Commonwealth of Virginia

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Travis A. Voyles
Secretary of Natural and Historic Resources

Michael S. Rolband, PE, PWD, PWS Emeritus
Director
(804) 698-4020

March 28, 2023

Neil Ellwein
Colonial Williamsburg Foundation
P.O. Box 1776
Williamsburg, VA 23187-1776

SENT VIA EMAIL: nellwein@cwf.org

RE: Application Number GW0036102
CWF – Golden Horseshoe Green Golf Course, City of Williamsburg, Virginia
Draft Groundwater Withdrawal Permit

Dear Mr. Ellwein:

This is to advise you that the Department of Environmental Quality (Department) is considering issuance of a groundwater withdrawal permit for the CWF – Golden Horseshoe Green Golf Course for a 15-year permit term. Enclosed is a copy of the Draft Groundwater Withdrawal Permit and associated documents for your facility. Please review the draft permit package including the Special Conditions carefully, and provide written acceptance, rejection, or comments regarding the draft permit conditions on the attached form by April 12, 2023.

Certain public notice and public participation procedures must be complied with before the actual permit may be issued. They are as follows:

1. The Department will ensure that the attached Public Notice is advertised once in a newspaper of general circulation in the area affected by the withdrawal. The applicant is responsible for authorizing payment for the public notice. Enclosed is a Public Notice Authorization Form that must be signed by the applicant and returned to us. The cost will be billed to you by the newspaper. The Department will terminate application processing for applicants that do not provide authorization within requested time periods.

2. A minimum of 30 days will be allowed for public response following the date of the public notice. If no public response is received, or if the public response received can be satisfactorily answered, then the permit may be issued. However, if there is significant public response, then it may be necessary to initiate public hearing procedures. If a public hearing is necessary, you will be so advised.

The Technical Evaluation of the application was conducted by Aquaveo, LLC for the Department. The predicted Area of Impact does not extend beyond the service area boundaries. As such, the Mitigation Plan is not required and has not been included by reference in this draft permit.

If you have any questions, please contact Caitlin Kelly at (804) 774-0828 or by email at caitlin.kelly@deq.virginia.gov.

Sincerely,

Joseph Grist
Water Withdrawal Permitting Program Manager

Enclosures

COMMONWEALTH of VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
DRAFT PERMIT
TO WITHDRAW GROUNDWATER IN THE
EASTERN VIRGINIA GROUNDWATER MANAGEMENT AREA

Permit Number: GW0036102
Effective Date: Xxxxxxx XX, XXXX
Expiration Date: Xxxxxxx XX, XXXX

Pursuant to the Ground Water Management Act of 1992 (Section 62.1-254 et seq. of the Code of Virginia) and the Groundwater Withdrawal Regulations (Regulations) (9VAC25-610), the Department of Environmental Quality hereby authorizes the Permittee to withdraw and use groundwater in accordance with this permit.

Permittee The Colonial Williamsburg Foundation

Facility CWF – Golden Horseshoe Green Golf Course

Facility Address 651 South England Street

Williamsburg, Virginia 23187

The Permittee's authorized groundwater withdrawal shall not exceed:

144,000,000 gallons for the permit term,
30,000,000 gallons per year,
10,000,000 gallons per month,

The permitted withdrawal will be used to provide supplemental water to the golf course ponds that are used to irrigate the CWF – Golden Horseshoe Green Golf Course. Other uses are not authorized by this permit.

The Permittee shall comply with all conditions and requirements of the permit.

By direction of the Department of Environmental Quality, this Permit is granted by:

Signed_____ Date _____
Scott Morris, DBA, P.E.
Director, Water Division

DRAFT

This permit is based on the Permittee's application submitted on June 30, 2020, and subsequently amended to include supplemental information provided by the Permittee. The following are conditions that govern the system set-up and operation, monitoring, reporting, and recordkeeping pertinent to the Regulations.

Part I
Operating Conditions

A. Authorized Withdrawal

1. The withdrawal of groundwater shall be limited to the following wells identified in the table below. Withdrawals from wells not included in Table 1 are not authorized by this permit and are therefore prohibited. 9VAC25-610-140 A

Owner Well Name	DEQ Well #	Well Depth (ft bls)	Screen Intervals	Aquifer	Latitude	Longitude	Datum
Green Golf Course – J	147-00235	472	412-462	Potomac	37° 15' 24.45"	-76° 41' 15.94"	NAD83

2. Any actions that result in a change to the status, construction, or pump intake setting of wells included in this permit must be pre-approved by the Department of Environmental Quality (Department or DEQ) in writing prior to implementing the change and a revised GW-2 Form must be submitted to the Department within 30 days after the physical construction of a well is altered or the pump intake setting has been changed. If changes are a result of an emergency, notify the Department within 5 days from the change. 9VAC25-610-140 C

B. Pump Intake Settings

1. The Permittee shall not place a pump or water intake device lower than the top of the uppermost confined aquifer that a well utilizes as a groundwater source or lower than the bottom of an unconfined aquifer that a well utilizes as a groundwater source in order to prevent dewatering of the aquifer, loss of inelastic storage, or damage to the aquifer from compaction. 9VAC25-610-140 A 6

2. Pump settings in individual wells are limited as follows. Any change in the pump setting must receive prior approval by the Department.

Owner Well Name	DEQ Well #	Max Pump Setting (feet below land surface)
Green Golf Course – J	147-00235	374

C. Reporting

1. Water withdrawn from each well shall be recorded monthly at the end of each month and reported to the Department, in paper or electronic format, on a form provided by the Department by the tenth (10th) day of each January, April, July and October for the respective previous calendar quarter. Records of water use shall be maintained by the Permittee in accordance with Part III.F, 1 through 5 of this permit. 9VAC25-610-140 A 9

2. The Permittee shall report any amount in excess of the permitted withdrawal limit by the fifth (5th) day of the month following the month when such a withdrawal occurred. Failure to report may result in compliance or enforcement activities. 9VAC25-610-140 C

3. The following is a summary of reporting requirements for specific facility wells:

Owner Well Name	DEQ Well #	Reporting Requirements
Green Golf Course – J	147-00235	Water Use

D. Water Conservation and Management Plan

1. The Water Conservation and Management Plan (WCMP) submitted in the application received June 30, 2020 and subsequently amended and then approved by the Department is incorporated by reference into this permit and shall have the same effect as any condition contained in this permit and may be enforced as such.

2. By the end of the first year of the permit cycle [*date*] the Permittee shall submit documentation to the Department that the leak detection and repair program defined in the WCMP has been initiated. This documentation shall include activities completed during the first year of the permit term. 9VAC25-610-100 B

3. As soon as completed but not later than the end of the second year of the permit cycle [*date*] the Permittee shall submit to the Department results of an audit of the total amount of groundwater used in the distribution system and operational processes. This documentation shall include any resulting changes to the leak detection and repair program in the WCMP. 9VAC25-610-100 B

4. A report on the plan's effectiveness in reducing water use, including revisions to those elements of the WCMP that can be improved and addition of other elements found to be effective based on operations to date shall be submitted by the end of years five [*date*] and ten [*date*] of the permit term. These reports shall include as appropriate: 9VAC25-610-140 C

    a. Any new water saving equipment installed or water saving processes adopted;

    b. WCMP actions taken to reduce the volume of water needed to supply the system;

    c. Planned short or long term efforts and actions to be added to the WCMP to improve the efficiency of water use in the system or by customers and for reducing the loss of water;

    d. Results of additional water audits completed;

    e. Review of water use category (residential, commercial, industrial) per-connection use in municipal systems;

    f. Evaluation of the leak detection and repair program;

    g. Description of educational activities completed; and

h. Identification of any water reuse opportunities identified.

5. If revisions or additions to the plan are necessary, an updated WCMP shall be submitted to the Department for approval along with the report prior to implementation of the revised plan.

6. Records of activities conducted pursuant to the WCMP are to be submitted to the Department upon request.

E. Well Tags

1. Each well that is included in this permit shall have affixed to the well casing, in a prominent place, a permanent well identification plate that records, at a minimum, the Department well identification number, the groundwater withdrawal permit number, the total depth of the well, and the screened intervals in the well. Such well identification plates shall be in a format specified by the Department and are available from the Department. 9VAC25-610-140 A 12

2. Well tags shall be affixed to the appropriate well casing within 30 days of receiving the tags from the Department. The accompanying well tag installation certification form shall be returned to the Department within 60 days of receipt of the tags. 9VAC25-610-140 C

Part II
Special Conditions

Review of the applicant's well construction data, facility operations, and Technical Evaluation did not identify a need for water quality or water level monitoring, pump intake reset, or well abandonment conditions in the permit. There are no new wells currently planned for construction during the permit term. Construction of observation wells or well nests, and geophysical boreholes to assist in monitoring or characterizing the local or regional aquifer system are not required at this time.

