NATIONAL BIOSOLIDS PARTNERSHIP
REVERIFICATION 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 Deputy Director
(Revised – 2015)

Draft Report – November 12, 2015

INTRODUCTION

The purpose of the Biosolids Management Program (BMP) re-verification audit is to verify the City of Richmond Wastewater Treatment Plant Biosolids Management Program conforms to the BMP requirements of the National Biosolids Partnership (NBP).

The method of the Third Party re-verification audit is to collect and evaluate objective evidence that determines whether the City of Richmond BMP is functioning as intended, that practices and procedures are conducted as documented, and that the BMP as implemented conforms to the NBP's BMP Elements, the Code of Good Practice and the City's BMP shows continual improvement through achievement of its goals and objectives and implementation of its corrective actions.

RECOMMENDATION

The results of the City of Richmond Wastewater Treatment Plant BMP re-verification 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 Certification status.

AUDIT SCOPE

The NSF-International Strategic Registrations, Ltd. (NSF-ISR) conducted a third party re-verification audit of the City of Richmond Wastewater Treatment Plant BMP from November 2, 2015 through November 6, 2015. The on-site audit team consisted of Dr. William R. Hancuff, Lead Auditor.

In general terms, the scope of the Third Party re-verification audit encompassed the entire biosolids value chain (pretreatment, collection and treatment, through final end use) at the Richmond Wastewater Treatment Plant facilities with special attention on those practices and management activities that directly support biosolids-related operations, processes, and activities within the biosolids value chain.

The scope of the re-verification audit specifically included a review of all of the NBP Elements requirements, and 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.

The physical biosolids facilities included in the audit and visited during the re-verification audit included the following critical control points of the biosolids value chain: bar screens, primary settling tanks, primary solids grit removal cyclones, primary

solids gravity thickening centrifuges and tanks, scum concentrators, activated sludge aeration tanks, methanol feed system, secondary clarifiers, waste-activated sludge centrifuges, anaerobic digesters, InNitri process, two biosolids storage tanks, biotowers for odor control, final dewatering centrifuges, effluent filter building, truck scales, ultraviolet light disinfection facilities, and concrete pad biosolids storage area. One land application site, the Renzor E. Tate Farm in Hanover County (HARET 1 – 4) used for hay/pasture was visited to observe those activities and interview land application contractor employees. Also, followed loaded biosolids truck along travel route from plant to land application site.

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
D'Juan Spencer - Biosolids Supervisor
Noureddine E. Elamghari, Utility Operations supervisor and BMP coordinator
Eric Whitehurst, Environmental Compliance Officer
Donald Carter, Project Management Analyst, Maintenance (Internal Auditor)
Barbara Jackson, Supervisor (Internal Auditor)
Avis Purrington, Chief Chemist, Quality Assurance, Pretreatment Water Quality Lab
Barry Deaton, Instrumentation & Control Technician
Angela Fountain, Public Information Manager
Percy Wyatt, Program Manager, Collections
Howard Glenn, Operations Manager, Collections
Thomas Harris, Occupational Safety & Health Specialist
Seth Mullens, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, Biosolids Specialist, Field Inspector, and Permit Writer.
Harrison Moody, Recyc Systems, Inc. Regional Manager
Mitch Priest, Field Manager, Recyc Systems, Inc.
Larry Rose, Field Manager, Recyc Systems, Inc.
Oscar Johnson, D. W. Cary Hauling Operation Manager
Tyrone Goodrich, WWTP Site Supervisor for D.W. Cary Hauling
Doug Goode, Driver for D.W. Cary Hauling

INTERIM AUDIT FINDINGS

The re-verification audit found no major non-conformances, 9 minor non-conformances, 9 opportunities for improvement and 3 positive commendations.

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 Observations

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 are the positive observations made during the re-verification audit.

Commendations:

- The BMP team has developed an excellent internal communication tool in its Biosolids Monthly Report compiled quarterly and distributed to all treatment plant employees to inform them of the performance of Biosolids Management Program and convey information on improvements in the quality of biosolids used for beneficial purposes.

- The BMP biosolids program supervisor conducted an all hands emergency response exercise on the release of biosolids on the plant property associated with a digester overflow (i.e. a spill drill). There was full participation of the entire sewer maintenance staff from all shifts in the exercise.

- The internal audit team conducted a detailed and comprehensive audit and identified several areas where the BMP could be improved. This audit provided considerable value added to the program.

