Alaimo Group

200 High Street, Mt. Holly, New Jersey 08060 Tel: 609-267-8310 Fax: 609-267-7452
2 Market Street, Paterson, New Jersey 07501 Tel: 973-523-6200 Fax: 973-523-1765

May 1, 2015

Mr. Eugene Callahan
NJDEP, Mail Code 401-04Q
Division of Water Supply & Geoscience
Water Systems Operations Element
Bureau of Water System Engineering
401 East State Street, Post Office Box 420
Trenton, New Jersey 08625-0420

Re: Township of Moorestown
Kings Highway & Hartford Road Water Treatment Plants
Engineering Evaluation
Our File No. A-730-053-000

Dear Mr. Callahan:

On behalf of Moorestown Township and in accordance with the Memorandum of Agreement between the Township and New Jersey Department of Environmental Protection, please find attached the Kings Highway and Hartford Road Water Treatment Plants – Plant Evaluation Report.

Should you have any questions regarding the information contained in the report, please call me.

Very truly yours,

ALAIMO GROUP

L. Russell Trice, P.E.
Senior Associate

LRT/das
Enclosures

cc/enc: D. Scott Carew, Township Manager, Township of Moorestown
Kenneth Ewers, Director, Moorestown Township Department of Public Works
Bill Butler, Utility Supervisor, Township of Moorestown
Anthony T. Drollas, Jr., Esquire, Solicitor, Township of Moorestown
Jennifer Myers, NJDEP, Division of Water Supply & Geoscience

Q:\Projects\A07300053000\Corresp\Callahan-eng eval report.docx

MOORESTOWN TOWNSHIP
NEW JERSEY

KINGS HIGHWAY AND HARTFORD ROAD
WATER TREATMENT PLANTS

PLANT EVALUATION REPORT

May 1, 2015
Our File No. A-730-0053-000

Richard A. Alaimo, P.E.
New Jersey License No. 13195 5/1/15

Alaimo Group
- Consulting Engineers -

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

1.0 Introduction and Background

1.1 Purpose

In accordance with recent Memorandum of Agreement (MOA) between the Township of Moorestown and the New Jersey Department of Environmental Protection (NJDEP), Alaimo Group has prepared the following engineering evaluation and corrective action plan for the Kings Highway Water Treatment Plant (WTP) and the Hartford Road WTP.

1.2 Existing Treatment Facilities

The original Kings Highway WTP, which is still in use was constructed in 1926. A major addition to the plant, which is also in service was constructed in 1947. Although no documentation exists, it is believed that the original plant was designed to produce approximately 1,500 gallons per day (GPD) with all filter units in operation and that the 1947 plant expansion increased the capacity such that the plant could produce 1,500 GPM with one (1) filter out of service for backwashing or repair. A few modifications/ upgrades have been constructed since 1947, however the major treatment processes constructed in 1926 and 1947 are still in use. Although the plant has a rated design capacity of 2.268 million gallon per day (MGD), Township personnel indicate that the plant is only able to produce approximately 0.6 MGD. The existing supply sources and treatment processes include three (3) wells (Nos. 3, 5 and 6), aeration, lime addition for pH adjustment, sedimentation, filtration, and gas chlorination for disinfection.

The Hartford Road WTP consists of two wells supplying two parallel process trains, each rated for 700 GPM (1.008 MGD). Well No. 4 and the first process train were constructed in 1961. Well No. 8 and an additional process train were constructed in 1969. The existing building was constructed with the initial treatment system, and two small additions were constructed in 1969. The treatment process generally consists of aeration, flocculation, settling, and filtration for iron removal; followed by disinfection. Filter backwash water is discharged to three (3) earthen settling/infiltration lagoons, with an overflow to nearby Kendall's Run.

1.3 Background

Purportedly, the Kings Highway WTP was capable of producing 2.268 MGD of finished water. However, over the last five (5) to then (10) year the plant's capacity has been reduced to approximately 0.6 MGD. The reduction in capacity does not appear to be a result of the failure of one particular process or piece of equipment. Rather the reduction in capacity is more likely attributable to the gradual deterioration of one or more treatment processes or pieces of equipment over an extended period of time.

Taken individually the failure of one piece of equipment or the deterioration in performance of a treatment process would not have resulted in a major reduction in capacity, if at all. However, the cumulative effect of all plant deficiencies has resulted in a large reduction in capacity. Based on the acknowledged decrease in capacity by the Township, the NJDEP has reduced the rated and firm capacity of the plant.

