NATIONAL BIOSOLIDS PARTNERSHIP
INTERIM AUDIT REPORT

City of Richmond,
Department of Public Utilities
Wastewater Treatment Plant
Richmond, Virginia

Audit conducted by

NSF-International Strategic Registrations

William R. Hancuff, Lead Auditor

References:
National Biosolids Partnership (NBP) BMP Elements
NBP Third Party Verification Auditor Guidance – November 2001
(Latest Revision August 2011)
NBP Code of Good Practice
City of Richmond, Virginia
Wastewater Treatment Plant
Biosolids Management Program Manual
Issued and Approved by Rosemary Green - Deputy Director
(Revised – 2016)

INTRODUCTION

The purpose of the Biosolids Management Program (BMP) interim audits is to verify through regular reviews the program’s health and effectiveness between verification audits. The third party on-site interim audits provide independent reviews and supports credibility between re-verification audits. The goal of the third party interim audit is to collect and evaluate objective evidence related to a portion of the BMP such that over the course of the four interim audits conducted between verification audits all 17 elements are covered. The audits determine whether the City of Richmond Wastewater Treatment Plant BMP is functioning as intended, that practices and procedures are conducted as documented, and that the BMP as implemented conforms to the NBP’s Code of Good Practice and BMP program objectives.

RECOMMENDATION

The results of the City of Richmond Wastewater Treatment Plant BMP interim audit and review of corrective action plans are positive, and it is the recommendation of the audit team that the City of Richmond BMP retain its Platinum Level Certification recognition.

AUDIT SCOPE

The NSF-International Strategic Registrations, Ltd. (NSF-ISR) conducted a third party interim audit of the City of Richmond Wastewater Treatment Plant BMP from December 12, 2016 through December 14, 2016. The on-site audit team consisted of Dr. William R. Hancuff, Lead Auditor.

The scope of the interim audit specifically included a review of the requirements of Elements 5, 14, and 17; namely the organization’s progress toward goals and objectives; BMP outcomes (environmental performance, regulatory compliance, interested party relations, and quality practices); actions taken to correct minor non-conformances; the management review process; and corrective and preventive action requests and responses. Because other system elements interact with the above specific requirements the interim audit also included partial auditing of activities found in elements 1, 2, 4, 6, 9, 15, and 16.

Since the NBP allows that any individual interim audit cover a portion of the BMP, but requires that over the course of the four interim audits conducted between verification audits the entire BMP (i.e. all 17 elements) must be covered, the following elements were audited in their entirety as part of this sixth interim audit: elements 3, 10, 12, and 13. Auditing these elements involved document review, interviews, and activity evaluations.
The physical biosolids facilities included in the audit and visited during the interim audit included the following critical control points of the biosolids value chain: bar screens, scum tanks, primary settling tanks, primary solids grit removal cyclones, primary solids thickening centrifuges and gravity thickening tanks, blower building, activated sludge aeration tanks, methanol feed system, ferric chloride storage building, secondary clarifiers, filters, UV building, waste-activated sludge centrifuges, anaerobic digesters, two biosolids storage tanks, final dewatering centrifuges, effluent filter building, truck biosolids loading facilities, truck scales, and concrete pad biosolids storage area and auxiliary landfill pad. One land application site, the Godsey Farms in Powhatan County (T-3947, fields 4 and 5; 22 and 10 acres respectively) used for hay/pasture was visited to observe staging and application activities and interview land application contractor employees.

The following individuals were interviewed as part of the audit process:

Rosemary Green, Deputy Director II
Clair Watson, Utility Operations Superintendent II – Plant Manager
Edwin Edmondson, Utility Operations Superintendent I – Assistant Plant Manager
Noureddine E. Elamghari, Utility Operations and BMP coordinator
Avis Purrington, Chief Chemist, Quality Assurance, Pretreatment Water Quality Lab
James Brown, Plant Operator
Ben Young, Biosolids Operator
John Harvey – Utility Operator Class II
Allen Blankenship – Utility Operator Class I
Brian Minor – Utility Operator Class III
Barbara Jackson, Supervisor (Internal Auditor)
Ed Alleyne – Engineer III – Tech Services
Laurissa Cubbage – Engineer, Greeley & Hansen Engineers, design engineers
David Simons – Vice President, Nutriblend (biosolids contractor)
John Faulkner – Field Manager, Nutriblend
Bobby Keye – Truck Driver, Simon Hauling Company (biosolids contract hauler)
Adam Eller, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, Permit Writer.