The hard work and dedication of the BMP Team must be acknowledged. Maintaining the BMP platinum level certification 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 guarantee the continued success of the program.

Minor Non-conformances

Requirement 2.1 – The organization is committed to the Code of Good Practice. Incorporated in that Code is a commitment to compliance with all federal, state and local requirements regarding use and disposal of biosolids away from the facility. Biosolids that are to be land applied must meet strict regulations and quality standards. The Part 503 rule governing the use and disposal of biosolids contain numerical limits for metals in biosolids, pathogen reduction standards, site restriction, crop harvesting restrictions and monitoring, record keeping and reporting requirements for land applied biosolids. In the General Provisions (Subpart A) it states that either the Class A or Class B pathogen requirements must be met when sewage sludge is applied to the land or placed on a surface disposal site. In April 2015 the biosolids discharged from the Richmond Wastewater Treatment plant digester had not met the time and temperatures regulatory requirement for either Class A or Class B pathogen reduction. Therefore these solids did not meet the requirements for land application. They

were, however, land applied. While they were incorporated into the soil within six hours of land application this does not meet the requirements for pathogen reduction.

Requirement 4.2 – No procedure was found that specifies how biosolids, which do not meet the pathogen reduction requirement for Class B biosolids, are to be handled.

Requirement 7.2 – In BMP Element 7 – Roles and Responsibilities it defines the Biosolids Supervisor's responsibility to ensure the policies and procedures related to the BMP are implemented. The Biosolids Supervisor did not have a comprehensive working knowledge of the Biosolids Management Program, especially a familiarity with the details of the biosolids management procedures and SOPs. (Note: this is a carryover finding from the recent internal audit that has not yet been corrected.)

Requirement 8.1 – The facility has not ensured that the biosolids supervisor has received Environmental Management System Training to ensure he is competent in the implementation of various BMP functions. (Note: this is a carryover finding from the last external interim audit, for which the corrective action was never implemented.)

Requirement 8.3 – The BMP does not currently have a comprehensive approach to tracking employee training, and more importantly who has not received required training. (Note: consider the biosolids supervisor developing an employee training spreadsheet containing all treatment plant employees names along with the dates and titles of all training topics provided)

Requirement 11.2 – The BMP staff conducted a review and evaluation of its emergency response and preparedness for a biosolids release, i.e. a spill drill; however, there was no evaluation of the effectiveness of the drill after the exercise.

Requirement 12.2(d) – The organization must maintain documentation and documents for the Biosolids Management Program including the 17 elements that are properly marked with version number, effective date(s) and reference to replaced or superseded versions. For each of the BMP Element procedures the date of last review was not always correct. The revision (version) number for each element procedure was also not correct in that it reflected the "Manual Revision" number and not the procedure revision number. And lastly the revision date (effective date) was the same for all procedures in the manual, even though there has been no revision made to every procedure in the manual.

Requirement 16.1 – BMP Element 16 – Internal BMP Audit procedure 4 indicates that the audit will be conducted according to the current version of the National Biosolids Partnership's Guidance. The 2015 internal audit was conducted using the 2002 version of the Guidance and not the most current version issued August 2011. (Note: the Internal Audit Checklist, which had no revision (version) number or effective date, was developed from the 2002 version of the Guidance.)

Requirement 16.3 – BMP Element 16 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 October 7, 2015 did not provide adequate details for each of the findings and in some cases the report simply stated that there were minor nonconformances that needed to be addressed without specifically itemizing each of the findings in the report.

Opportunities for Improvement

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. Consider establishing a goal and objective for eliminating grit and non-biodegradable organics.

Requirement 5.2 – Consider establishing a goal and objective to have all the large sewers routinely cleaned on an annual schedule to remove grit and debris to reduce maintenance costs associated with pumping and lift stations, and to prevent grit and debris from reaching the wastewater treatment plant.

Requirement 5.2 – Consider having Public Information Office of Public Utilities establish a goal and objective related to the “relations with interested parties” outcome area.

Requirement 5.5 – Consider adding a column to Table 5.1 – Goals and Objectives for Continual Improvement that uniquely identifies the Specific, Measureable, Achievable, Relevant and Time-bound (SMART) criteria identified for each goal and objective.

Requirement 5.7 – In Table 5.1 – Goals and Objectives for Continual Improvement consider identifying the name of the individual specifically responsible for achieving the biosolids goal and objective, instead of a position title.

Requirement 5.7 – Consider clarifying in the action plan associated with goal and objective of “exercising valves in the biosolids area” to include identifying all non-functioning valves and repairing or replacing them.