When the Hartford Road WTP was operating, the filters required frequent backwashing, which caused an unacceptable portion of the pumped groundwater to be wasted. In addition, the manual backwash process required significant operator attention. Due to these problems, the Township ceased operating the Hartford Road WTP in 2000 and has not operated it since that time. Subsequently, the plant has deteriorated to the point that essential components such as the clarifiers are completely inoperable. As a result, NJDEP recently reduced the rated capacity of the plant to zero, and reduced the Township's firm capacity accordingly. The plant in its current condition would require significant upgrades and repairs in order to be placed back into service.

2.0 Evaluation of Existing Treatment Facilities

2.1 Kings Highway Water Treatment Plant Evaluation

The existing treatment plant consists of a spray aerator, settling tank, three (3) gravity sand filters, a concrete backwash water holding tank, an elevated backwash water supply tank, lime and chlorine storage and feed equipment, a finished water clearwell and three (3) high service pumps.

Groundwater from each well is pumped directly to the spray aerators. Each well is manually operated from the Control House. Each time a well is started, a blowoff sequence is completed by manually operating valves in the control house. Well pumping rates are controlled by throttling each valve using a pre-determined number of turns. A modulating float valve is also installed to prevent overflow of the settling tank beneath the aerators. Lime is added following the aerators for pH adjustment. From the settling tank, water flows by gravity to the sand filters located in the Filter Building. The flow to each filter is regulated by means of an eight (8) inch float operated butterfly valve. Filtered water flows by gravity from each filter to a below grade concrete clearwell adjacent to the filter building. Gaseous chlorine is added to the clearwell for disinfection, and the clearwell provides chlorine contact time. Chlorine injection is manually controlled based on measured residuals in the clear well. Three (3) high service pumps then supply water from the clear well into the water distribution system.

Based on visual inspection of the existing facilities, conversations with Township personnel, and review of available plant records and design documents, the plant was evaluated for compliance with the Safe Drinking Water Act Rules at NJAC 7:10-11.13 and 11.14 and recommended design standards. In general, multiple deficiencies were noted with the wells and well pumps, the spray aerators, settling tank, filters, backwash water holding tank, chemical feed systems, auxiliary power, and instrumentation and controls throughout the plant.

Wells 3, 5, and 6 are all equipped with 50 HP motors. Redevelopment and pump repair were last completed for each well in 2002, 1999, and 2008, respectively. Based on conversations with Township personnel and review of available inspection data, all three wells appear to be in working condition.

Individual well flow meters located in the building are not working properly. Only the totalizing function of the flow meters is functioning, so it is not possible to determine instantaneous flow rates for the wells.

The existing aerator is an open system consisting of lateral distribution piping, spray heads, and a collection basin below the spray heads. A chemical mixing chamber and settling tank are located beneath the aerator tray. The spray aeration and settling tank design are an unconventional design, do not comply with current standards, and provide limited treatment functionality. Entry to the settling tank, which is classified as a confined space, is required to manually remove accumulated iron sludge. The entire aerator and settling tank structure is in deteriorated condition and is considered to be in need of immediate replacement.

The existing Lime Building was constructed in 1988 of CMU walls, and contains a lime dry feeder and bag storage area. The building appears to be in good condition.

Filter No. 1 has a surface area of 270 square feet and was constructed in 1921. Filters No. 2 and No. 3 each have a surface area of 250 square feet, and were constructed in 1926 and 1948, respectively. The existing filter control float valves are original, and are no longer functioning properly. Replacement parts are no longer available, and work on the float valves or filter distribution piping requires the plant to be taken out of service. In their current condition, only one filter can be operated at a time since flow is not evenly distributed among the filters. If two (2) or more filters are operated, all of the filters overflow. Each filter is equipped with a direct acting controller to maintain the desired flow rate. However, the controllers are not functioning properly, which causes variations in the filter flow rates. Since the filters are not equipped with flow meters, the actual flow rate to each filter cannot be accurately determined. Head loss columns, which are used to determine when a filter should be backwashed, are also not functional.