INTERIM AUDIT FINDINGS

The interim audit found no major non-conformances, 7 minor non-conformances, 4 opportunities for improvement and 1 positive commendation.

The following is a review of the positive observation made during the interim audit. The minor non-conformances and opportunities for improvement follow and are listed by item number, which correspond to the element minimum conformance requirements found in the NBP Third Party Verification Auditor Guidance. These findings are presented in the sequence of the NBP standard elements.
Positive Observation

The Richmond Wastewater management and all plant personnel involved in the biosolids environmental management program development and maintenance should be recognized for their outstanding achievements, and the exceptional features of their Biosolids Program. The following is the positive observation made during the interim audit.

Commendation:

- Operational staff implemented a significant change in plant operations by issuing a cease and desist order to the Reco company to prohibit the discharge of landfill leachate to the wastewater treatment plant thus significantly reducing operational problems associated with nitrogen constituents.

The hard work and dedication of the BMP Team must also be acknowledged. Maintaining the BMP platinum level certification recognition is obviously a team effort and the BMP team is to be commended. Additionally, the support, encouragement and active participation of the new Deputy Director II, Rosemary Green, in the management system process will continue to guarantee the success of the program.

Minor Non-conformances

Requirement 4.2 – Records of the applicable biosolids legal requirements must be identified and maintained. There was no identification of a new regulation 9 VAC 25-32-550 related to storage facility requirements in Table 4.1 – List of Relevant Legal and Other Requirements in Biosolids Management System Manual.

Requirement 5.2 – Operations personnel identified the leading single root cause of operation and maintenance problems throughout the biosolids value chain as grit (and non-biodegradable organics such as fibers). Grit wears on all moving equipment, such as pumps, centrifuges, flights, screw conveyors, etc. It also causes frequent failure of all those pieces of equipment, which requires extensive resources for maintenance and repair. Grit and fibers also substantially reduce digester capacity and efficiency, and requires digesters to be taken out of service for maintenance more frequently than would otherwise be required.

The goal and objective number 1/20/16 is to record 100% of grit removed form the collection system and wastewater treatment plant. This goal and objective did not meet the SMART criteria in that it does not result in any measureable improvement. It is an action plan to gather data on grit removed from the collection system, but does not identify what specific improvements will be implemented once the data is collected. It was suggested by plant personnel that this data may be used in the future to establish a new goal and objective for reducing the grit and non-biodegradable organics from the collection system before it reaches the headworks.

Requirement 5.2 – The goal and objective number 10/01/14 was to lower the percentage of open work orders closed, within 100 days and up, to 6%; to increase the percentage of work
orders closed in less than two weeks to 90%; and to increase the percentage of work orders closed the same day to 10%. The most recently summarized results of work order closures indicated that as of November 2016: 13% (over double off the desired target) were open more than 100 days; those closed in two weeks were 38% (less than half off the desired target); and the same day closure were 12% (slightly better than the desired target). The latter target was the only one accomplished. There was no documented explanation of the reason the targets were not met and more importantly what actions or adjustments would be made in the future to meet this goal and objective.

Requirement 5.2 – Goal and objective number 02/19/16 is to reduce grit entering the plant through the headworks by 90%. The action plan is to install a new headworks including a cyclone grit remover. The action plan does not currently include a description of the methodology or equipment to be used to measure the grit entering the headworks and exiting the headworks so that the measureable improvement can be determined.

Requirement 11.2 – The BMP staff conducted a table top exercise to evaluate the effectiveness of emergency preparedness and response, however this did not include any active participation in an actual field response. While tabletop exercises are valuable they cannot replace the evaluation of effectiveness derived from an actual field drill.