Part III
General Conditions

A. Duty to Comply

The Permittee shall comply with all conditions of the permit. Nothing in this permit shall be construed to relieve the permit holder of the duty to comply with all applicable federal and state statutes, regulations and prohibitions. Any permit violation is a violation of the law and is grounds for enforcement action, permit termination, revocation, modification, or denial of a permit application. 9VAC25-610-130 A

B. Duty to Cease or Confine Activity

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the activity for which a permit has been granted in order to maintain compliance with the

conditions of the permit. 9VAC25-610-130 B

C. Duty to Mitigate

The Permittee shall take all reasonable steps to avoid all adverse impacts that may result from this withdrawal as defined in 9VAC25-610-10 and provide mitigation of the adverse impact when necessary as described in 9VAC25-610-110 D 3 g and 9VAC25-610-130 C.

D. Inspection, Entry, and Information Requests

Upon presentation of credentials, the Permittee shall allow the Department, or any duly authorized agent of the Department, at reasonable times and under reasonable circumstances, to enter upon the Permittee's property, public or private, and have access to, inspect and copy any records that must be kept as part of the permit conditions, and to inspect any facilities, well(s), water supply system, operations, or practices (including sampling, monitoring and withdrawal) regulated or required under the permit. For the purpose of this section, the time for inspection shall be deemed reasonable during regular business hours. Nothing contained herein shall make an inspection time unreasonable during an emergency. 9VAC25-610-130 D

E. Duty to Provide Information

The Permittee shall furnish to the Department, within a reasonable time, any information that the Department may request to determine whether cause exists for modifying or revoking, reissuing, or terminating the permit, or to determine compliance with the permit. The Permittee shall also furnish to the Department, upon request, copies of records required to be kept by regulation or this permit. 9VAC25-610-130 E

F. Monitoring and Records Requirements

1. The Permittee shall maintain a copy of the permit on-site and/or shall make the permit available upon request. 9VAC25-610-130 E

2. Monitoring of parameters shall be conducted according to approved analytical methods as specified in the permit. 9VAC25-610-130 F 1

3. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. 9VAC25-610-130 F 2

4. The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart or electronic recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit, for a period of at least three years from the date of the expiration of a granted permit. This period may be extended by request of the Department at any time. 9VAC25-610-130 F 3

5. Records of monitoring information shall include as appropriate: 9VAC25-610-130 F 4

    a. the date, exact place and time of sampling or measurements;

b. the name(s) of the individual(s) who performed the sampling or measurements;

c. the date the analyses were performed;

d. the name(s) of the individual(s) who performed the analyses;

e. the analytical techniques or methods supporting the information, such as observations, readings, calculations and bench data used;

f. the results of such analyses; and

g. chain of custody documentation.

G. Environmental Laboratory Certification

The Permittee shall comply with the requirement for certification of laboratories conducting any tests, analyses, measurements, or monitoring required pursuant to the State Water Control Law (§ 62.1-44.2 et seq. of the Code of Virginia), Environmental Laboratory Certification Program (§ 2.2-1105 et seq. of the Code of Virginia), Certification for Noncommercial Environmental Laboratories (1VAC30-45), and/or Accreditation for Commercial Environmental Laboratories (1VAC30-46), and

1. Ensure that all samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

2. Conduct monitoring according to procedures approved under 40CFR Part 136 or alternative methods approved by the U.S. Environmental Protection Agency.

3. Periodically calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals that will ensure accuracy of measurements. 1VAC30-45-20

H. Future Permitting Actions

1. A permit may be modified or revoked as set forth in Part VI of the Groundwater Withdrawal Regulations. 9VAC25-610-290 and 9VAC25-610-130 G

2. If a Permittee files a request for permit modification or revocation, or files a notification of planned changes, or anticipated noncompliance, the permit terms and conditions shall remain effective until the Department makes a final case decision. This provision shall not be used to extend the expiration date of the effective permit. 9VAC25-610-130 G

3. Permits may be modified or revoked upon the request of the Permittee, or upon Department initiative, to reflect the requirements of any changes in the statutes or regulations. 9VAC25-610-130 G

4. The Permittee shall schedule a meeting with the Department prior to submitting a new, expanded or modified permit application. 9VAC25-610-85

5. A new permit application shall be submitted 270 days prior to the expiration date of this permit, unless permission for a later date has been granted by the Department, to continue a withdrawal greater than or equal to 300,000 gallons in any month while an application for a renewal is being processed. 9VAC25-610-96

6. A new permit application shall be submitted 270 days prior to any proposed modification to this permit that will (i) result in an increase of withdrawal above permitted limits; or (ii) violate the terms and conditions of this permit. 9VAC25-610-96

7. The applicant shall provide all information described in 9VAC25-610-94 for any reapplication. 9VAC25-610-96 C

8. The Permittee must notify the Department in writing of any changes to owner and facility contact information within 30 days of the change. 9VAC25-610-140 C

I. Metering and Equipment Requirements

1. Each well and/or impoundment or impoundment system shall have an in-line totalizing flow meter to read gallons, cubic feet, or cubic meters installed prior to beginning the permitted use. Meters shall produce volume determinations within plus or minus 10% of actual flows. An alternative method for determining flow may be approved by the Department on a case-by-case basis. 9VAC25-610-140 A 7 b

    a. A defective meter or other device must be repaired or replaced within 30 days.

    b. A defective meter is not grounds for not reporting withdrawals. During any period when a meter is defective, generally accepted engineering methods shall be used to estimate withdrawals. The period during which the meter was defective must be clearly identified in the groundwater withdrawal report required by Part I, Subsection D of this permit.

2. Each well shall be equipped in a manner such that water levels can be measured during pumping and non-pumping periods without dismantling any equipment. Any opening for tape measurement of water levels shall have an inside diameter of at least 0.5 inches and be sealed by a removable plug or cap. The Permittee shall provide a tap for taking raw water samples from each permitted well. 9VAC25-610-140 A 7 e

J. Minor Modifications

1. A minor modification to this permit must be made to replace an existing well(s) or add an additional well(s) provided that the well(s) is screened in the same aquifer(s) as the existing well(s), and is in the near vicinity of the existing well(s), the total groundwater withdrawal does not increase, the area of impact does not increase, and the well has been approved by the Department prior to construction. 9VAC25-610-330 B 4 and B 5

2. A minor modification to this permit must be made to combine withdrawals governed by multiple permits when the systems are physically connected as long as interconnection will not result in additional groundwater withdrawal and the area of impact will not increase. 9VAC25-610-330 B 6

3. Minor modifications to this permit must also be made to:

    a. Change an interim compliance date up to 120 days from the original compliance date, as long as the change does not interfere with the final compliance date. 9VAC25-610-330 B 7

    b. Allow for change in ownership when the Department determines no other change in the permit is necessary and the appropriate written agreements are provided in accordance with the transferability of permits and special exceptions. 9VAC25-610-320 and 9VAC25-610-330 B 8

    c. Revise a Water Conservation and Management Plan to update conservation measures being implemented by the Permittee that increase the amount of groundwater conserved. 9VAC25-610-330 B 9

K. Well Construction

At least two weeks prior to the scheduled construction of any well(s), the Permittee shall notify the Department of the construction timetable and receive prior approval of the well(s) location(s) and acquire the Department Well number (DEQ Well #). All wells shall be constructed in accordance with the following requirements.

1. A well site approval letter or well construction permit must be obtained from the Virginia Department of Health prior to construction of the well. 9VAC25-610-130 A

2. A complete suite of geophysical logs (16"/64" Normal, Single Point, Self-Potential, Lateral, and Natural Gamma) shall be completed for the well and submitted to the Department along with the corresponding completion report. 9VAC25-610-140 C

3. The Permittee shall evaluate the geophysical log and driller's log information to estimate the top of the target aquifer and; therefore, a depth below which the pump shall not be set. The Permittee's determination of the top of the target aquifer shall be submitted to the Department for review and approval, or approved on site by the Department's Groundwater Characterization staff, prior to installation of any pump. 9VAC25-610-140 A 6

4. The Permittee shall install gravel packs and grout in a manner that prevents leakance between aquifers. Gravel pack shall be terminated close to the top of the well screen(s) and shall not extend above the top of the target aquifer. 9VAC25-610-140 C

5. A completed GW-2 Form and any additional water well construction documents shall be submitted to the Department within 30 days of the completion of any well and prior to the initiation of any withdrawal from the well. The assigned Department Well number shall be included on all well documents. 9VAC25-610-140 C