Requirement 6.1 – In order to increase the proactive public participation approach to involve interested parties in the Biosolids Management Program planning process, consider distributing an index card to each individual who participates in a wastewater treatment plant tour and requesting they write in one sentence what they consider to be the most important thing they learned about biosolids during the tour.

Requirement 14.4 – Consider increasing the use of the Biosolids Corrective Action Reports for more high priority and/or resource intensive corrective actions throughout the biosolids value chain and at more diverse critical control points. (Note: determine which of the projects currently tracked in "Mainsaver" might be better analyzed for root cause through the corrective action approach).

Element 16 – Have the internal audit team review the definitions of major nonconformance, minor nonconformance and opportunity for improvement as identified in the National Biosolids Partnership Third Party Verification Auditor Guidance, Section 4.3 Evaluation Criteria: System Nonconformances.

CITY OF RICHMOND COMMENTS

The Richmond wastewater plant internal and re-verification audits were very helpful in identifying the areas of weakness and provided a value added to continual improvement. Some of the audit findings have been addressed while others are in process as scheduled. The BMP team is striving to involve different parties from maintenance, sewer maintenance, pretreatment, public information office and operation in the BMP program and the best management practices (to be reviewed and completed)

OUTCOMES MATTER

The City of Richmond Public Utilities Biosolids Management Team continued to reinvent its goals and objectives program in 2015 after revamping its goals and objectives program in 2014 to redefine all the goals and objectives as only goals and reference those goals to specific outcome areas. In 2013 the team modified its approach to identifying goals and objectives and made it more robust by adding new goals and removing completed ones throughout the year. Historically in 2011 Richmond had established 13 objectives, in 2012 this increased to 14, in 2013 there were 17 objectives.

The BMP coordinator and Biosolids Team developed the goals in 2015 reducing the number from 13, to 8. Several of the earlier goals were accomplished, some were not, and others were delayed until more information and data could be developed so that Specific, Measurable, Achievable, Relevant, and Time Bound (SMART) criteria could be used in their formulation. 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 BMP team continued to improve its use of SMART criteria in establishing goals and objectives for 2015, and they began using cost savings as an addition measure of improvement.

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.

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

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.

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 may be 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 – Reduce Methanol Consumption by 25% (In Progress).

This goal, originally introduced in 2012 has been moved forward through 2015, 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. Because of the need for adjustments to the system the startup date has been delayed from October 2015 to 2017.

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 The 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 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 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.

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 (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: 59/41; and to date 2015: 48/52. The shift in this ratio will require a few years. However, by increasing as much as possible the number of assets in the preventive maintenance program will increase the preventive hours used for maintenance, and hopefully concurrently reduce the corrective hours required in the future.

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. (In Progress).

Another new goal for 2015 is 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 is to verify that the inventory is correct and then test all valves for functionality and exercise each through its full range. All malfunctioning valves will be repaired or replaced and then placed on in the "routine work program" to continue this exercising annually. Because of the number of valves the four identified areas will be tested quarterly through the year: the dewatering building 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. (In Progress).

This new 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.

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.

CONCLUSIONS AND RECOMMENDATIONS

The results of the re-verification 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 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

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 – 2015.
- BMP Element 1 – Documentation, Rev 14, 10/28/2015.
- Table 1.1 – BMP Organization By Categories.
- BMP Element 2 – Biosolids Management Policy, Rev 14, 10/28/2015.
- Interview with Rosemary Green, Deputy Director II
- Biosolids Management Policy Statement signed by Willie Horton (former Deputy Director).
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- BMP Element 3: Critical Control Points, Rev 14, 10/28/2015.
- 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.
- BMP Element 7 – Roles and Responsibilities, Rev 14, 10/28/2015; Key Biosolids BMP Roles and Responsibilities – Hauling/Land Application Contractor.
- BMP Element 9 – Communication, Rev 14, 10/28/2015.
- BMP Element 11 – Emergency Preparedness and Response, Rev 14, 10/28/2015.
- Recyc Systems Operation and Maintenance Manual presenting Recyc's Participation with Richmond on its EMS Program, October 2014.