Requirement 16.1 – The Biosolids Management System Manual: Element 16 – Internal BMP Audit procedure 4 indicates that the internal audit will be conducted according to the current version of the National Biosolids Partnership’s Guidance. The 2016 internal audit was conducted using the version issued August 2011, which is the most current version; however the Internal Audit Checklist, had no revision (version) number or effective date, and it was not identified as being based on the 2011 version of the Guidance.

Requirement 16.3 – The Biosolids Management System Manual: Element 16 – Internal BMP Audit procedure 10 requires the lead auditor to write the internal audit report itemizing all findings and identifying them as major nonconformance, minor nonconformance, or opportunities for improvement. The internal audit report prepared on November 17, 2016 did not provide adequate categorization for each of the findings. Although there were some recommendations suggested in the report it wasn’t clear if those were corrective actions or opportunities for improvement. (This was a carryover finding from the re-verification audit.)

Opportunities for Improvement

Requirement 5.2 – The goal and objective number 10/02/14 is to have zero noticeable odors in the gravity thickening area upon the start-up of the fermentation process. Consider using an olfactometer to provide a more objective scientific basis to the quantitative measurability of odors than a subjective noticeable smell test.

Element 8 – Consider having the biosolids supervisor attend an ISO 14001 lead auditor training course.
Requirement 8.3 – Consider sharing the “training log template” developed for tracking the training of biosolids personnel with other divisions so they may have a better handle of who has and more importantly who has not received specifically required or desirable training.

Element 13 – Consider expanding the information contained in “Mainsaver” to include not just the number of work orders but also the labor hours and material costs associated with each work order so that additional analyses and optimization can be performed.

CITY OF RICHMOND COMMENTS

The City of Richmond is proud to maintain its National Biosolids Partnership platinum certification. Richmond continues its commitment to best management practices and continual improvement. The interim audit helped us find organizational strengths and weaknesses. The City is pleased to work with Dr. Bill Hancuff the lead auditor and to address the audit's recommendations in a timely manner.

OUTCOMES MATTER

The City of Richmond Public Utilities Biosolids Management Team continued to readjust its goals and objectives program after revamping it in 2014/15 by redefining all the goals and objectives as only goals and referencing those goals to specific outcome areas.

The team has worked at improving its approach to more clearly formulating and rechecking its goals employing Specific, Measurable, Achievable, Relevant, and Time Bound (SMART) criteria and using cost savings as an addition measure of improvement. The wastewater treatment plant biosolids goals for its BMP were established cognizant of each of the four outcome areas of the NBP program as identified below:

- Environmental Performance,
- Regulatory Compliance,
- Relations with Interested Parties, and
- Quality Biosolids Management Practices

The biosolids team revised the goal numbering system and use the date on which the goal was established as its unique identifier. The narrative title is also used for clarification. The discussion below is presented using the goal number (date of origin) and descriptive titles.

While it is not a requirement to accomplish all objectives established, it is a critical part of the system to make progress towards the overall goals. The Plant’s performance
relative to each of its goals is addressed below and the outcome areas affected by the goal are addressed at the end of each discussion.

The BMP coordinator and Biosolids Team added two new goal in 2016 and retired two others, which will be continued as a standard practices. Currently there are eight ongoing goals and objectives.

**01/05/12 – Reduce Quantity Of Paper And Ink At Scales By 100% (Completed).**

This goal has been slow to be completed, but the last step of installing the computer and software will be finished by December 2015. The objective was to replace existing printer data logging system at the truck scales (biosolids) with a wireless Ethernet system supplying data directly to the Biosolids Supervisor computer database.

The goal, initiated in 2012, was delayed by awaiting parts until December 2013. The delays continued and by the end of 2014 I&C was waiting on parts to repair the equipment. Subsequent to that it was determined that the supporting computer required to be upgraded. By the end of October 2015 the data line had been installed and the computer and software was scheduled for delivery by December 2015. This goal was attained and retired in 2016.

While this goal had its measurability defined as savings in printer paper (about 2 boxes of paper per year) and reduction in consumption of ink, its true improvement in the biosolids value chain is associated with improving the data capture, reducing errors in transcription, and significantly improving the capability to perform data analysis.