The filters have an underdrain system consisting of a sixteen (16) inch center manifold pipe embedded in concrete, which supplies two (2) inch galvanized laterals with drilled orifices. The laterals are on six (6) inch centers and are connected to the manifold via tees and nipples. The filter media was last replaced and underdrains rebuilt in 2008. The concrete-encased manifold has never been replaced and is believed have deteriorated to the point where the filters cannot readily drain or be adequately backwashed. The filter piping underneath the filter room floor slab is also in deteriorated condition and is leaking. During a recent inspection of the filter backwash operation areas of turbulent water (boils) were observed at several locations. Media expansion was also observed after the backwash cycle. These observations are indicative of a failed underdrain system. The condition of the filters appears to be one of the major plant deficiencies contributing the decreased capacity.

The existing plant backwash operation is manually controlled. Backwash water is supplied from the existing 40,000 gallon elevated steel tank. The backwash flow rate is set by opening a control valve to a predetermined number of turns, since there is no backwash flow meter. The backwash cycle is concluded by visually inspecting the quality of clear water. The backwash water supply tank is in good condition and could be re-used.

Filter backwash water is pumped to a backwash holding tank by two (2) 50 HP pumps. Only one pump can be operated at a time since the electrical controls are undersized. The backwash water pumping station is in fair condition.

The existing concrete backwash holding tank has a 91,000 gallon capacity. The roof on the backwash tank collapsed and was not replaced, and since that time the tank has not been used for its intended purpose of settling iron sludge and decanting backwash water. Currently, backwash water is discharged to the sanitary sewer instead of being recycled. As a result, 80,000 gallons of water is wasted each day under normal operating conditions. The backwash holding tank is in fair condition and could be reused if a new roof is installed.

The existing 116,000 gallon finished water clear well is reported to be in good condition. The clear well is currently full of water and should be drained and inspected.

Two (2) of the high service pumps, installed over the clear well, were likely installed as part of the 1947 plant upgrade. The pumps are no longer manufactured and replacement parts are difficult to obtain. The existing vacuum priming systems also do not function properly. Township personnel indicated that it takes about a half hour to prime the high service pumps. In the event of power failure, the pumps must be re-primed. The two high service pumps are considered to be at the end of their useful life and in need of replacement.

The third high service pump is a vertical turbine pump with a 1,650 GPM capacity and was installed in 2004. The pump is equipped with a 100 HP motor and VFD. The pump was apparently oversized and is not capable of handling the reduced flow from only one filter. There also are problems with the design of the pump control panel and VFD, and the pump is not currently operational.

The plant has a generator which is not functional. A portable generator is used to supply power to plant buildings during power outages, but is not capable of operating the treatment facilities.

A building containing all of the incoming plant electrical supply and distribution equipment is located next to the office building. The building dates to the 1947 upgrade or earlier. The existing electrical supply and distribution equipment was installed at a later date.

Based on a limited visual assessment of the buildings and structures throughout the plant, it is assumed that many unidentified repairs will be required. Due to the age of the buildings, each should be assessed in detail for compliance with current regulations and building codes as well as structural integrity.

2.2 Hartford Road Water Treatment Plant Evaluation

The existing treatment plant consists of two (2) induced draft aerators, two (2) 31' diameter x 14' deep solids contact clarifiers, two (2) 10' diameter x 36' long horizontal pressure filters with anthracite media, and three (3) earthen backwash lagoons. According to original operational manuals provided by Township personnel, General Filter Company supplied both of the existing treatment systems. The stated goal of the treatment process was iron removal, although the raw water quality used to design the system was not documented. The treatment units are arranged as two separate and parallel process trains, each supplied by one of two wells. Piping interconnections allow either well to feed either treatment system. Volumetric feeders for lime and alum feed directly into the aerator trays, prior to the clarifiers, for pH adjustment and coagulation. Two (2) 40 HP well pumps supply raw water to the aerators, which is then fed by gravity through the clarifiers and into the 24,000 gallon concrete clearwell located beneath the building floor slab. Chlorine gas is used for disinfection, and is added to the clearwell. Two (2) 50 HP vertical turbine pumps then supply water from the clearwell through the pressure filters and into the distribution system.

