20-40
† Adjustments are to be made based upon testing results and turf response. WS = Water soluble; SR = Slow release; NO = Natural organic						