Element 2. Biosolids Management Policy

- BMP Element 2 – Biosolids Management Policy (including Code of Good Practice), Rev 14, 10/28/2015.
- BMP Element 9 – Communication, Rev 14, 10/28/2015.
- Interview with Rosemary Green, Deputy Director II
- Interviews with D'Juan Spencer, 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

- BMP Element 3: Critical Control Points, 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)

- Aerial view of Richmond Wastewater Treatment Facility layout with processes identified
- Field observation of new, modified, and most significant Critical Control Points.
- Field visit to land application site – Hanover County, VA – Renzor E. Tate Farm (Site # HARET 1 – 4).
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, Ed Edmondson and Eric Whitehurst.
- Additional interviews with Donald Carter, Barbara Jackson, Avis Purrington, Barry Deaton, Percy Wyatt, and Howard Glenn.
- Interviews with contractors - Harrison Moody, Recyc Systems, Inc. (land application contractor), Regional Manager; Mitch Priest, Field Manager, Recyc Systems, Inc.; Larry Rose, Field Manager, Recyc Systems, Inc.; Oscar Johnson, DW Cary Hauling (hauler and field application contractor), Manager; Tyrone Goodrich, wastewater treatment plant site supervisor for D.W. Cary Hauling; and Doug Goode, Driver for D.W. Cary Hauling.

Element 4. Legal and Other Requirements

- BMP Element 4 – Legal and Other Requirements, Rev 14, 10/28/2015.
- Table 4.1 List of Relevant Legal and Other Requirements.
- Recyc Systems, Inc. Operation and Maintenance Manual, containing Biosolids regulations and permits.
- Land Application Site Notebook for the Renzor E. Tate Farm site # HARET fields 2 & 3 in Hanover County, VA.
- VPDES Permit Number VA0063177, expiration June 30, 2018.
- Letter (May 15, 2015) from City of Richmond to Recyc Systems on low digester "time and temperature" data in April 2015.
- Reviewed Virginia Administrative Code requirements for Class B pathogen reduction.
- Review of Pretreatment Program with Eric Whitehurst (Environmental Compliance Officer).
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, and Ed Edmondson.
- Interviews with contractors - Harrison Moody, Recyc Systems, Inc. (land application contractor), Regional Manager; Mitch Priest, Field Manager, Recyc Systems, Inc.; Larry Rose, Field Manager, Recyc Systems, Inc.; Oscar Johnson, DW Cary Hauling (hauler and field application contractor), Manager; Tyrone Goodrich, wastewater treatment plant site manager for Cary Hauling; and Doug Goode, Driver for DW Cary Hauling.
- Interview with regulator - Seth Mullens, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, Environmental Specialist II, Field Inspector, and 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 for 2013.
- BMP Element 5.1 (Table) – Goals and Objectives for Continual Improvement form 2015.
- 2014 Biosolids Management Program Performance Report.
- Biosolids Goal Action Plan form for tracking outcomes and objectives and targets.
- Work Order Summary for 2013, 2014 and 2015.
- Reviewed archived tables containing Goal Wins and Goals Not Achieved.
- Reviewed Record of Biosolids Goal Action Plan covering 2013, 2014 and 2015.
- Evaluated 2015 G&O for SMART criteria.
- Interview with Rosemary Green, Deputy Director II
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, Eric Whitehurst, Ed Edmondson, Harrison Moody, Angela Fountain, Percy Wyatt and Howard Glenn.

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.
- NBP pocket size folded handout – outcome areas and elements of the program.
- Interview with Angela Fountain, Public Information Officer.
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, Ed Edmondson and Eric Whitehurst.
- Additional interviews with Donald Carter, Barbara Jackson, Avis Purrington, Barry Deaton, Perry Wyatt, and Howard Glenn.
- Interviews with contractors – Harrison Moody, Recyc Systems, Inc. Regional Manager (land application), Larry Rose, Field Manager, Recyc Systems, Inc. Mitch Priest, Field Manager, Recyc Systems, Inc. and Doug Goode, Driver for DW Cary Hauling.
- Interview with regulator - Seth Mullens, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, Environmental Specialist II, Field Inspector, and VPDES Permit Writer.
- Discussed Recyc attendance and participation in Agricultural Exposition held on August 6, 2015 in Orange County, VA.
- Reviewed City's support of the Virginia Biosolids Council.

Element 7. Roles and Responsibilities

- BMP Element 7 – Roles and Responsibilities, Rev 14, 10/28/2015.
- Table 7.1 – Biosolids BMP Responsibilities.
- Organization diagram for Water, Wastewater and Water Distribution – 20 July 2015.