6. In addition to the above requirements, if required by the permit, construction of a Water Level Monitoring State Observation Well (SOW) requires:

    a. The Permittee shall coordinate activities with the Department's Groundwater Characterization Program (GWCP) to determine the appropriate observation well location

and construction schedule, along with the needed screen interval(s), and other completion details following review of geophysical logging. 9VAC25-610-140 C

b. Prior to preparation of bid documents for construction of the observation well, the Permittee shall notify the Department and shall include any GWCP requirements in the bid documents. At a minimum, the Department will require a pre-bid meeting with interested drilling contractors and a pre-construction meeting with the successful bidder. 9VAC25-610-140 C

c. Instrumentation to meet the requirements for real-time data transmission consistent with the State Observation Well Network shall be purchased by the Permittee. The Permittee shall submit a purchase order based on the Department's equipment specifications for review and approval prior to purchase of the equipment. The Permittee shall install the real-time equipment infrastructure with Department oversight. The Department will conduct the installation of the transducer and final hook-up of the equipment. 9VAC25-610-140 C

7. In addition to the above requirements, if required by the permit, construction of a Chloride Monitoring SOW requires:

a. The Permittee shall coordinate activities with the Department's Groundwater Characterization Program (GWCP) to determine the appropriate observation well location and construction schedule, along with the needed screen interval(s), and other completion details following review of geophysical logging. 9VAC25-610-140 C

b. Prior to preparation of bid documents for construction of the observation well, the Permittee shall notify the Department and shall include any GWCP requirements in the bid documents. At a minimum, the Department will require a pre-bid meeting with interested drilling contractors and a pre-construction meeting with the successful bidder. 9VAC25-610-140 C

c. Instrumentation to meet the requirements for real-time data transmission consistent with the State Observation Well Network shall be purchased by the Permittee. The Permittee shall submit a purchase order based on the Department's equipment specifications for review and approval prior to purchase of the equipment. The Permittee shall install the real-time equipment infrastructure with Department oversight. The Department will conduct final hook-up of the equipment. 9VAC25-610-140 C

d. Instrumentation to meet the requirements for continuous measurement of specific conductance from multiple levels within the well screen shall be purchased by the Permittee. The Permittee shall submit a purchase order based on the Department's equipment specifications for review and approval prior to purchase of the equipment. The Permittee shall install the real-time equipment infrastructure with Department oversight. The Department will conduct the final hook-up of the equipment. 9VAC25-610-140 C

L. Permit Reopening

This permit may be reopened for the purpose of modifying the conditions of the permit as follows:

1. To meet new regulatory standards duly adopted by the Board. 9VAC25-610-140 A 11

2. When new information becomes available about the permitted withdrawal, or the impact of the withdrawal, which had not been available at permit issuance and would have justified the application of different conditions at the time of issuance. 9VAC25-610-310 B 1

3. When the reported withdrawal is less than 60% of the permitted withdrawal amount for a five year period. 9VAC25-610-310 B 2

4. If monitoring information indicates the potential for adverse impacts to groundwater quality or level due to this withdrawal. 9VAC25-610-140 C

COMMONWEALTH of VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

PERMIT ISSUANCE FACT SHEET

Groundwater Withdrawal Permit Number: GW0036102
Application Date: June 30, 2020

The Department of Environmental Quality (Department or DEQ) has reviewed the application for a Groundwater Withdrawal Permit. This document provides the pertinent information concerning the legal basis, scientific rationale, and justification for the issuance/reissuance/modification of the Groundwater Withdrawal Permit listed below. Based on the information provided in the application and subsequent revisions, the Department has determined that there is a reasonable assurance that the activity authorized by the permit is a beneficial use as defined by the regulations. Groundwater impacts have been minimized to the maximum extent practicable. The following details the application review process and summarizes relevant information for developing the Permit and applicable conditions.

Permittee / Legal Responsible Party

Name & Address: The Colonial Williamsburg Foundation
P.O. Box 1776
Williamsburg, VA 23187-1776
Phone: (757) 220-7629

Facility Name and Address

Name & Address: CWF – Golden Horseshoe Green Golf Course
651 South England Street
Williamsburg, VA 23187
Phone: (757) 220-7629

Contact Information:

Name: Neil K. Ellwein
E-mail: nellwein@cwf.org
Phone: (757) 220-7629

Proposed Beneficial Use: The proposed groundwater withdrawal will be used to provide supplemental water to the golf course ponds that are used to irrigate the CWF – Golden Horseshoe Green Golf Course.

DRAFT

Staff Findings and Recommendations

Based on review of the permit application, staff provides the following findings.

- The proposed activity is consistent with the provisions of the Ground Water Management Act of 1992, and will protect other beneficial uses.
- The proposed permit addresses minimization of the amount of groundwater needed to provide the intended beneficial use.
- The effect of the impact will not cause or contribute to significant impairment of state waters.
- This permit includes a plan to mitigate adverse impacts on existing groundwater users.

Staff recommends Groundwater Withdrawal Permit Number GW0036102 be issued as proposed.

Approved: _____
Scott Morris, DBA, P.E.
Director, Water Division

Date: _____

Processing Dates

Processing Action	Date Occurred/Received
Pre-Application Meeting:	March 6, 2020
Application Received by DEQ:	June 30, 2020
Permit Fee Deposited by Accounting:	June 26, 2020
Application Review Conducted:	January 11, 2023
Request for Additional Information Sent:	February 2, 2023
Response to Request for Additional Information Received:	February 3, 2023
Local Government Ordinance Form Received by DEQ:	June 30, 2020
Application Complete:	February 3, 2023
Submit Request for Technical Evaluation:	February 16, 2023
Technical Evaluation Received by DEQ:	March 15, 2023
Draft Permit Package Sent:	
Public Notice Published:	
End of 30-Day Public Comment Period:	
Response to Public comment:	
Public Meeting or Hearing:	

Application

Application Information

Description:

Background / Purpose of Facility:
The Colonial Williamsburg Foundation (CWF) Golden Horseshoe Green Golf Course was first permitted October 1, 1995 to withdraw 49,000,000 gallons per year (gal/yr) and 14,200,000 gallons per month (gal/mo) under Groundwater Withdrawal Permit (GWP) No. GW0036100. This permit expired September 30, 2005 and was reissued on April 1, 2011 under permit No. GW0036101 which authorized withdrawals of 34,000,000 gal/yr, 10,000,000 gal/mo, and a 10-year permit term limit of 128,000,000 gallons (gal). This permit expired on March 31, 2021 and was administratively continued pursuant to 9VAC25-610-96.

The CWF Golden Horseshoe Golf Club uses groundwater on an as-needed basis to supplement water to the golf course ponds that are used to irrigate the Golden Horseshoe Golf Club Green Course. Groundwater is withdrawn from one well designated as Green Golf Course – J (DEQ Well # 147-00235) which is screened in the Potomac Aquifer.

Location of Facility/Withdrawal:

Water Supply Planning Unit: Hampton Roads PDC

City: Williamsburg
GWMA/Aquifer: Eastern Virginia GWMA / Potomac Aquifer

Conjunctive Use Source: No conjunctive use.

Withdrawal Use, Current Need, and Projected Demand:

Basis of Need:
Groundwater withdrawal is used on an as-needed basis to supplement water to the golf course ponds used to irrigate the CWF Golden Horseshoe Golf Club Green Course. The need arises when environmental conditions such as drought, high temperatures, and/or below average rainfall create a need to supplement the on-site ponds used for the irrigation of the golf course.

Water Demand and Projections:
The proposed withdrawal permit amounts were determined based on evaluation of historic groundwater withdrawals along with observations regarding usage at CWF Golden Horseshoe Green Course during the period 1991 – 2019.

The maximum annual withdrawal during the period 2005 – 2019 compared to the 1992 – 2019 period reduced from 34,020,000 gal to 21,296,000 gal. The average annual withdrawal for the same periods reduced from 9,472,007 gal/yr to 7,028,667 gal/yr. Based on the decrease in the maximum and average annual withdrawals during these periods while accounting for periods of drought, a reduction in the annual permit withdrawal from 34,000,000 gal/yr to 30,000,000 gal/yr was proposed. This equates to a 13% reduction from the existing permitted annual withdrawal limit.

The facility proposes to reduce the average annual withdrawal of the 15-year permit term limit compared to the average annual withdrawal of the existing 10-year permit term limit from 12,800,000 average gal/yr (128,000,000 total gallons for 10-year permit term limit) to 9,600,000 average gal/yr (144,000,000 total gallons for the 15-year permit term limit). This represents is a 25% reduction.

No change to the existing monthly withdrawal permit amount of 10,000,000 gal/mo was proposed. Historic high monthly withdrawals were provided for June 2002 (6,909,000 gal/mo), August 2002 (8,179,000 gal/mo), August 2008 (8,577,000), and June 2010 (5,915,000 gal/mo). The observations regarding usage note that drought or dry conditions with below average rainfall occurred during the years 2002, 2008, and 2010.