The accomplishment of this goal has an outcome in the quality biosolids management practices area as well as the environmental performance area. It also has an overall environmental side benefit of slightly lowering the solid waste generated by the plant.

**01/07/12 – Schedule Two Public Outreaches Per Year For Schools (Completed).**

This goal was established in early 2012 because it was felt that the communication program was not as robust as it could be. The biosolids team saw the benefits of the communications program of the hauling/land application contractor, which improves the understanding of individuals most interested in land application of biosolids, and determined that increased education of school age children would improve the long-term understanding of the wastewater renovation process. While this goal has been carried over for the past few years, it was implemented again in 2015 through an elementary school career day in March and another school lecture scheduled for the end of November. This goal was accomplished and retired and become a standard operating procedure of the BMP.

The outcome area impacted by these meetings was in the relations with interested parties outcome.
08/01/12 – Lower Methanol Consumption from 2.1 gal/lb of Nitrate/Nitrite reduced to 1.6 gal/lb reduced. (In Progress).

This goal, originally introduced in 2012 has been moved forward through 2016, with only partial success. A very limited description of how this goal is to be accomplished is documented. However, the concept is to convert one of the plant digesters (#6) into a fermentation tank that will produce organic acids that can be used in the denitrification process as an energy source to replace methanol. The measurability of the goal is in the reduction of gallons of methanol used to reduce nitrate/nitrite nitrogen in pounds to nitrogen gas. The baseline for the reduction is the relatively smooth operation of the denitrification process observed in 2014, which for the year averaged 2.1 gallons of methanol per pound of nitrate/nitrite converted.

The fermentation pumps and associated piping, electrical, etc. were put into service in May 2014; and the foul air control system associated with the gravity thickeners commenced. The system was partially ready to be placed into service but the fermentation pumps had to be upgraded. Additionally through 2015 there were operational difficulties that caused the use of methanol to increase substantially from the baseline average of 2.1 gal/lb. to 3.4 gal/lb. It was discovered that landfill leachate being added to the influent cause a massive increase in ammonia nitrogen and the resultant nitrates/nitrite from nitrification. This caused the jump in methanol consumption. Since banning the addition of landfill leachate from the plant the use of methanol had dropped to 1.9 gal/lb as of July 2016. However, as of December 2016 the fermentation system has not been operating as intended and redesign of grinders was necessary. The attainment of the target is anticipated to be accomplished by October 2018 as the process is optimized.

The primary target of this goal is to improve environmental performance through quality management practices and reduce the quantity of methanol purchased. The baseline demand for methanol is 3,000 to 3,500 gallons per day and reduction in methanol consumption by 25% has a highly significant impact on costs. At current rates the overall reduction could be in the range of $500,000 per year with no loss in quality of product.

This goal results in outcomes in all required areas; namely, environmental performance, regulatory compliance, relations with interested parties (cost savings), and quality biosolids management practices.

10/01/14 – Improve Maintenance Management Work Order Processing And Closure (In Progress).

The objective of improving maintenance management was originally established in 2011. It was associated with improving the response time for maintenance work requests. This was found to be highly successful, and logically lead to establishment of two new objectives namely: generation of work requests for 100% of the incidents in the biosolids areas and improving internal communication in the biosolids areas such that the number
of days a work order remains open is reduced. The latter was accomplished through daily monitoring of work order status.

In 2014 an evolved objective demonstrated considerable measurable improvement. The target was to lower the total days spent to close work orders. This was tracked by measuring three parameters: 1) lowering the percentage of open work orders closed in 100 days and up, to under 10%, 2) increasing the percentage of work orders closed in less than two weeks to over 85%, and 3) increasing the percentage of work orders closed the same day to over 5%. Once this target was achieved the next goal for 2015 was established.