Based on visual inspection of the existing facilities, conversations with Township personnel, and review of available plant records and design documents, the plant was evaluated for compliance with the Safe Drinking Water Act Rules at NJAC 7:10-11.13 and 11.14. Several aspects of the plant design were noted that do not comply with current NJDEP regulations:

- Well No. 4 discharge piping is connected to Well No. 8 discharge piping without a check valve;
- There is no blowoff installed on Well No. 4;
- There is no apparent method of flow control on Well No. 4;
- Well No. 4 foundation is less than 12" above the surrounding floor and is below the exterior grade near the well;
- Well No. 8 discharge piping is not adequately protected from freezing;
- The existing standby generator is not sized to supply power to all pumping and water treatment processes;
- Post-chlorination for disinfection with five minutes of chlorine contact time is not provided;
- There is no chlorine analyzer installed;
- There is no window in the gas chlorinator room to permit visual inspection prior to entry;
- Chemical feed equipment is not configured for flow or residual pacing;

- The chemical feeders do not appear to be individually sized and configured to treat the entire flow through the plant;

- Adequate space for 30 days of chemical storage is not available in the existing building;

- The clarifier surface loading rate of 1.04 GPM/SF exceeds the regulatory maximum of 1.0 GPM/SF.

The frequent backwashing required during operation of the pressure filters is believed to have been caused by faulty operation of the clarifiers. Most likely, iron floc escaped the clarifiers and reached the pressure filters. While grains of iron passing the clarifiers would be oxidized and adsorb to media particles throughout the depth of the pressure filter bed, iron floc would tend to accumulate on the surface of the filter bed and quickly plug it. Solids contact clarifiers are known for their efficient and space-saving operation and are commonly employed in both surface and groundwater treatment plants for turbidity reduction, iron removal, or softening. The Contraflo solids contact clarifier by General Filter was a standard design that is still manufactured. However, solids contact clarifiers are highly susceptible to changes in flow, chemical feed rates, and water quality and must be operated within a certain set of parameters. Improper propeller speed, sludge blanket depth, flocculation zone solids concentration, and chemical feed rates can result in incomplete flocculation. Floc particles too small to settle would escape the clarifier, in this case clogging the pressure filters.

In its current condition, the existing plant cannot be placed back into service without significant repairs and replacement of equipment. The existing below grade clarifier tanks are inoperable and the tank walls have failed due to an apparent design deficiency. Original design and construction drawings of the tanks do not indicate any lateral bracing on the welded steel tank walls that would resist groundwater and earth pressure forces against the walls of the tank. Consequently, the tank walls have undergone significant buckling failure. An excavation along one of the tank walls shows a complete failure of the coating system below grade, with no remaining coating visible. Any corrosion and section loss of the steel tank wall would further contribute to its failure. The tanks are currently full of water and could collapse if they were to be emptied for inspection or repair. Additionally, the drive mechanisms are seized in their current positions, electrical wiring to the clarifiers is damaged, and the existing coating systems have failed in multiple locations, resulting in corrosion of steel components.

The well pumps are operational but have not been tested recently to demonstrate that they are capable of producing the rated flows. Well No. 8 was constructed in 1969, and Well No. 4 was constructed in 1961 and re-drilled around 1980. Records for well redevelopment and pump repair are not available, though a 1997 ASR Feasibility Investigation Report by CH2M Hill indicates that Well No. 4 was last tested in 1990 and Well No. 8 in 1994. Several deficiencies in the well discharge piping configuration are noted above, and the coating system on Well No. 8 discharge piping in vaults and above ground is in deteriorated condition. The flow control valve for Well No.8 is assumed to be in need of replacement due to its age and apparent condition.

Induced draft aerators were installed as part of the original construction in 1961 and the expansion in 1969. Their internal condition is unknown, but Well No. 4 aerator reportedly overflows when the pump is operated. This could be due to clogging of the aerator or excessive flow from the well.

Two sets of volumetric feeders for lime and alum were installed in 1995. One lime feeder and one alum feeder is dedicated to each aerator tray. The feeders have not been tested recently, and their operational status is not known.

There are no reported functional issues with the electrical service and distribution equipment within the building, although it can be considered to be at the end of its useful life. Equipment of its age does not usually survive major upgrades since replacement parts are generally not available.

The concrete clearwell located within the building is full of water and should be drained, cleaned, and inspected to determine its condition and suitability for re-use. Several access hatches were noted in the concrete floor over the clearwell. Steel support beams visible through the access hatches appear rusted, with no coating visible at all.