Withdrawal Volumes Requested:
The applicant requested the following withdrawal volumes based upon the projected groundwater demand.

Period of Withdrawal	Total Volume (gal.)	Volume in gal/day
Maximum Monthly:	10,000,000	322,581
Maximum Annual:	30,000,000	82,192
Maximum Fifteen Year:	144,000,000	26,301

Department Evaluation

Historic Withdrawals:
CWF Golden Horseshoe Green Golf Course provided annual groundwater withdrawals from 1991 – 2019, and historic high monthly withdrawals recorded in 2002, 2008, and 2010 along with observations regarding usage. The observations regarding usage include information such as amount of rainfall, drought or dry conditions, and construction or renovation activities that occurred at the golf course during the 1991 – 2019 period. Additionally, the Department evaluated recent reported use from 2020 – 2022. The average annual use from 2020 – 2022 is 5,521,000 gal/yr and the highest annual withdrawal occurred in 2022 at 8,534,000 gal/yr. The highest monthly withdrawal from 2020 – 2022 was 4,848,000 gal/mo in July 2020. These values are consistent with the historic data presented in the application.

Analysis of Alternative Water Supplies:
The golf course currently utilizes surface water as the primary source of water for irrigation. The facility doesn't have access to other significant sources of surface water. The golf course is located within the City of Williamsburg's service area for municipal water, which is pumped from the Waller Mill Reservoir. However, the current Williamsburg Water System wouldn't be capable of meeting the additional demand of the golf course.

The surficial aquifer's geology is highly variable including clay, silt, sand, and shell fragments. The surficial aquifer is susceptible to dry periods, meaning water availability within this aquifer will likely be limited during times when groundwater is necessary to supplement the irrigation ponds. Based on the general characteristics of the surficial aquifer in this region it's unlikely that it will be capable of meeting the total water demand for the golf course.

Public Water Supply:
The proposed beneficial use does not contain a public water supply component.

Water Supply Plan Review:
Colonial Williamsburg Foundation (CWF) - Golden Horseshoe Green Course is included in the Hampton Roads Regional Water Supply Plan (2011). Water Supply Plan demand projections for the facility were included in the Plan and could be considered in the evaluation of the permit request. The Statement of Needs and Alternatives in the Water Supply Plan stated that projected demand in the York-James region would exceed supply by the end of the planning period (2040).

Department Recommended Withdrawal Limits:
The Department reviewed the requested limits and found the determination of the proposed withdrawal limits and supporting documentation sufficient as a basis for the request.

The Department recommends the following withdrawal volumes based upon evaluation of the groundwater withdrawal permit application and additional supplemental information provided by the applicant.

Period of Withdrawal	Total Volume (gal.)	Volume in gal/day
Maximum Monthly:	10,000,000	322,581
Maximum Annual:	30,000,000	82,192
Maximum Fifteen Year:	144,000,000	26,301

Technical Evaluation:
Aquaveo, LLC performed a technical evaluation of the application for the Department based on the VAHydro Groundwater Coastal Plain Model (VAHydro-GW-VCPM). The objectives of this evaluation were to determine the areas of any aquifers that will experience at least one foot of water level decline due to the proposed withdrawal (the Area of Impact or AOI), to determine the potential for the proposed withdrawal to cause salt-water intrusion, and to determine if the proposed withdrawal meets the 80% drawdown criteria. Aquaveo, LLC also evaluated water levels in the Coastal Plain Model compared to measured field values.

The Department concluded that the proposed withdrawals satisfy the technical evaluation criteria for permit issuance. A summary of the results of the evaluation and the AOI for the Potomac aquifer is provided in the Technical Evaluation (Attachment 1).

Part I
Operating Conditions

Authorized Withdrawals:

Owner Well Name	DEQ Well #	Aquifer	Type	Pump Intake Limit (ft. bls)
Green Golf Course – J	147-00235	Potomac	Production	374

Apportionment:
Apportionment is not required because there is only one production well at the facility.

Additional Wells:

Observation Wells: No observation wells.

Abandoned Wells: No abandoned wells.

Out of Service Wells: No out of service wells.

Pump Intake Settings:
Department staff reviewed available information and made the following determinations regarding the location of the aquifer tops for the following well. Information reviewed in this process was the GW2 Well Construction form for DEQ Well #147-00235, and the geophysical log from DEQ Well #147-00235 drilled by Sydnor Hydro on December 1, 1989, and The Virginia Coastal Plain Hydrogeologic Framework (USGS Professional Paper 1731).

Unit	DEQ Well 147-00235 (ft/bls)
Potomac Aquifer Top	374
Potomac Aquifer Bottom	Unknown

All well pumps are correctly positioned in accordance with 9VAC25-610-140 A 6. The pump intake for the Green Golf Course – J well (DEQ Well #147-00235) is set at 253 feet below land surface.

Withdrawal Reporting:
Groundwater withdrawals are to be recorded monthly and reported quarterly.

Water Conservation and Management Plan:
A Water Conservation and Management Plan (WCMP) meeting the requirements of 9VAC25-610-100 B was submitted and reviewed as part of the application process. The accepted Plan is to be followed by the permittee as an operational Plan for the facility/water system, is incorporated by reference into this permit, and shall have the same effect as any condition contained in this permit and may be enforced as such (Attachment 2). In addition, the Permit includes conditions requiring the following:

- Documentation that the leak detection and repair program defined in the WCMP has been initiated is due by the end of the first year of the permit term.
- A result of an audit of the total amount of groundwater used in the distribution system and operational processes is due by the end of the second year of the permit term.
- A report on the plan's effectiveness in reducing water use, including revisions to those elements of the WCMP that can be improved and addition of other elements found to be effective based on operations to date shall be submitted by the end of years five [*date*] and ten [*date*] of the permit term.

Mitigation Plan:
The predicted AOI resulting from the Technical Evaluation does not extend beyond the service area boundaries. A Mitigation Plan was therefore not required for the permit.

Well Tags:
Well tags will be transmitted by the Department after issuance of the final permit.

Part II
Special Conditions

Review of the applicant's application, well construction data, operations at the facility, and the Technical Evaluation of the application did not identify a need for water quality or water level monitoring, pump intake reset, or well abandonment conditions in the permit. There are no new wells currently planned for construction during the permit term. Construction of observation wells or well nests, and geophysical boreholes to assist in monitoring or characterizing the local or regional aquifer system are not required at this time.

Part III
General Conditions

General Conditions are applied to all Groundwater Withdrawal Permits, as stated in the Groundwater Withdrawal Regulations, 9VAC25-610.

Public Comment

The following sections will be completed after close of the public comment period.

Relevant Regulatory Agency Comments:

Summary of VDH Comments and Actions:
This facility is not a public water supply so soliciting comments from VDH was not required.

Public Involvement during Application Process:

Local and Area wide Planning Requirements:
The City of Williamsburg City Manager certified on June 10, 2020, that the facility's operations are consistent with all ordinances. The Department received this certification on June 30, 2020.

Public Comment/Meetings:
The public notice was published in xxxxxx on XXX. The public comment period ran from xxxxx to xxxxx

Changes in Permit Part II Due to Public Comments

Changes in Permit Part III Due to Public Comments

Attachments

1. **Technical Evaluation**
2. **Water Conservation and Management Plan**
3. **Public Comment Sheet *(if warranted)***

COMMONWEALTH of VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

TECHNICAL EVALUATION FOR PROPOSED GROUNDWATER WITHDRAWAL

Date: February 16, 2023

Application /Permit Number: GW0036102

Owner / Applicant Name: The Colonial Williamsburg Foundation

Facility / System Name: CWF Golden Horseshoe Green Golf Course

Facility Type: Commercial (golf course)

Facility / System Location: City of Williamsburg

The Commonwealth of Virginia's Groundwater Withdrawal Regulations (9VAC25-610) provide that, for a permit to be issued for a new withdrawal, to expand an existing withdrawal, or reapply for a current withdrawal, a technical evaluation shall be conducted. This report documents the results of the technical evaluation conducted to meet the requirements for the issuance of a permit to withdraw groundwater within a Designated Groundwater Management Area (9VAC25-600).

This evaluation determines the:

(1) The Area of Impact (AOI): The AOI for an aquifer is the areal extent of each aquifer where one foot or more of drawdown is predicted to occur as a result of the proposed withdrawal.

(2) Water Quality: The potential for the proposed withdrawal to cause salt water intrusion into any portion of any aquifers or the movement of waters of lower quality into areas where such movement would result in adverse impacts on existing groundwater users or the groundwater resource.