For 2015 the target was to lower the percentage of open work orders closed in 100 days and up, to under 6%, to increase the percentage of work orders closed in less than two weeks to 90%, and to increase the percentage of work orders closed the same day to over 10%. The results thus far in 2015 showed a reduction to only 3.9% open after 100 days, 40% closed in less than two weeks, and 9.6% work orders closed the same day. The over 100 day open work orders surpass the target and the same day closures are close to the target, while the closure of work orders within two weeks is below target, but considerably improved from 2014 measure of 26%.

The most recently summarized results of work order closures indicated that as of November 2016 there was a significant increase in work orders open more than 100 days and was running 13% - over double the intended percentage and an increase of over triple the percentage of the previous year. The work orders closed in two weeks were 38% (less than half off the desired target) and virtually no improvement over the past year; and the same day closure were 12%, slightly better than the desired target, and the best showing to date. The latter target was the only one accomplished in 2016.

The reduction in time to correct operational deficiencies will improve the environmental performance of the biosolids value chain as well as the entire plant, thus minimizing the time when additional operational complications can develop. This goal also satisfies the requirements of the quality biosolids management practices outcome area.

**10/02/14 – Generate Zero Noticeable Odors In The Gravity Thickening Area (In Progress).**

This goal evolved from an earlier goal and is to create zero noticeable odors in the gravity thickening area upon startup of the fermentation process. To accomplish this goal, in 2013 thickening tank covers were installed along with biofilters and carbon filters. This target was established to maintain zero noticeable odors for 2 years after start-up of the fermentation tank. Once operations begin, the shift operators will perform the subjective odor monitoring twice per day.

Considerable delays have been experienced with the full operation of the fermentation tank, therefore causing a delay in the establishment of routine monitoring of
odors associated with that tank. There were startup attempts but considerable problems associated with rags. Delays are expected to carry this goal into 2017. Additionally in 2016 it was determined to use a more scientifically based measurement of odors by employing an olfactometer that provides objective numerical readings and a goal of 4 odor units is being considered as the target for this objective. The measurement device has been purchased and background readings should commence by the first of 2017. Routine readings will be made once the fermentation tank begins operation.

This goal results in outcomes in environmental performance and quality biosolids management practices. The attainment of this goal will have an impact in the relations with interested parties outcome area though reducing noticeable biosolids odors on tours.

01/01/15 – Improve Ratio of Preventive/Corrective Maintenance Work Hours to 70/30 (In Progress).

This is a new goal in 2015, which has long-term implications. To change the ratio of hours spent on preventive work orders to corrective work orders requires a long lead-time to attain. Preventive measures reduce the frequency and resources required for corrective measures however, many assets that have not been properly maintained will fail even if the required preventive measures are introduced. This is due to the fact that the asset may have already sustained damage because of the lack of maintenance. The true savings associated with the improvement in this ratio is the cost reduction in replacement parts, materials and equipment associated with high cost assets.

A view of the history of preventive hours to corrective hours ratios shows how the variation stays within a range: 2012: 51/49; 2013: 41/59; 2014:43/57; 2015: 52/48; and as of Aug 2016: 55/45. The shift in this ratio requires a few years to demonstrate an improvement. This year 2016 has the best record to date, however the target is still a long way from accomplishment. However, it is contemplated that by increasing as much as possible the number of assets in the preventive maintenance program that this will increase the preventive hours used for maintenance, and hopefully concurrently reduce the corrective hours required in the future. Also, the measurement of material/equipment/supply costs may be added to the tracking system in the future since this component can ultimately be a controlling variable in equipment replacement decision making.

This goal results in outcomes in environmental performance and quality biosolids management practices.

09/04/15 – Exercise 100 % of The Valves in the Biosolids Area. (Completed).

Another new goal for 2015 was to ensure the operability of 100% of the valves in the biosolids area. Malfunctioning or inoperable valves cause serious disruptions of plant operations by forcing operators to find “work arounds” during emergency situations. These “work arounds” can severely impact many areas of the treatment plant that would otherwise remain undisturbed.
The action plan involves using the wastewater plant’s asset inventory on “Mainsaver” to identify all hydraulic valves in the biosolids area (dewatering building, #1 control building, #2 control building, and the thickening area). The first data search identified 287 valves.