- Storm water (and wastewater collection) Operations Organization Chart – April 21, 2015.
- Interviews with Rosemary Green.
- Interviews with Clair Watson, Ed Edmondson, D'Juan Spencer, and Noureddine E. Elamghari.
- Interviews with contractors - Harrison Moody, Recyc Systems, Inc. (land application contractor), Regional Manager; Mitch Priest, Field Manager, Recyc Systems, Inc.; Larry Rose, Field Manager, Recyc Systems, Inc.; Oscar Johnson, DW Cary Hauling (hauler and field application contractor), Manager; Tyrone Goodrich, wastewater treatment plant site supervisor for D.W. Cary Hauling; and Doug Goode, Driver for D.W Cary Hauling.

Element 8. Training

- BMP Element 8 – Training, Rev 14, 10/28/2015.
- Interviews with D'Juan Spencer, and Noureddine E. Elamghari.
- Interviews with plant personnel – Clair Watson, Edwin Edmondson, Eric Whitehurst, Donald Carter.
- Interviews with contractors - Harrison Moody, Recyc Systems, Inc. (land application contractor), Regional Manager; Mitch Priest, Field Manager, Recyc Systems, Inc.; Larry Rose, Field Manager, Recyc Systems, Inc.; Oscar Johnson, DW Cary Hauling (hauler and field application contractor), Manager; Tyrone Goodrich, wastewater treatment plant site manager for D.W. Cary Hauling; and Doug Goode, Driver for D.W. Cary Hauling.
- Reviewed publicly displayed Wastewater Works Operator Licenses – Class I and Class II for several employees.
- Discussed Recyc's wastewater treatment plant staff training on land application and beneficial use of biosolids – Feb 28, 2015.
- Reviewed EMS Awareness Training Power Point slides.
- Reviewed sign-in sheets for EMS Awareness Training – August 28, 2015.

Element 9. Communications

- BMP Element 9 – Communication, Rev 14, 10/28/2015.
- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- Richmond Public Utilities webpage on Biosolids.
- NBP pocket size folded handout – outcome areas and elements of the program.
- Biosolids Monthly Report published quarterly for employees (containing selected biosolids value chain performance).
- Discussed the 2015 Public Outreach Activities for Biosolids by Recyc, Inc. (several examples.)
- Discussed Recyc attendance and participation in Agricultural Exposition held on August 6, 2015 in Orange County, VA.
- Virginia Department of Environmental Quality – Biosolids Frequently Asked Questions – Get the Facts (website information.)

- BMP Awareness Training Roster for 2015 and identification of all those not receiving training.
- Interview with Angela Fountain, Public Information Officer.
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, Ed Edmondson and Eric Whitehurst.
- Additional interviews with Donald Carter, Barbara Jackson, Avis Purrington, Barry Deaton, Percy Wyatt, and Howard Glenn.
- Interview with regulator - Seth Mullens, State of Virginia, Department of Environmental Quality, Piedmont Regional Office, Environmental Specialist II, Field Inspector, and VPDES Permit Writer.
- Interviews with contractors – Harrison Moody, Recyc Systems, Inc. Regional Manager (land application), Larry Rose, Field Manager, Recyc Systems, Inc. Mitch Priest, Field Manager, Recyc Systems, Inc. and Doug Goode, Driver for D.W Cary Hauling.

Element 10. Operational Control of Critical Control Points

- BMP Element 10 – Operational Control of Critical Control Points, 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 13 – Monitoring and Measurement, Rev 14, 10/28/2015.
- Asset list of control valves (287) in the biosolids management area.
- EMS Procedure: Control Building Digesters # 1 – 5 SOP.
- SOP: Biosolids Spill Response Plan, Rev 3, 9/02/2015.
- SOP: Emergency Action Plan, Rev 1, 9/22/2015.
- Recyc Systems, Inc. land application site books with plans.
- Land Application Site Notebook for the Renzor E. Tate Farm site # HARET fields 2 & 3 in Hanover County, VA.
- Observed truck weigh in and weigh out procedures.
- Reviewed Recyc System's standard operating procedures of biosolids transportation.
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, Ed Edmondson and Eric Whitehurst.
- Additional interviews with Donald Carter, Barbara Jackson, Avis Purrington, Barry Deaton, Percy Wyatt, and Howard Glenn.
- Interviews with contractors - Harrison Moody, Recyc Systems, Inc. (land application contractor), Regional Manager; Mitch Priest, Field Manager, Recyc Systems, Inc.; and Doug Goode, Driver for DW Cary Hauling.