The pressure filters appear to be in fair condition. Some coating loss and corrosion was noted on the piping and valves, and to a lesser extent on the pressure filters. Records provided by the Township indicate that the media in filter No. 4 may have been replaced in 1978. The current condition of the media, underdrains, distribution piping, and tank interior is unknown. Given the age of the filters, media, and underdrains and the condition of the distribution piping the filters are considered to be at the end of their useful lives. The manual backwash process, which requires manually opening and closing valves and turning pumps on and off is labor intensive, requiring regular operator attention. Since there is no dedicated source for backwash water, the plant effluent is reduced from 1,400 GPM to 400

GPM during backwashing as effluent from in-service filter cells is applied to backwashing.

Three (3) clay-lined backwash lagoons, constructed in 1961 and 1968, are used to hold and settle backwash water from the pressure filters. Backwash water is infiltrated to groundwater and discharged to Kendall's Creek under NJPDES permit NJ0029548. Review of the permit database indicates that the permit expired in 2012 and has not been renewed since. Significant vegetation and algal growth are present in the lagoons, which are currently full of water. Visible components of the lagoons such as piping, baffle walls, and access platforms are in various states of disrepair and do not appear to be functional.

Built in 1960, the existing treatment building houses the pressure filters, electrical equipment, clearwell, high service pumps, chemical feed equipment, lavatory facilities, Well No. 4, its aerator, a small propane fueled generator for building lighting, and a workshop space. The building is constructed of CMU walls with brick veneer, and a wood framed roof. The garage/workshop area was added and the chemical feed equipment room extended in 1969. A replacement asphalt shingle roof was recently installed, but there is a leak along the back of the building where two different roof pitches join. Some of the wood roof framing is visible from the building interior near the aerator and appears to be structurally sound. The aluminum windows and most of the steel doors appear to be original. A wood panel 12' x 10' overhead door in the filter room is in deteriorated condition, with dry rot and loose panels near the bottom of the door. Widespread minor cracking is visible on both sides of the exterior brick and CMU walls in the area of the well room. The cracking does not appear to present a significant structural hazard at this time, and is most likely the result of failed waterproofing and minor settling. Various masonry repair methods are available that could be employed to restore the walls and prevent further deterioration. Significant settlement cracking is present on the masonry knee wall in the front of the building. The wall does not have any apparent function and could easily be demolished.

3.0 Evaluation of Alternatives for Kings Highway Water Treatment Plant

Three alternatives are considered for the Kings Highway WTP to bring the plant back to its former rated capacity of 1,600 GPM while complying with current regulations and design standards. The majority of existing equipment is in poor condition and in need of replacement. Regulations, design standards, and treatment requirements have changed, and much of the existing equipment is obsolete. The first alternative includes the replacement of existing equipment where required, and re-use or rehabilitation of equipment where practical or feasible. New treatment technologies are available that offer more efficient treatment and operation compared to the existing equipment. Accordingly, the remaining two alternatives consider installation of new treatment equipment, with re-use of existing components such as tanks and pumps where possible.

All three alternatives include demolition of the Control House, spray aerators, settling tank, and gaseous chlorine feed system. Based on reports from Township personnel, it is understood that much of the existing underground piping and valves will need to be replaced due to its condition. The majority of electrical equipment in the plant has reached the end of its useful life and will be replaced. The backwash tank will also be restored and provided with a new aluminum dome cover. The existing high service pumps can be re-used and the concrete finished water clear well will be drained, inspected, and repaired and epoxy coated if required. Existing buildings can be re-used and will be repaired as needed and brought into compliance with all current building codes and regulations. Installation of a new diesel fueled standby generator, new chemical feed systems, and instrumentation and control equipment are also included in the scope of all three (3) alternatives to bring the plant into compliance with current regulations and design standards and provide for reliable operation of the plant with minimal operator attention. The plant will be capable of fully automatic operation, with motor operated valves, VFDs to control pump flow rates, flow and residual paced chemical feed equipment, PLC based control panel(s), and all other required instrumentation.

3.1 Alternative 1 –Rehabilitation of Existing System

In addition to the above mentioned items, this alternative includes re-use and rehabilitation of the existing backwash supply tank, backwash pump station, electrical buildings, chemical buildings, garage, office building, and high service pumps.

The existing spray aerators and settling basins will be demolished and replaced with two (2) aerators and two (2) 34' diameter 18' high solids contact clarifiers. The existing filters, including the influent piping, underdrains, backwash piping, and media will be replaced within the existing building footprint. Instrumentation will be provided for fully automated backwash operation, and backwash water will once again be recycled in the restored holding tank.