(3) The Eighty Percent Drawdown (80% Drawdown): The proposed withdrawal in combination with all existing lawful withdrawals will not lower water levels, in any confined aquifer that the withdrawal impacts, below a point that represents 80% of the distance between the land surface and the top of the aquifer at the points where the one-foot drawdown contour is predicted for the proposed withdrawal.

Requested withdrawal amount:

Requested Withdrawal Amount	
Fifteen (15) Year Value	144,000,000 gallons (26,301 average gpd)
Annual Value	30,000,000 gallons/year (82,192 average gpd)
Monthly Value	10,000,000 gallons/month (322,581 average gpd)

Requested Apportionment of Withdrawal:

DEQ Well #	Owner Well #	Aquifer	Percent of Withdrawal
147-00235	Green Golf Course – J	Potomac	100%

Summary of Requested Withdrawal:
The Colonial Williamsburg Foundation (CWF) Golden Horseshoe Golf Club uses groundwater on an as-needed basis to supplement water to the golf course ponds that are used to irrigate the CWF Golden Horseshoe Golf Club Green Course. The well pump is operated manually based on observations of water level in the Reese Jones Pond. Generally, the pond water level is maintained by normal rainfall events, but during extended drought periods and concurrent periods of high temperature the well operation becomes necessary to supplement the ponds.

Production Wells:

Identification	Location	Construction	Pump Intake	Source Aquifer
Owner Well Name: Green Golf Course – J DEQ Well Number: 147-00235 MPID: 371514076412401	Lat: : 37° 15' 24.45" Lon: 76° 41' 15.94" Datum: NAD83 Elevation: 40 ft. amsl	Completion Date: 12/01/1989 Screens (ft/bls): 412 – 462 Total Depth (ft/bls): 472	253	Potomac Aquifer

Geologic Setting:
The CWF Golden Horseshoe Green Golf Course wells (applicant wells) are located in Williamsburg County. The applicant's production wells are screened in the Potomac aquifer. USGS Professional Paper 1731[1], *The Virginia Coastal Plain Hydrogeologic Framework* (VCPHF), is the most recent study discussing the aquifers and confining units of the Virginia Coastal Plain. The study utilized numerous boreholes throughout the Virginia Coastal Plain to interpolate the elevations of the different hydrogeologic units found in the Coastal Plain.

According to the study, the Potomac aquifer is the "largest, deepest, and most heavily used source of ground water in the Virginia Coastal Plain." The aquifer is underlain across its entire extent with basement bedrock. The aquifer is found below the Potomac confining zone. The aquifer is primarily composed "of fluvial-deltaic coarse-grained quartz and feldspar sands and gravels and interbedded clays."

The nearest east-west geologic cross section, ED-ED', from the USGS Professional Paper 1731 is shown in the figure at the end of this report.

Hydrologic Framework:
Data from the VCPHF is reported in this technical report to illustrate the hydrogeologic characteristics of the aquifers in the Virginia Coastal Plain near the applicant well and identify major discrepancies between regional hydrogeology and site logs interpreted by DEQ staff. The Virginia Coastal Plain Model[2] (VCPM) framework was constructed by extracting the hydrogeologic unit tops and thicknesses from the VCPHF. The original USGS VCPM was updated and adapted for use in the VA-DEQ well permitting process and is referred to as VAHydroGW-VCPM.

[1] McFarland E. R., and Bruce T.S., 2006. The Virginia Coastal Plain Hydrologic Framework: U.S. Geologic Survey Professional Paper 1731. 118 p., 25 pls. (available online at http://pubs.water.usgs.gov/pp1731/).
[2] Heywood, C.E., and Pope, J.P., 2009, Simulation of groundwater flow in the Coastal Plain aquifer system of Virginia: U.S. Geological Survey Scientific Investigations Report 2009–5039, 115 p.

VAHydroGW-VCPM Model:
The following table lists the location of the applicant production well within the VAHydroGW-VCPM Model.

VAHydroGW-VCPM Model Grid				
Well	**Well Number**	**MPID**	**Row**	**Column**
Green Golf Course – J	147-00235	371514076412401	80	47

The following aquifer top elevations and thicknesses are simulated in the VAHydroGW-VCPM Model at the model cell containing the applicant well.

VAHydroGW-VCPM Model Hydrogeologic Unit Information		
Aquifer	**Elevation (ft-msl)**	**Depth (ft-bls)**
Surface	46	0
Water Table aquifer (bottom)	21	25
Yorktown-Eastover (top)	20	26
Yorktown-Eastover (bottom)	-22	68
Piney Point (top)	-180	226
Piney Point (bottom)	-215	261
Aquia (top)	-292	338
Aquia (bottom)	-327	373
Potomac (top)	-343	389
Potomac (bottom)	-1408	1454

Note: ft-msl = feet above mean sea level

Groundwater Characterization Program Recommendations:
Department staff reviewed available information and made the following determinations regarding the location of the aquifer tops for the following well. Information reviewed in this process was the GW2 Well Construction form for DEQ Well #147-00235, and the geophysical log from DEQ Well #147-00235 drilled by Sydnor Hydro on December 1, 1989, and The Virginia Coastal Plain Hydrogeologic Framework (USGS Professional Paper 1731).

Unit	DEQ Well 147-00235 (ft/bls)
Potomac Aquifer Top	374
Potomac Aquifer Bottom	Unknown

Comparison of the Hydrogeologic Framework and Geologist Report:
The VCPMF identifies the top and thickness of the Potomac aquifer at an elevation of 389 ft-bls and 1,065 feet thick at the cell containing the applicant well. The top elevation of the Potomac aquifer given by DEQ staff is 374 ft-bls. The top elevation of the Potomac aquifer identified by the VCPMF is 15 feet lower than, but in general agreement with the value provided by DEQ staff. The thickness of the Potomac was not provided by the DEQ so a comparison to the VCPMF could not be made.

Pump Intake Elevation:
Virginia regulations specify that well pump intakes must be placed at or above the top of the source aquifer. Based on a review of available site information by DEQ staff, the pump intake elevation for the production well is in compliance with the limits specified by regulation[3].

Water Level Comparison:
The *Virginia Coastal Plain Model (VAHydroGW-VCPM) 2021-2022 Annual Simulation of Potentiometric Groundwater Surface Elevations of Reported and Total Permitted Use* report (the *2021-2022 report)* and modeling files[4] provide two sets of simulated potentiometric water surface elevations. These water elevations are based upon, 1) the reported withdrawal amount of wells in the VAHydroGW-VCPM model ("the reported use simulation") and, 2) the total permitted withdrawal amount for wells in the VAHydroGW-VCPM model ("the total permitted simulation"). USGS regional observation network well water levels were compared to the water levels in the 2021-2022 report in order to evaluate the performance of the regional model in the vicinity of the applicant wells and assess historical groundwater trends. In the tables below, simulated water levels from the year 2021, from the reported use simulation, were compared to USGS measured water levels for the same year. For comparison, the total permitted simulated water levels are also reported. The total permitted water levels are taken from the end of the 50 year total permitted simulation and represent simulated water levels, 50 years from present, if all GWMA wells were to pump at their total permitted amount.

The USGS regional observation network wells closest to the applicant wells are shown in Figure 1 and listed in the following tables. The depth of these wells corresponds with the Potomac aquifer. The distances from the applicant wells to the USGS wells are also given in the tables. The 2021 annual average water levels observed in the regional observation network wells are given in the following tables. The VAHydroGW-VCPM row and column containing the USGS wells are also given. The water levels obtained from the regional observation network wells are shown in Figures 2 and 3**.** These figures also show the water levels from the reported use VAHydroGW-VCPM simulation for the cell containing each USGS well.

The water level graph for the first well in the Potomac aquifer (56H 22 SOW 135A) shows a steady decline in water levels from the time of the earliest available records (1979) to about 2000. Between 2000 and the present there are significantly more annual fluctuations in the recorded water levels, with some years seeing up to twenty feet of change. The overall decline in water levels continued over the last twenty years, however over the last few years those water levels have begun to stabilize and even show a slight recovery. The VAHydroGW-VCPM simulated reported use water levels at this location are within a few feet of the USGS observed water levels up until the last ten years or so when the simulated values have been up to 10 feet higher than the USGS observed water levels, but are in general agreement.

The water level graph for the second well in the Potomac aquifer (57E 14 SOW 144A) also shows a steady decline in water levels from the time of the earliest available records (1980) to about 2010. From 2010 to the present the water levels have also increased steadily. The VAHydroGW-VCPM simulated reported use water levels at this location are within one to five feet of the USGS observed water levels and are therefore in general agreement.