The next step was to verify that the inventory was correct and then test all valves for functionality and exercise each through its full range. The field verification resulted in identification of the following: 245 in dewatering, 285 in #1 and #2 Control Buildings and 151 valves in the thickening building for a total of 81 valves. The focus of this effort has been on the #1 & #2 buildings and the thickening building (436 valves). All the latter valves have been exercised. Sixty-five valves were found to be malfunctioning and of these 20 have been repaired or replaced. Because the goal of exercising 100% of the valves has been reported to have been accomplished this valve exercise activity will be moved into an annual “routine work program.” Because of the number of valves in the four identified areas will be tested quarterly throughout the year: the dewatering building will be tested from October to December; the #1 control building from January to March; the #2 control building from April to June; and the thickening area from July to September.

This goal results in positive outcomes in environmental performance and quality biosolids management practices. It could also have an effect in the regulatory compliance outcome area by avoiding catastrophic malfunctioning of the system during emergency situations.

**09/05/15 – Lower Polymer Usage in the Centrifuge Operation. (Completed).**

This goal was established in late 2015 and consists of lowering the polymer usage by the centrifuge by 5% from 106 pounds of polymer per ton of dry biosolids produced, to 100 lbs./ton. This will result in an average annual cost savings of $20,000 to $30,000. Accomplishing the goal and objective requires optimizing the centrifuge pinion speed, polymer feed, centrate clarity and biosolids cake produced. The actions required were to calibrate the scales, provide class training on dewatering SOP and testing various scenarios to measure performance values. The results of the first trial run on 1 centrifuge conducted in October 2015 were encouraging and resulted in polymer usage of 90 lbs./ton.

The following are the monthly average values of polymer used per ton of dry solids produced: Dec – 87; Jan – 68.9; Feb – 68.3; Mar – 78; April – 80; May – 72; June – 70; July – 69.9; Aug – 69.6; and Sept – 73.0. The average amount of polymer used for the 10 months giving is 73.7 lbs/ton; far exceeding the goal. A followup goal may be established to even further optimize the use of polymer before moving the improvements into a standard operating procedure.
This goal results in outcomes in most of the required areas; namely, environmental performance, relations with interested parties (cost savings), and quality biosolids management practices.

**01/20/16 – Establish a System to Record 100% of the Grit Removed from the Collection System and wastewater treatment plant.**

While this goal and objective does not meet the SMART criteria it can still function as the first phase a goal to reduce the amount of grit reaching the wastewater treatment plant through removing the the grit from sanitary sewers and storm sewers. The action plan described is directed at collecting background information that can be used to establish background information on quantities of grit that if not otherwise removed would reach the wastewater treatment plant and potentially overwhelm the new grit removal system being designed.

Once modified to meet the SMART criteria this goal and objective will result in outcomes in environmental performance and quality biosolids management practices.

**02/19/16 – Remove 90% of the influent grit through the new headworks degritting operation**

Modification of the plant through the addition of a new headworks operation is the action plan required to ensure this goal and objective is attained. The final engineering design was completed in June 2016. Permitting and approvals were granted in August and the bid and award is scheduled for March 2017. Construction and project closeout is set for August 2019.

This goal and objective will result in outcomes in environmental performance and quality biosolids management practices.

**CONCLUSIONS AND RECOMMENDATIONS**

The results of the interim audit are positive. The review and approval of the proposed action plans for each of the minor non-conformances identified during the audit has been completed. The full implementation of the corrective actions for the minor findings will be accomplished according to the schedule proposed in the corrective action reports (CARs) and it is the recommendation of the audit team that the City of Richmond Wastewater BMP retain its platinum certification recognition status.