Generally, the existing treatment process will remain unchanged. Lime and chlorine will continue to be fed using new chemical feed equipment. A coagulant feed may also be required for the clarifiers. The construction cost estimate for this alternative, shown in Table 1.1, is $4,600,000.

3.2 Alternative 2– Aeration and Greensand Filtration

Filtration with manganese greensand is widely used to remove iron and manganese from groundwater. Once primarily manufactured from glauconite, a naturally occurring mineral, synthetic forms of manganese greensand are now manufactured using silica sand with a thermally bonded coating of manganese dioxide. Depending on the system configuration, manganese greensand can also be used to remove radium, arsenic, and hydrogen sulfide. Manganese greensand is more efficient than conventional filtration using sand or anthracite media due to the catalytic oxidation of iron and manganese that takes place directly on the filter media. Chlorine or potassium permanganate is typically introduced to the raw water feed to oxidize the majority of iron and manganese prior to the filter media, and the remaining iron and manganese is oxidized on contact with the media. Similar to conventional filtration, the media is periodically backwashed.

This alternative includes aeration, chlorine addition for oxidation, greensand pressure filtration, lime addition for pH adjustment, and disinfection. Two (2) aerators and three (3) 12' x 36' pressure filters will be provided. A new clear well will be constructed beneath the aerators and filter pumps will pump water from the new clear well through the pressure filters and into the existing finished water clear well. A new 1,500 square foot masonry building will be constructed to house the pressure filter ends and exposed piping, and new chemical feed equipment. The construction cost estimate for this alternative, shown in Table 1.2, is $5,630,000.

3.3 Alternative 3–Packaged Treatment Units

Several manufacturers offer packaged treatment systems that employ aeration, flocculation, sedimentation, and filtration in pre-assembled compact units. Exact configurations and technologies used vary by manufacturer. The units are installed in parallel to achieve the desired treatment system capacity. Pumps, chemical feed systems, backwash supply and recycling tanks, and clear wells are typically provided separately.

This alternative includes complete replacement of the existing process equipment with a packaged treatment system consisting of aeration, settling, and filtration. Chlorine addition for oxidation and disinfection, lime addition for pH adjustment, and possibly coagulant addition will also be required. Two (2) packaged treatment systems will be installed in parallel to achieve the required capacity. The treatment units will be housed in a new 5,500 square foot pre-engineered steel building with a clear inside height of 25-30'. Chemical feed equipment and chemical storage will also be contained within the proposed building. The construction cost estimate for this alternative, shown in Table 1.3, is $6,400,000.

3.4 Recommendations

All three alternatives described above are capable of achieving the treatment goals while complying with the regulatory requirements. The packaged treatment system alternative has the highest capital cost without providing any significant advantage. Rehabilitation of the existing filters, as described in the first alternative, has the lowest capital cost and therefore is the recommended alternative. However, the plant must be taken out of service for an extended period of time. If it is critical that plant operation be maintained to the extent possible during construction, the second alternative including installation of aerators and greensand pressure filters should be considered.

4.0 Evaluation of Alternatives for Hartford Road Water Treatment Plant

Two alternatives are considered herein with the goal of restoring the treatment plant to its rated capacity of 1,400 GPM while complying with all current regulations and design standards, allowing operation of the plant with minimal operator attention, and minimizing the possibility of equipment failure. In general, re-use of existing equipment at the Hartford Road WTP is not advantageous or feasible. Much of the existing equipment is either non-functional or has reached the end of its useful life. Since the original equipment was installed in 1961 and 1968, regulatory requirements have changed and advancements in treatment technology have been made. Accordingly, both alternatives include the installation of completely new treatment systems, with the possible re-use of some facilities where feasible.

