Quality Management System
Operational Plan
Markham Distribution System
Revision 5.0

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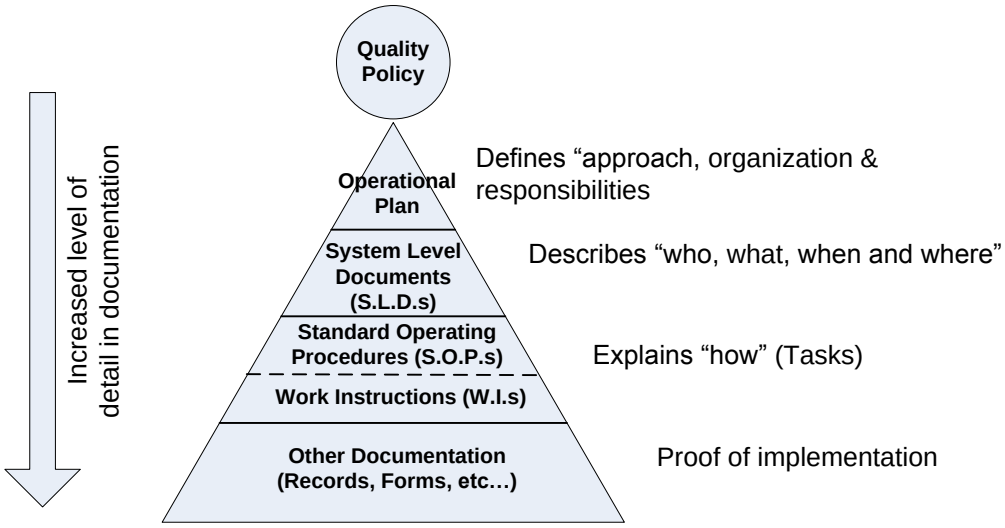
Introduction

As required by the Drinking Water Quality Management Standard (DWQMS), documentation is required to outline all the processes within the Quality Management System (QMS). The following structure is implemented as the QMS documentation structure for the City of Markham:

QMS Documentation Structure



Implementation of the DWQMS is divided into three steps – PLAN/DO, CHECK and IMPROVE. For the PLAN/DO step, the development and implementation of an Operational Plan is required and then followed by the documentation of the System Level Documents, the Standard Operating Procedures and Work Instructions as necessary for each individual process as required by DWQMS.

The Operational Plan is the highest level documentation in the structure and therefore it only defines the approach, organization and responsibilities for each element of DWQMS. The System Level Documents explain the "Who, What, When and Where" of the DWQMS elements in more detail. Under System Level Documents are Standard Operating Procedures where the "How" of specific tasks is documented. If there is a need to further expand a Standard Operating Procedure then specific Work Instruction is developed for a specific task. Generally it is expected that there can be multiple Work Instructions coming out from one single Standard Operating Procedure. Lastly, records are maintained as the proof of activities listed in the above levels of documents.

1. Element 1 – Quality Management System

1.1 Purpose

The Corporation of the City of Markham is defined as both the Owner of the Markham Drinking Water System as represented by Council, and the Operating Authority, as represented by the Waterworks Division, is required to achieve conformance to the Drinking Water Quality Management Standard (DWQMS) developed by the Ministry of Environment and Climate Change. This Operational Plan has been developed to represent the Operating Authority's Quality Management System (QMS) that conforms to DWQMS.

1.2 Scope

The QMS as described in this Operational Plan applies to all the requirements prescribed in the DWQMS.

1.3 Definitions

Not applicable.

1.4 Description

The ultimate goal of achieving DWQMS conformance must be fully understood, and activities must strive to meet the requirements of the standard. An organization is a network of interdependent, value-adding processes, and improvement is achieved through understanding and changing these processes to enhance the total system. To facilitate long-term improvements, a mindset of continuous improvement that is fostered by preventive rather than corrective measures should be applied to eliminate the root causes of non-conformances. Decisions are made based upon measured data, internal and external comparisons, and an understanding of the cause and effect mechanisms at work, not simply on the basis of instinct, authority or anecdotal data. A focus on continuous improvement is the cornerstone for breakthrough thinking and innovation. No matter how much improvement has been accomplished, there are always practical and innovative ways of enhancing, and of providing improved water services to the customer.

1.5 Associated System Level Document (SLD)

Not applicable.

1.6 References

Drinking Water Quality Management Standard (DWQMS)

2. Element 2 - Quality Management System Policy

2.1 Purpose

To state and communicate the City of Markham's Quality Management System Policy.