As was mentioned previously, the BMP is a continually improving process. The results of this and future audits will provide value added to the system and should be viewed as an overall opportunity to improve. Every audit is a snapshot in time, and does not, or cannot, identify each and every area for improvement. And yet, while no single audit identifies all of the areas for improvement the results of each audit provide an additional incremental step in the overall system’s improvement.
Based on discussions between the Plant’s BMP Coordinator and the third party auditor, the schedule of individual elements to be audited in their entirety such that all the elements of the BMP are covered before the next re-verification audit are as follows:

Year 6 (third party) – Elements 3, 10, 12, 13 (completed)

Year 7 (third party) – Elements 1, 8, 15, 17

Year 8 (third party) – Elements 5, 6, 9, 14, 16

Year 9 (third party) – Elements 2, 4, 7, 11

Year 10 (third party) Re-verification
Attachment 1

Documents and Other Objective Evidence Reviewed During the Interim Audit

Element 1. Documentation of Biosolids Management Program

- City of Richmond Wastewater Treatment Facility Biosolids Management Program Manual Issued and Approved by Deputy Director II – 2016.
- Table 1.1 – BMP Organization By Categories.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (undated).
- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.

Element 2. Biosolids Management Policy

- Interview with Rosemary Green, Deputy Director II
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Policy displayed throughout wastewater treatment plant on posters.
- Policy communicated to interested parties through availability on web site.

Element 3. Critical Control Points

- Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (undated).
- Operations (including relationship to value chain, operational control references and environmental impacts). (undated)
- Aerial view of Richmond Wastewater Treatment Facility layout with processes identified
- Field observation of most significant Critical Control Points.
- Field visit to land application site – Powhatan County, VA – Godsey Farms (Site T-3947, fields 4 and 5)
Element 4. Legal and Other Requirements

- Table 4.1 List of Relevant Legal and Other Requirements.
- Land Application Site Notebook for the Godsey Farms (Site T-3947, fields 4 and 5) in Powhatan County, VA.
- Review new state regulation 9 VAC 25-32-550 related to storage facility requirements.
- VPDES Permit Number VA0063177, expiration June 30, 2018.
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Interview with contractor David Simons – Vice President, Nutriblend.
- Interview with regulator - Adam Eller, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, VPDES Permit Writer.

Element 5. Goals and Objectives for Continual Improvement

- BMP Element 5 – Goals and Objectives for Continual Improvement, Rev 14, 10/28/2015. (Element Procedure)
- BMP Element 5.1 (Table) – Goals and Objectives for Continual Improvement, Rev 15, 06/03/16.
- Biosolids Goal Action Plan form for tracking outcomes and objectives and targets.
- Evaluated all G&O for SMART criteria.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Noureddine E. Elamghari, Clair Watson, Ed Edmondson, and David Simons.
- Reviewed grit removal evaluation particle size distribution and cyclone grit removal technology to determine efficiency (Feb 18, 2016).

Element 6. Public Participation in Planning

- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- Reviewed the City’s Biosolids BMP website information.
- City of Richmond, Department of Public Utilities, Biosolids Management Brochure, 2013.
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Interview with contractor – David Simons – Vice President, Nutriblend.
Element 7. Roles and Responsibilities

- Table 7.1 – Biosolids BMP Responsibilities.
- Interview with Rosemary Green.
- Interviews with Clair Watson, Ed Edmondson, and Noureddine E. Elamghari.
- Interview with contractor – David Simons – Vice President, Nutriblend

Element 8. Training

- BMP Element 8 – Training, Rev 14, 10/28/2015.
- Interview with Noureddine E. Elamghari.
- Interviews with plant personnel – Clair Watson, Edwin Edmondson, James Brown, Ben Young, Allen Blankenship, Brian Minor, and Ed Alleyne.
- Interview with contractor – David Simons – Vice President, Nutriblend
- Reviewed publicly displayed Wastewater Works Operator Licenses – Class I and Class II for several employees.
- Reviewed EMS Awareness Training Power Point slides.

Element 9. Communications

- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- Richmond Public Utilities webpage on Biosolids.
- Virginia Department of Environmental Quality – Biosolids Frequently Asked Questions – Get the Facts (website information.)
- BMP Awareness Training Roster for 2016 and identification of all those not receiving training.
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Additional interviews with James Brown, Ben Young, Allen Blankenship, Brian Minor, Barbara Jackson, and Ed Alleyne.
- Interview with regulator - Adam Eller, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, VPDES Permit Writer.
- Interviews with contractors David Simons – Vice President, Nutriblend, John Faulkner – Field Manager, Nutriblend, Bobby Keye – Truck Driver, Simons Hauling Company.