Both alternatives include demolishing and/or eliminating the solids contact clarifiers, pressure filters, backwash lagoons, and electrical service and distribution equipment. The clarifiers are at risk of collapse and are beyond repair. Extensive rehabilitation as well as re-permitting would be required to restore the backwash lagoons to service. The electrical service and distribution equipment presents an unacceptable risk of failure since it has reached the end of its useful life and replacement parts may be difficult or impossible to obtain. In conjunction with replacement of the existing electrical distribution equipment, upgrading the existing 230V service to the industry standard 480V is recommended since it allows for significantly reduced conductor sizing and easier replacement of motors. Several equipment items such as the high service pumps, well pumps, and No. 8 aerator could be re-used if tested, inspected, and repaired. However, the scope of both alternatives include replacement of these items since their current condition and maintenance history is unknown. The chemical feed equipment should be replaced as it is nearing the end of its useful life. Re-use of the pressure filters is not practical as it would require replacement of underdrains, media, face piping and valves, and re-certification of the vessels. Items such as backwash recycling, full-plant standby power, instrumentation and control equipment, variable frequency drives (VFDs), and post-chlorination, and a chlorine contact tank are included in the scope of both alternatives in order to bring the plant into compliance with current regulations and design standards and provide for reliable operation of the plant with minimal operator attention.

4.1 Alternative 1 – Aeration and Greensand Filtration

With its increased efficiency compared to the conventional filtration process currently used at the Hartford Road WTP, a manganese greensand filtration system can be installed within the footprint of the existing pressure filters. The filtration system will be similar to the one described for the Kings Highway WTP Alternative 2. The solids contact clarifiers can also be eliminated. Though not required for iron and manganese oxidation, aerators will be included in this alternative to strip dissolved carbon dioxide from the water, if existing concentrations are found to be problematic. Two 10' x 30' horizontal pressure filters can be installed with minimal modifications to the existing building, and the building will be repaired as discussed above. Underground piping will be re-used, and exposed piping within the building will be replaced. Both aerators will be located outside the existing building. The existing concrete clearwell inside the building will be rehabilitated and new vertical turbine pumps will be used to pump water through the pressure filters and into the distribution system, similar to the existing arrangement. An above ground backwash supply tank with a capacity of approximately 100,000 gallons will allow the plant to continue producing at least 80% of its rated capacity during backwashing. A second above ground tank with a capacity of approximately 120,000 gallons will be installed to recycle backwash and rinse water from a full backwash and rinse cycle. Supernatant from the recycle tank will be pumped back to the filter influent, and the remaining sludge drained by gravity to a nearby sanitary sewer manhole. The plant will be capable of fully automatic operation, with motor operated valves, VFDs to control pump flow rates, flow and residual paced chemical feed equipment, PLC based control panel(s), and all other required instrumentation. The construction cost estimate for this alternative, shown in Table 2.1, is $4,960,000.

4.2 Alternative 2 - Packaged Treatment Units

For the Hartford Road WTP, the existing aerators, clarifiers, and pressure filters can be replaced with a packaged treatment system as described in section 3.3 above. This alternative will require demolition of the existing building and construction of a new, larger building to house the packaged treatment units, electrical distribution equipment, and chemical feed equipment. The building will be constructed over Well No. 4 and the existing clearwell, to avoid having to construct a separate building in that area or repair the existing building. A pre-engineered steel building will be utilized to minimize capital cost. Approximately 5,400 square feet of floor space and a 25-30' clear inside height will be required.