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[3] 9 VAC 25 610 140.A.5. "The permittee shall not place a pump or water intake device lower than the top of the uppermost confined aquifer that a well utilizes as a ground water source or lower than the bottom of an unconfined aquifer that a well utilizes as a ground water source;

[4] Refer to "Virginia Coastal Plain Model (VAHydroGW-VCPM) 2021-2022 Annual Simulation of Potentiometric Groundwater Surface Elevations of Reported and Total Permitted Use" at http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/ReportsPublications.aspx

Potomac Aquifer		
Measurement	**Well 56H 22 SOW 135A**	**Well 57E 14 SOW 144A**
Distance from nearest applicant well (miles)	10.9	14.5
Elevation (ft-msl)	105	86
VAHydroGW-VCPM Row	71	94
VAHydroGW-VCPM Column	40	45
VAHydroGW-VCPM Cell Elevation	111	85
USGS Regional Well 2021 Average Water Level (ft-bls)	200.7	159.7
USGS Regional Well 2021 Average Water Level (ft-msl)	-95.7	-73.7
VAHydroGW-VCPM 2021 Reported Use Simulated Water Level (ft-bls)	196.7	156.2
VAHydroGW-VCPM 2021 Reported Use Simulated Water Level (ft-msl)	-85.7	-71.2
VAHydroGW-VCPM Total Permitted Simulated Water Level (ft-bls)	205.5	178.5
VAHydroGW-VCPM Total Permitted Simulated Water Level (ft-msl)	-94.5	-93.5

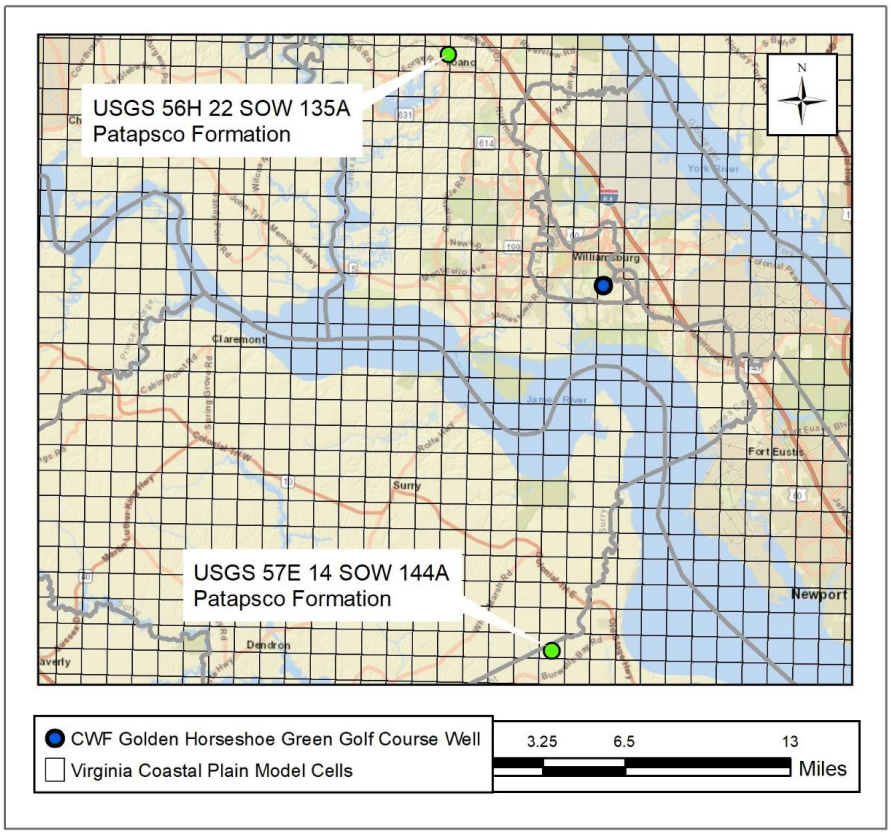


Figure 1. Nearest USGS regional observation network wells.

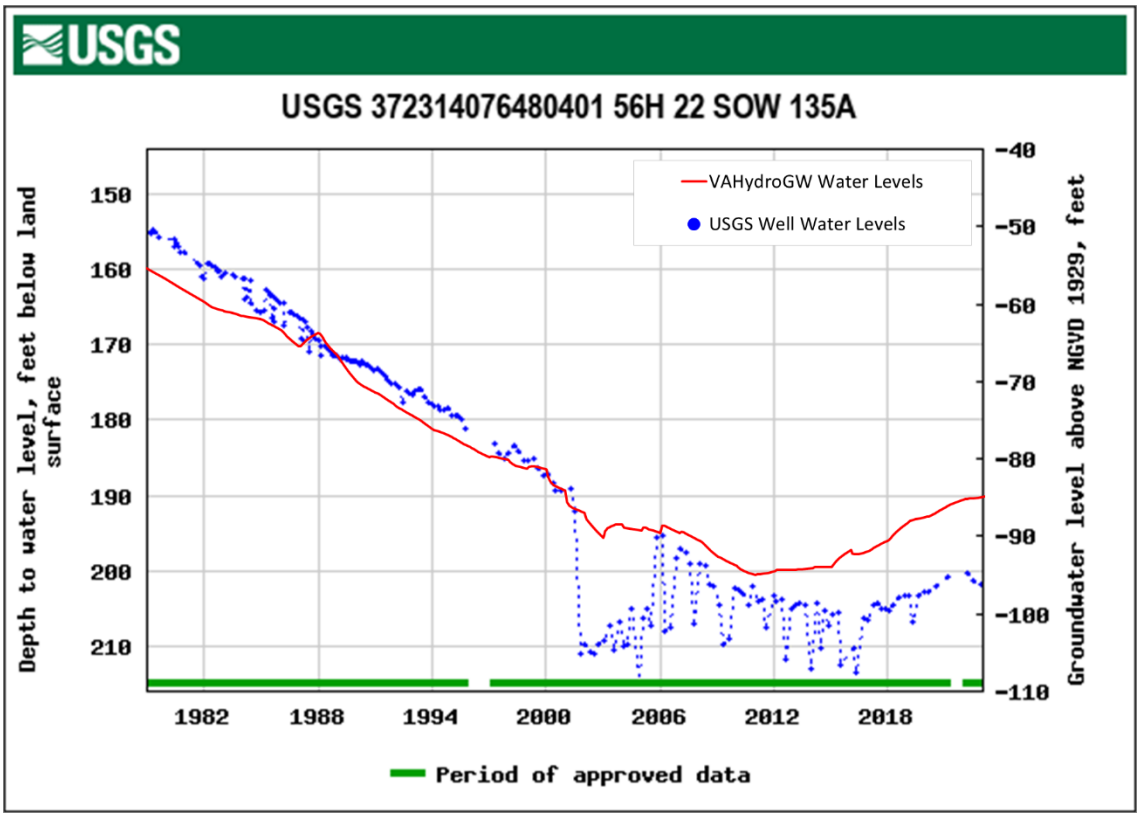


Figure 2. USGS Regional Observation Well 56H 22 SOW 135A, Potomac aquifer water levels (Patapsco Formation) recorded from 1979 to present (well depth 645 ft bls, land surface 105 ft msl) and VAHydroGW-VCPM reported use water levels.