Element 10. Operational Control of Critical Control Points

- **Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (including relationship to value chain, operational control references and environmental impacts).** (undated)
- **BMP Element 13 – Monitoring and Measurement, Rev 14, 10/28/2015.**
- **SOP: Biosolids Handling When Pathogen Reduction & Volatile Solids Reduction Requirements Not Met.**
- **SOP: Biosolids Spill Response Plan, Rev 3, 12/08/2016**
- **Land Application Site Notebook for the Godsey Farms (Site T-3947, fields 4 and 5) in Powhatan County, VA.**
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Additional interviews with plant personnel – Clair Watson, Edwin Edmondson, James Brown, Ben Young, Allen Blankenship, Brian Minor, and Ed Alleyne.
- Interviews with contractors David Simons – Vice President, Nutriblend, John Faulkner – Field Manager, Nutriblend, Bobby Keye – Truck Driver, Simons Hauling Company.

**Element 11. Emergency Preparedness and Response**

- **BMP Element 11 – Emergency Preparedness and Response, Rev 14, 10/28/2015.**
- **SOP: Biosolids Spill Response Plan, Rev 3, 12/08/2016.**
- Interviews with Noureddine E. Elamghari.
- Interview with contractor – David Simons – Vice President, Nutriblend
- Reviewed.
- Biosolids Spill drill, post evaluation undated but conducted in 2016. (tabletop exercise)

**Element 12. BMP Documentation and Document Control**

- **BMP Element 12 – Documentation, Document Control, and Record Keeping, Rev 14, 10/28/2015.**
- **Document Control Log – Last Updated Feb 16, 2016.**
- **Land Application Site Notebook for the Godsey Farms (Site T-3947, fields 4 and 5) in Powhatan County, VA.**
- Interviews with Noureddine E. Elamghari and David Simons.

**Element 13. Monitoring and Measurement**

- **BMP Element 13 – Monitoring and Measurement, Rev 14, 10/28/2015.**
- **Element 3: Critical Control Points, Table 3.1- Critical Control Points (CCP) Operations (including relationship to value chain, operational control references and environmental impacts).** (undated)
- **BMP Element 10 – Operational Control of Critical Control Points, Rev 15, 11/11/2016.**
- Summary of Work Request Status Report (prepared daily) to track number of days since work request was entered into system.
- Land Application Site Notebook for the Godsey Farms (Site T-3947, fields 4 and 5) in Powhatan County, VA.
- Interviews with Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Additional interviews with plant personnel – Clair Watson, Edwin Edmondson, James Brown, Ben Young, Allen Blankenship, Brian Minor, and Ed Alleyne.
- Interviews with contractors David Simons – Vice President, Nutriblend, John Faulkner – Field Manager, Nutriblend, Bobby Keye – Truck Driver, Simons Hauling Company.

Element 14. Nonconformance: Preventive and Corrective Action

- Reviewed CARs prepared to address third party re-verification audit from 2015 (CAR 103 – 120)
- Reviewed CARs prepared to address internal audit from 2016 (CAR 124 – 129)
- Interview with Noureddine E. Elamghari.

Element 15. Periodic Biosolids Program Report

- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- Reviewed 2015 Biosolids Management Program Performance Report (BMPPR)
- Interview with Rosemary Green, Deputy Director II
- Interview with Noureddine E. Elamghari.

Element 16. Internal BMP Audit

- BMP Element 16 – Internal BMP Audit, Rev 14, 10/28/2015.
- Biosolids Internal Audit Plan for 2015.
- Reviewed EMS Biosolids – Internal Audit Checklist (blank and completed for 2016).
- Reviewed CARs prepared to address internal audit from 2016 (CAR 124 – 129)
- Interviews with Noureddine E. Elamghari.

Element 17. Periodic Management Review of Performance

- BMP Management Review Meeting minutes for October 18, 2016, 11:00 am.
- Interview with Rosemary Green, Deputy Director II
- Interviews with Clair Watson, Edwin Edmondson, and Noureddine E. Elamghari.