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**Missimer Division**
**ViroGroup, Inc.**
428 Pine Island Road, S.W.
Cape Coral, FL 33991
Phone 813-574-1919
FAX 813-574-8106

May 24, 1994

Mr. Bob Oreskovich
Dare County Water Production Department
600 Mustian Street
Kill Devils Hills, NC 27948

Re: Water-Table Aquifer Impacts due to Pumpage from the Mid-Yorktown Aquifer

Dear Bob:

This letter is in response to your request for information regarding the potential for Water-Table aquifer impacts due to pumpage from the new reverse osmosis production wells. As you know, the production zone for the proposed reverse osmosis feedwater wells occurs within the Mid-Yorktown aquifer which is encountered at a depth of approximately 300 feet below land surface in the Nags Head Woods area. Immediately above the aquifer lies a sequence of very low permeability clays that form a confining unit with a thickness of approximately 170 feet. This confining unit effectively separates the production zone from overlying formations. A unit consisting of quartz sand and gravel termed the Principal aquifer is present above the main confining unit. This unit would contribute water if any vertical leakage occurred due to pumpage from the Mid-Yorktown aquifer. The Principal aquifer would provide substantial if not total attenuation of hydraulic impacts of leakage due to Mid-Yorktown aquifer withdrawals so that no effect would be perceived on the surface environment. The Principal Aquifer is separated from the Water-Table aquifer by a clay layer that again has very low permeability. The geologic sequence beneath the Nags Head Woods area is shown graphically on the enclosed figure. Based on the geology, it is our opinion that the production zone is very well confined from overlying strata and there is negligible hydraulic connection to the Water-Table aquifer.

Shallow Water-Table aquifer wells were placed at test sites #9 and #10 behind the Fresh Pond in Nags Head, NC as required in the contract documents. These wells were constructed in order to determine drawdown effects in the Water-Table aquifer due to the withdrawal of formation water from the Mid-Yorktown aquifer. Construction details for the wells are given in the table below.

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**DARE COUNTY WATER PRODUCTION DEPARTMENT**
**SHALLOW MONITOR WELLS AT WELL SITES #9 &#10**

| Surface Well Number | Total Depth (feet below land surface) | Casing & Screen Diameter (inches) | Screened Interval (feet below land surface) | Screened Slot Size | Annulus Material (feet below land surface) | |
|---|---|---|---|---|---|---|
| | | | | | Cement Slurry | Gravel Pack |
| WT-#9 | 40 | 4 | 30-40 | 0.025 | 0-25 | 25-40 |
| WT-#10 | 40 | 4 | 30-40 | 0.025 | 0-25 | 25-40 |

Four Stage Step-drawdown tests were performed at each site on the two test wells tapping the Mid-Yorktown aquifer. The testing period lasted for approximately 11 hours at both sites. Water levels in the shallow wells were monitored every half hour using a wetted tape during the pump tests on the Mid-Yorktown aquifer test wells.

Results of the water level monitoring are included on the enclosed table and show that no significant drawdown was noted in the shallow monitor wells during the 11 hour test at either site.

Background water level fluctuation data from these shallow wells will be obtained prior to the aquifer performance tests (APT) on the Mid-Yorktown aquifer at each site. The Water-Table aquifer will also be monitored during these tests. The data gathered at that time will provide additional information regarding the degree of hydraulic connection between the two aquifers. In summary, it appears that pumpage from the Mid-Yorktown aquifer will have negligible effects on the Water-Table aquifer or surface environment.