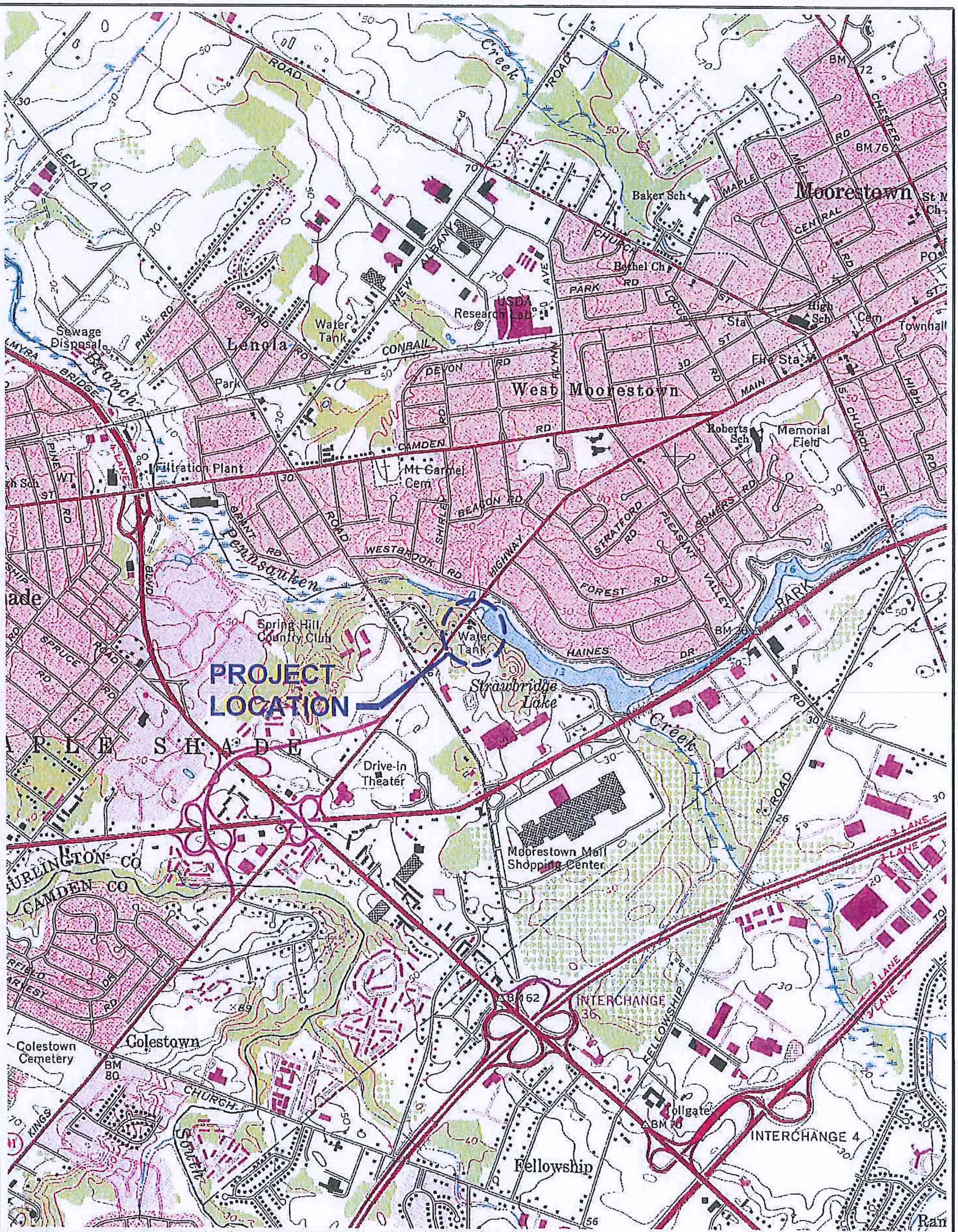
This alternative, similar to the previous one, will include backwash supply and recycling tanks and pumps, all instrumentation and control required for fully automatic operation, replacement of the existing well and high service pumps, and rehabilitation of the existing clearwell. The construction cost estimate for this alternative, shown in Table 2.2, is $6,380,000.

4.3 Recommendations

Both alternatives described above will provide a similar level of treatment, and are expected to have similar operation & maintenance costs. The second alternative has a significantly higher capital cost with no significant advantage. Any benefit, such as an accelerated construction schedule, that would be realized by the installation of a packaged treatment system is negated by the need for construction of a new building. The first alternative, including re-use of the existing building and installation of aerators and manganese greensand pressure filters, is recommended to restore the plant to its full capacity.

5.0 Project Schedule

For both the Kings Highway and Hartford Road Plants, the estimated project schedule from design and permitting through plant startup is approximately 23 months. See Table 3.1 for a breakdown of the various tasks.



SOURCE: U.S.G.S. 7.5 MINUTE SERIES QUADRANGLE, MOORESTOWN, NJ

A-1

ALAIMO GROUP Consulting Engineers NJDCA 24GA27988400 200 HIGH STREET MOUNT HOLLY, N.J. 2 MARKET STREET PATERSON, N.J.	CLIENT: MOORESTOWN TOWNSHIP PROJECT NAME: KINGS HIGHWAY & HARTFORD ROAD WATER TREATMENT PLANT EVALUATION PROJ. NO. A-0730-0053-000 CONTR. NO.	TITLE: FIGURE 1.1 KINGS HIGHWAY WTP PROJECT LOCATION MAP SCALE 1" = 2000'	DATE MAY 2015 DES. Y.S.V. DRN. MAC CHK. Y.S.V.

Plotted: 5/1/2015 7:39 AM Last saved: 5/1/2015 7:39 AM File Name: Q:\Projects\A07300053000\Drawings\EOZ-A1-Kings-USGS.dwg