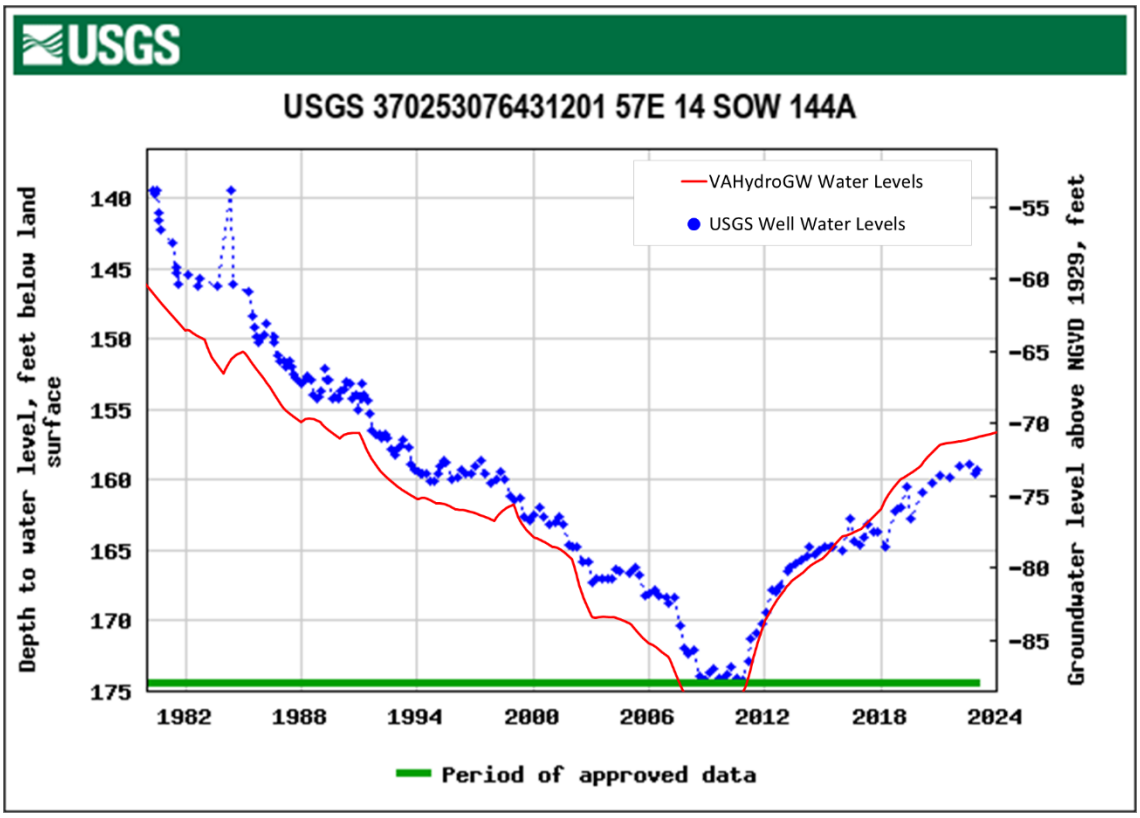


Figure 3. USGS Regional Observation Well 57E 14 SOW 144A, Potomac aquifer water levels (Patapsco Formation) recorded from 1980 to present (well depth 600 ft bls, land surface 86 ft msl) and VAHydroGW-VCPM reported use water levels.

Aquifer Test(s):
There are no aquifer tests available for this facility.

The hydraulic properties for the VAHydroGW-VCPM cell containing the applicant well are shown in the following table.

Hydrogeologic Unit	Horizontal Conductivity (ft/day)	Transmissivity (ft^2/day)	Storage Coefficient	Specific Storage (1/ft)
Surficial (Columbia) aquifer	2	50	-	0.000032
Yorktown-Eastover aquifer	22.4	939.6	0.00135	0.000032
Piney Point aquifer	18.8	656.3	0.00113	0.000032
Aquia aquifer	109	3,815	0.00113	0.000032
Potomac aquifer	49.4	52,607.1	0.00198	0.000002

Model Results

Evaluation of Withdrawal Impacts:
The magnitude of the proposed withdrawal does not allow for assessment of the area of impact using VAHydroGW-VCPM. The aquifer parameters from the VAHydroGW-VCPM were used to perform a two-dimensional analytical simulation to simulate drawdown due to the requested withdrawal for this technical evaluation. The drawdown in the Potomac aquifer resulting from the proposed withdrawal was calculated using Theis (1935) 2-D analytical simulations. The Theis simulation predicts the drawdown in a confined aquifer assuming constant discharge from a fully penetrating well. The average yearly withdrawal amount used for the 2-D analytical simulations was determined by dividing the fifteen year value (144,000,000 gallons) by the term duration (fifteen) which resulted in a value of 9,600,000 gallons per year. For the 2-D analytical simulations the following parameters were used:

Model Input Parameters (source: VAHydroGW-VCPM model properties for row 80, col 47):
Potomac Transmissivity = 52,607.1 ft^2/day
Potomac Storage Coefficient = 1.98×10^{-3}

Withdrawal rate/Simulation Time = 50 years at 9,600,000 gallons per year (26,301 gallons per day).

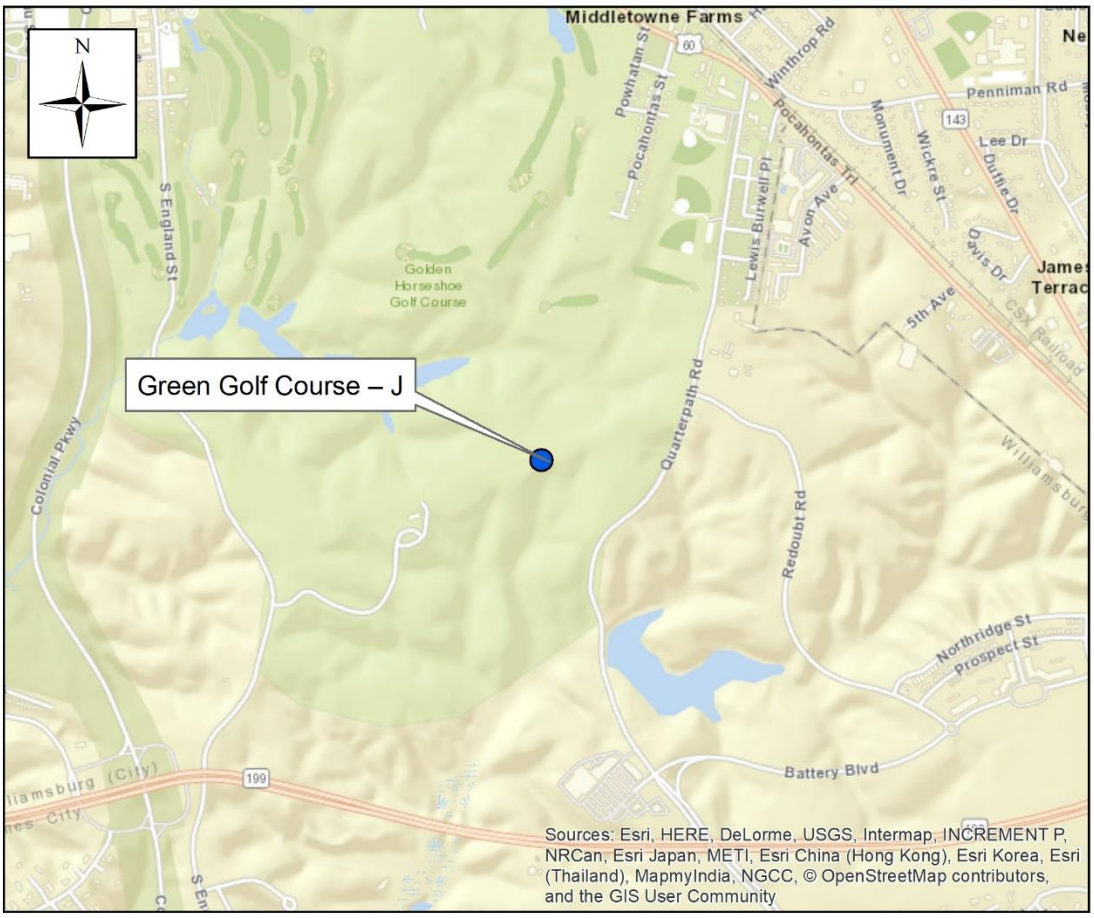
Area of Impact:
The AOI for an aquifer is the areal extent of each aquifer where one foot or more of drawdown is predicted to occur as a result of the proposed withdrawal. The results from the Theis analytical simulation, with the parameters listed above, do not simulate an AOI in the Potomac aquifer because the simulated drawdown at the production wells is less than one foot.

Water Quality:
The regional model (VAHydroGW-VCPM) does not indicate any changes to regional flow patterns that would lead to reduced water quality.

80 % Drawdown:
With no area of impact, <u>this withdrawal is within the limits set by the 80% drawdown criterion.</u> The requested withdrawal is allocated 100% to the Potomac aquifer.

Conclusion:
The withdrawal requested by The Colonial Williamsburg Foundation for CWF Golden Horseshoe Green Golf Course satisfies the technical evaluation criteria for permit issuance.