Justice Dennis R. O'Connor, in Part Two of the Report of the Walkerton Inquiry, recommended the adoption of a quality management system for the drinking water system and that a standard be specifically designed for drinking water systems. The Drinking Water Quality Management Standard implemented by the Province complies with Justice O'Connor's recommendation.

The Markham Drinking Water System is a distribution subsystem of the Region of York Transmission and Distribution System. Markham is responsible to maintain the quality of the water once it has entered the distribution system. Supplied water is treated either by the City of Toronto or the Region of Peel.

2.2 Scope

This plan describes the commitment of the City of Markham to establish, adopt and manage a quality management system as a means to deliver safe drinking water and to enhance customer confidence in the quality of the drinking water.

2.3 Definitions

Not applicable.

2.4 Description

Quality Management System Policy

The City of Markham owns, operates and maintains the Markham Distribution System.

The City of Markham is committed to:

Trusted supply of safe and reliable drinking water for the customer
Achieve compliance with applicable legislation and regulations, while ensuring staff are trained and competent to perform their duties
Protect our drinking water and provide necessary resources for continual improvement of the quality management system

2.5 Associated System Level Document (SLD)

Not applicable.

2.6 References

Element 12 - Communications

3. Element 3 - Commitment and Endorsement

3.1 Purpose

To communicate the Corporation of the City of Markham's commitment to and endorsement of the Quality Management System (QMS) described in this Operational Plan.

3.2 Scope

Commitment and Endorsement refers to the QMS as described in the Operational Plan, for the Waterworks Division of the City of Markham.

3.3 Definitions

Top Management:
Chief Administrative Officer, Commissioner of Community and Fire Services and Director of Environmental Services.

Owner and Operating Authority:
The Corporation of the City of Markham is defined as both the Owner of the Markham Drinking Water System as represented by Council, and the Operating Authority, as represented by the Waterworks Division.

3.4 Description

The City of Markham is committed to ensuring that a QMS is developed and implemented according to the requirements of the Drinking Water Quality Management Standard (DWQMS). Steps will be taken to ensure that the established QMS complies with all applicable legislation and regulations and all resources that are required for the maintenance and continual improvement of the system are that identified and provided.

The Operational Plan for the QMS has been reviewed and approved for the City of Markham by the Top Management and endorsed by Council as Owner of the drinking water system. The City of Markham further commits to ensuring that the QMS is regularly assessed, and updated as required to confirm its continued applicability and relevance.

Written endorsement by Council is provided in the form of a resolution from the Council Meeting. To promote awareness and understanding of the QMS, this written endorsement of the Operational Plan will be communicated to relevant parties according to the Communications Procedure.

3.5 Associated System Level Document (SLD)

Not applicable.

3.6 References

Not applicable.

4. Element 4 - QMS Representative

4.1 Purpose

To identify the QMS Representative for the City of Markham and outline the associated responsibilities.

4.2 Scope

This plan applies to the QMS Representative selected for the City of Markham.

4.3 Definitions

Not applicable.

4.4 Description

The QMS Coordinator has been appointed as the QMS Representative by the City of Markham. The QMS Representative is authorized and responsible for administering all processes associated with the operation and performance of the QMS. Reporting on the performance of the QMS and the need for improvement will be communicated to Top Management through regular management review meetings. Detailed roles and responsibilities of the QMS Coordinator are outlined in the Standard Operating Procedure for Organizational Roles, Responsibilities and Authorities.

The awareness of the QMS will be promoted to personnel through staff meetings, annual information meetings, internal audits, and other communication methods deemed necessary. A formal communications process will also be used to promote awareness throughout the City of Markham.

4.5 Associated System Level Document (SLD)

SLD 5a – Control of Documents

SLD 5b – Control of Records

4.6 References

Not applicable.

5. Element 5 - Document and Records Control

5.1 Purpose

To ensure that all Quality Management System (QMS) related documents and records are maintained and controlled according to established protocols and procedures.

5.2 Scope

All internal and external QMS documents and records as required by the DWQMS for activities that will impact the quality and safety of the City's drinking water shall be maintained and controlled.

5.3 Definitions

Documents:
Policies, System Level Documents, Standard Operating Procedures, Work Instructions, Forms, Regulations, etc.

Records:
Any documents that contain recorded data such as inspection sheets, time logs, training records, meeting minutes, internal auditing results, work orders, etc.

5.4 Description

A procedure for both documents and records control has been established to describe the methods and activities for ensuring that documents and records are properly:

i) Identified,
ii) Stored,
iii) Protected,
iv) Retained, and
v) Disposed/Discarded.

The procedures also explain methods for ensuring legibility and irretrievability.

5.5 Associated System Level Document (SLD)

SLD 5a – Control of Documents

SLD 5b – Control of Records

5.6 References

Not applicable.