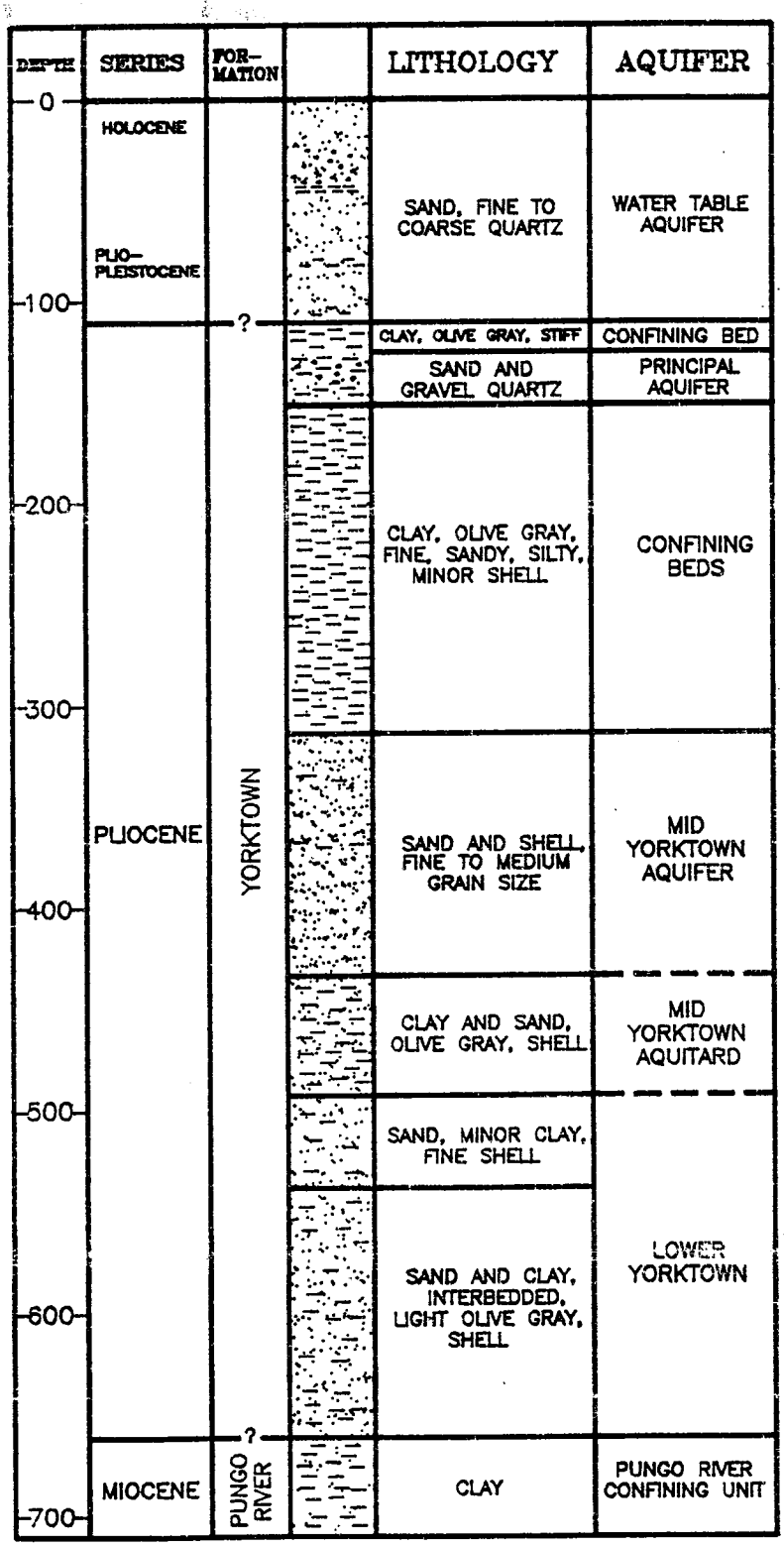
If you have any questions or comments regarding this information please do not hesitate to call this office.

Sincerely,

Jack Breland

Jack Breland, P.G.

| WATER LEVELS IN THE WATER-TABLE AQUIFER WELLS DURING THE FOUR STAGE STEP DRAWDOWN TESTS AT SITES #9 AND #10 | | | | | |
|---|---|---|---|---|---|
| SITE #9<br>STATIC WATER LEVEL IS 12.35 FT. BELOW TOP OF CASING (TOC) | | | SITE #10<br>STATIC WATER LEVEL IS 12.35 FT. BELOW TOP OF CASING (TOC) | | |
| TIME (MINUTES FROM BEGINNING) | RATE (GPM) | WATER LEVEL (FT. TOC) | TIME (MINUTES FROM BEGINNING) | RATE (GPM) | WATER LEVEL (FT. TOC) |
| 30 | 100 | 12.35 | 30 | 100 | 6.76 |
| 60 | 100 | 12.35 | 60 | 100 | 6.76 |
| 90 | 100 | 12.35 | 90 | 100 | 6.76 |
| 120 | 100 | 12.35 | 120 | 100 | 6.76 |
| 150 | 200 | 12.35 | 150 | 200 | 6.76 |
| 180 | 200 | 12.35 | 180 | 200 | 6.76 |
| 210 | 200 | 12.35 | 210 | 200 | 6.76 |
| 240 | 200 | 12.36 | 240 | 200 | 6.76 |
| 270 | 350 | 12.35 | 270 | 350 | 6.76 |
| 300 | 350 | 12.35 | 300 | 350 | 6.76 |
| 330 | 350 | 12.35 | 330 | 350 | 6.76 |
| 360 | 350 | 12.35 | 360 | 350 | 6.76 |
| 390 | 350 | 12.35 | 390 | 350 | 6.76 |
| 420 | 350 | 12.35 | 420 | 350 | 6.77 |
| 450 | 480 | 12.36 | 450 | 470 | 6.77 |
| 480 | 480 | 12.36 | 480 | 470 | 6.77 |
| 510 | 480 | 12.36 | 510 | 470 | 6.77 |
| 540 | 480 | 12.36 | 540 | 470 | 6.77 |
| 570 | 480 | 12.36 | 570 | 470 | 6.77 |
| 600 | 480 | 12.36 | 600 | 470 | 6.78 |
| 630 | 480 | 12.36 | 630 | 470 | 6.78 |
| 660 | 480 | 12.36 | 660 | 470 | 6.78 |




| M&A | ENVIRONMENTAL AND GROUNDWATER SERVICES | Missimer & Associates, Inc. |
|---|---|---|
| | DRN. BY: CAM DWG NO. C-C0401GE2-3 DATE: 3/24/92 | |
| | PROJECT NAME: DARE COUNTY, NORTH CAROLINA NUMBER: CH0-401 | |

FIGURE 3-1. HYDROGEOLOGIC SECTION OF DARE COUNTY BAUM TRACT WELLFIELD.