CWF Golden Horseshoe Green Golf Course
Area of Impact - Potomac Aquifer



CWF Golden Horseshoe Green Golf Course Well

Potomac AOI

Potomac Aquifer Critical Cells

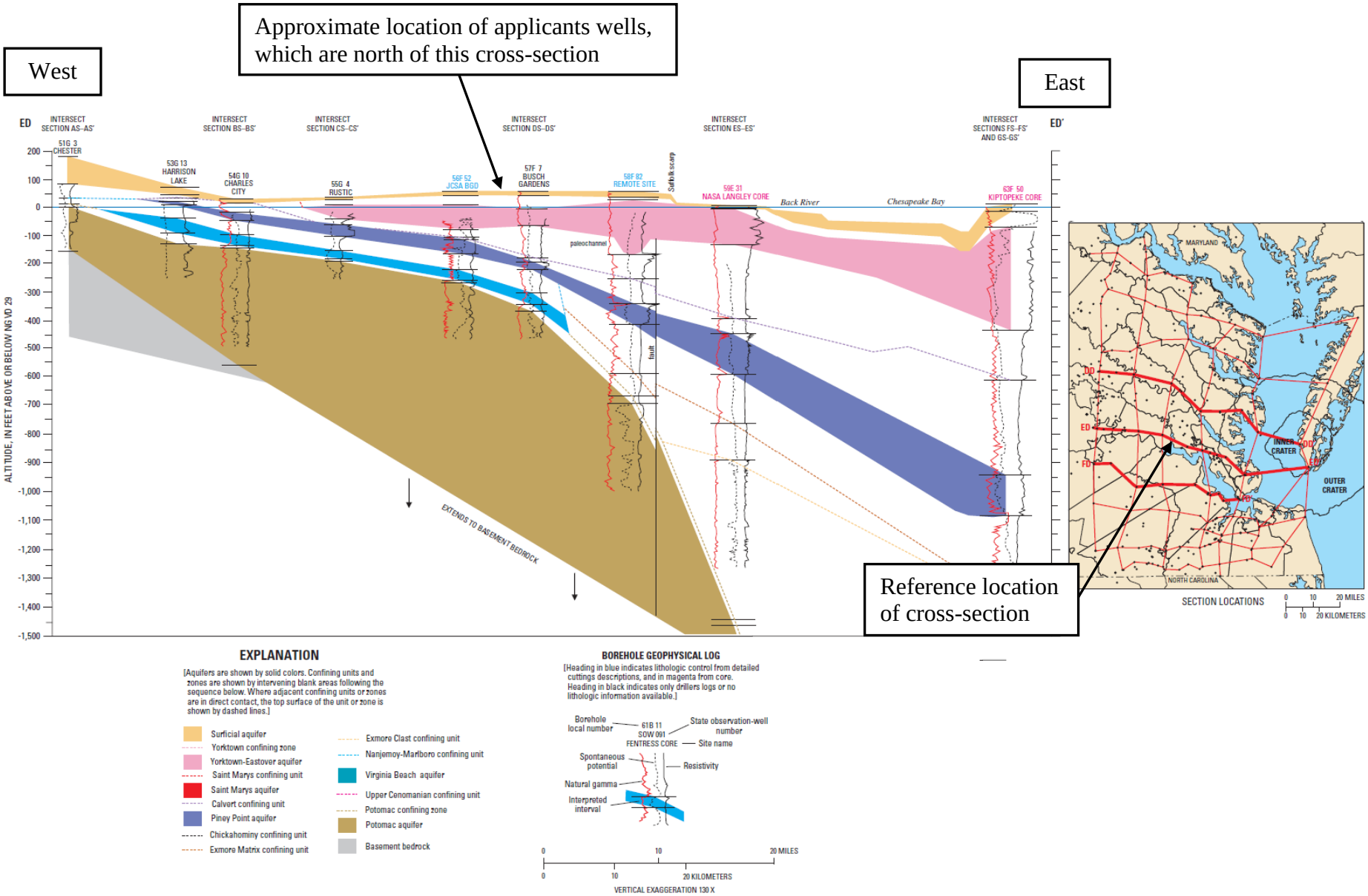
0 0.125 0.25 0.5 Miles

Simulated drawdown at or exceeding one foot in the Potomac aquifer resulting from a withdrawal of 9,600,000 gallons per year for 50 years from the Potomac aquifer using a two-dimensional Theis (1935) simulation.

Simulated drawdown is less than one foot.

Technical Evaluation performed by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply Planning
March 15, 2023

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY



Coastal Plain (2006) Cross Section ED-ED' from USGS Professional Paper 1731.

Paragraph 10 response:

Water Conservation and Management Plan

Pre-amble Background Information:

The Colonial Williamsburg owned Golden Horseshoe Golf Club Golf Courses utilize Toro Lynx/Site Pro with Network VP and Osmac field controllers for irrigation management with N.S.N. supported computerized software, field satellites and hand held irrigation controls.

Toro Lynx and Site pro systems gives us precise control over our water applications by automatically adjusting to precipitation and infiltration rates, plant types, slopes, rainfall, and evapotranspiration even when these factors vary on the course.

Irrigations systems operators are properly trained by the vendor and manufacturer of the systems. This operators training is refreshed as updates become available to improve system performance. The course Superintendents and Irrigation Technicians have been trained and know how to correctly operate and manage the irrigation system.

Our irrigation system is properly designed, correctly installed, and performance has been tested.

We have eliminated all non-target watering (e.g. sidewalks, Ponds, habitat areas).

We have installed part circle irrigation heads where possible to save water.

We incorporate evapotranspiration rates or weather data into daily irrigation decisions.

The turf grass on our greens, tees and fairways is appropriate for our local climate and growing conditions.

1) Water Loss Reduction Program

Groundwater Distribution System

The groundwater distribution system consists of 200 LF of 4" PVC pipe run from the well head underground to Pond #1. The Leak Detection and Repair Program will consist of visual observation of the pipe route looking for sink holes or other tell-tale signs that might indicate a pipe leak. Any visual signs indicative of a potential leak will be responded to by excavating to observe the pipe and make any corrective measures (repair/replace) necessary.

The first-year permit requirement for the groundwater system leak detection and repair program will include a schedule for inspection of the piping for leaks.

The first two years audit requirement of the amount of groundwater used in the distribution system and operational processes will be expected to be zero, as the risk to that underground pipe failing is very low. In the unexpected event that a leak in the distribution system is discovered in that time frame, the amount of loss will be calculated for audit reporting.

Golf Course Irrigation System

The series of ponds have watersheds that are capable on average of providing approximately 80% of the golf courses total irrigation requirements. Water conservation is a top priority in our management approach, including:

- Our irrigation system must be checked for proper water distribution in all irrigated areas at least once a year and all leaks shall be repaired immediately.
- All irrigation equipment and pump stations must be checked daily and maintained on a regular schedule per manufacturer's recommendation.
- The irrigation system and components of the system (e.g., valves, sprinkler heads, nozzles, and computer software) shall be upgraded as needed to reduce inefficiencies and malfunctions to reduce water use.
- Only water "Hot Spots" to target needed areas only instead of running the irrigation at peak evapotranspiration times.
- Work to maintain an effective water cycle to maximize water absorption and reduce runoff and evaporation, including maintaining soil cover, improving soil structure, adding or maintaining natural organic matter in the soil and improving drainage to minimize runoff and maximize water penetration through soil layers.
- Reduce or eliminate irrigation on all unused or minimally used portions of the property, and monitor daily water use, tally monthly usage, and set targets for yearly improvement.
- An inventory of sprinkler, valves etc. shall be maintained for effective repairs to the irrigation system in a timely manner by our irrigation technician.

2) Evaluation of Potential Water Reuse Options

Water reuse is not available at this time, but if any potential for water reuse becomes available in the future it will be fully considered.

3) Education and Training

Key maintenance staff must be able to identify the water sources used for irrigation. Only key staff members consisting of course superintendents and irrigation technicians operate the irrigation system. These staff members are required to be trained and know how to correctly operate/manage the irrigation system. Toro Lynx training is conducted initially at time of software installation for a brief overview of operational control and set up. More in depth training is conducted in a classroom setting through Smith Turf and Irrigation partnered with Toro/NSN. This training covers operations and controls, utilization of evapotranspiration rates, hydraulic operations, watering plan operation, program creation, course reporting and utilization, mapping function and usage features, and mobile control of lynx systems. A Toro/NSN training manual reference binder is provided with training class. Education Training and troubleshooting support has been secured through a yearly subscription with Toro/NSN contract. This provides 24 hour a day telephone support to programing repairs and hardware replacement for both irrigation control systems. "On call" field technician are available through Smith Turf and Irrigation to train in repair and troubleshooting irrigation performance issues and maximization of system. Additional training is conducted at the yearly national GCSAA conference and multiple state conferences on water conservation and auditing. All training is to be done by the irrigation system vendor/or manufacturer. New employees must be trained on system operation and water conservation prior to operating and maintaining the system.

4) Well Pump Operation

The well pump is operated manually based on observations of the water level in the Reese Jones Pond. Pond water level is generally maintained by normal rainfall events, but during extended drought and concurrent periods of high temperature, well operation becomes necessary to supplement the ponds. When these conditions occur, course maintenance supervisor and irrigation staff keep close watch to assure pond water level does not drop below 27.5'. This is the critical minimum depth that is about 1' above the level that the irrigation pumps would be inoperable.

When drought and high temperature conditions have caused the need for well operation, oversight of irrigation and well operations becomes the highest priority. During these conditions, pond levels are inspected as frequently as every 3 hours to decide on irrigation pump and well pump operation. Pond level is carefully monitored and well pump is turned off when pond level is approximately 6" below the standpipe elevation of 28.8' to prevent unintentional overflow into the Golden Horseshoe Gold Course Pond.

5) Water Shortage Emergencies

The Colonial Williamsburg Foundation and its Golf courses are in full compliance with all mandatory water use reduction during water shortage emergencies declared by the local governing body or the Director of D.E.Q. and agree to pay any penalties for non-compliance.