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, 9/02/2015.
- SOP: Emergency Action Plan, Rev 1, 9/22/2015.

- Reviewed Contractors (Recyc) emergency response procedure for on-site and off-site minor and major spills.
- Interviews with D'Juan Spencer and Noureddine E. Elamghari.
- Interview with Thomas Harris, Occupational Safety & Health Specialist.
- Interviews with contractors – Harrison Moody, Recyc Systems, Inc. Regional Manager (land application), Mitch Priest, Field Manager, Recyc Systems, Inc., and Edmond Green, Driver for D.W. Cary Hauling.
- Reviewed "Shelter in Place" After Action Report for wastewater treatment plant drill held on July 31, 2015.

Element 12. BMP Documentation and Document Control

- BMP Element 12 – Documentation, Document Control, and Record Keeping, Rev 14, 10/28/2015.
- Recyc Systems, Inc. Operation and Maintenance Manual, Land Application of Biosolids, VDEQ, April 15, 2014 (contains Biosolids regulations and permits).
- Land Application Site Notebook for the Renzor E. Tate Farm site # HARET fields 2 & 3 in Hanover County, VA.
- Cary Hauling – Truck Handbook by Recyc, undated.
- Interviews with D'Juan Spencer, and Noureddine E. Elamghari.

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 14, 10/28/2015.
- 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 Renzor E. Tate Farm site # HARET fields 2 & 3 in Hanover County, VA.
- Observed truck weigh in and weigh out procedures.
- Reviewed Recyc System's standard operating procedures of biosolids transportation.
- Reviewed Operations log of moisture analyzer through November 2, 2015.
- Interviews with D'Juan Spencer, Noureddine E. Elamghari, Clair Watson, Ed Edmondson and Eric Whitehurst.
- Additional interviews with Donald Carter, Barbara Jackson, Avis Purrington, Barry Deaton, Perry Wyatt, and Howard Glenn.
- Interviews with contractors - Harrison Moody, Recyc Systems, Inc. (land application contractor), Regional Manager; Mitch Priest, Field Manager, Recyc Systems, Inc.; and Doug Goode, Driver for DW Cary Hauling.

Element 14. Nonconformances: Preventive and Corrective Action

- BMP Element 14 – Nonconformance: Preventive and Corrective Action, Rev 14, 10/28/2015.
- Reviewed Corrective Action Report (CAR) format.
- Reviewed CARs prepared to address third party interim audit from 2014 (CAR 63 - 78).
- Reviewed CARs prepared to address operational problems in the biosolids value chain in 2015 (CAR 79, 81, 82, and 103).
- Reviewed Wastewater Plant Biosolids BMP Internal Audit Report dated October 7, 2015.
- Reviewed CARs prepared to address results from internal audit conducted October 5 & 6, 2015 (CAR 84 – 102)
- Interviews with D'Juan Spencer and Noureddine E. Elamghari.
- Interviews with internal auditors: Donald Carter (lead) and Barbara Jackson.

Element 15. Periodic Biosolids Program Report

- BMP Element 15 – Performance Report, Rev 14, 10/28/2015.
- BMP Element 6 – Public Participation in Planning, Rev 14, 10/28/2015.
- BMP Element 9 – Communication, Rev 14, 10/28/2015.
- Reviewed Biosolids Management Program Performance Report (BMPPR) 2014
- Viewed BMPPRs on website.
- Interview with Rosemary Green, Deputy Director II
- Interviews with D'Juan Spencer, and Noureddine E. Elamghari.

Element 16. Internal BMP Audit

- BMP Element 16 – Internal BMP Audit, Rev 14, 10/28/2015.
- Reviewed EMS Biosolids – Internal Audit Checklist (blank and completed).
- Reviewed Wastewater Plant Biosolids BMP Internal Audit Report dated October 7, 2015.
- Interviews with D'Juan Spencer, and Noureddine E. Elamghari
- Interviews with internal auditors: Donald Carter (lead) and Barbara Jackson.

Element 17. Periodic Management Review of Performance

- BMP Element 17 – Periodic Management Review of Performance, Rev 14, 10/28/2015.
- 2014 Biosolids Management Program Performance Report.
- BMP Management Review Meeting minutes for October 26, 2015, 8:00 am.
- The City of Richmond Virginia Wastewater Treatment Facility Annual Biosolids Report – 2014.
- Interview with Rosemary Green, Deputy Director II
- Interviews with D'Juan Spencer, and Noureddine E. Elamghari.