6. Element 6 - Drinking Water System

6.1 Purpose

This document describes the City of Markham's drinking water system. It presents an overview of the main components of Markham's water infrastructure, and provides details regarding its connections to Region of York's and City of Toronto's water transmission systems.

6.2 Scope

This description provides background information for the risk assessment documented in Elements 7 and 8.

6.3 Definitions

Not applicable.

6.4 Description

Water System Description

The Markham Drinking Water System is a distribution subsystem of the Region of York and the City of Toronto Transmission System.

Markham's distribution system connects to both the City of Toronto and the Region of York's water systems. The water distribution and transmission network in Markham is composed of watermains owned by Markham, the Region of York and the City of Toronto. Separate Operational Plans have been developed by the City of Toronto and the Region of York to describe their drinking water systems.

City of Markham purchases water from the Region of York, which in turn purchases it from the City of Toronto and the Region of Peel. Markham's local distribution watermains are fed from York Region and Toronto Water trunk feedermains connected between the pumping stations and storage facilities in the Region of York and City of Toronto. The City of Markham's distribution system is divided in three pressure districts (PDs): PD5, PD6, and PD7. The location of each PD is shown in Figure 1.

PD5 is integrated with the City of Toronto's water system south of Steeles Avenue and supplied directly by Toronto-owned pumping stations (PS) in Markham (Thornhill and Milliken PS's) and by supply points along Steeles Avenue. The supply points at McCowan and Steeles, and Woodbine and Steeles are directly fed from the City of Toronto (PD4, and Kennedy PS). Two connections at Willowdale and Highland, and Yonge and Elgin usually outflow from Markham system to Toronto and Vaughan respectively. The pressure district 5M (PD5 modified) located at Kennedy and 14th Avenue is fed from Milliken PS and Milliken Tower.

The pressure district PD6 is supplied by the Regional system through the Markham PD6 PS, Markham Reservoir, North Markham Reservoir, and Bayview PS. The western side of PD6 (west of Highway 404 and south of Highway 7- known as pressure district 6A) and the area corresponding to Buttonville (generally bounded by 16th Avenue, Warden Avenue, Highway 7, and Highway 404, to the north, east, south, and west, respectively – known as pressure district 6RA) are supplied from the Bayview PS and Dufferin Reservoir. The PD6 reduced pressure district 6RC located at McCowan and 16th Avenue is fed from Markham PS and North Markham Reservoir.

Bayview PS also supplies water to the Town of Richmond Hill PD 6 through the Region of York transmission line in Markham. North Markham Reservoir is also the supply source for the Town of Stouffville zone 2 through Zone 2 PS.

The pressure district PD7 is located north-east corner of Elgin Mills and Hwy 404. This pressure district is supplied by the Richmond Hill PD7 PS from the water main on Elgin Mills Road.

Water Source Description

The City of Toronto treats water and then transmits this water to the Markham system via Toronto/Region's transmission mains. The City of Toronto owns and operates four water treatment plants (WTPs): the R.C. Harris, R.L. Clark, F.J. Horgan, and Island WTPs. City of Toronto's water treatment facilities are surface water treatment plants that treat water from Lake Ontario with chemically assisted filtration, primary disinfection with chlorine, fluoridation, and chloramination to maintain chlorine residual throughout the distribution system (secondary disinfection). Since the City of Toronto's water distribution system is an interconnected pipe network, the water received by the Region of York, and the City of Markham may have been treated at any of the four plants. However, water received in Markham is most likely treated at the R.C. Harris, F.J. Horgan, and Island WTP, with the majority coming from F.J. Horgan.

The water transmitted from the Region of Peel to the Region of York is treated at Peel's Lakeview Water Treatment Facility. Water from Lake Ontario is treated at this facility by a process that includes chemically assisted filtration, primary disinfection with chlorine, and fluoridation. The treated water is then chloraminated (ammonia is added to maintain chlorine residual levels for longer periods of time) at the Airport Road PS prior to being fed to the Region of York.

The quality of the water supplied to Markham is monitored and controlled by the City of Toronto, Region of York, and the Region of Peel. Toronto's and York's SCADA systems control and operate their facilities in Markham. Chlorine residual is monitored at the City of Toronto's Milliken and Bayview Reservoirs, and the Region of York's Markham and North Markham Reservoirs. Markham does not have real-time access to York's/Toronto's SCADA systems, but can get data/information on request.

The City of Markham relies on the City of Toronto and the Region of York for notification of water related events which may directly affect the quality of the water supplied to the customers of the Markham distribution system. Source water event driven fluctuations and operational challenges are as described in the Region of York and City of Toronto's Operational Plans.

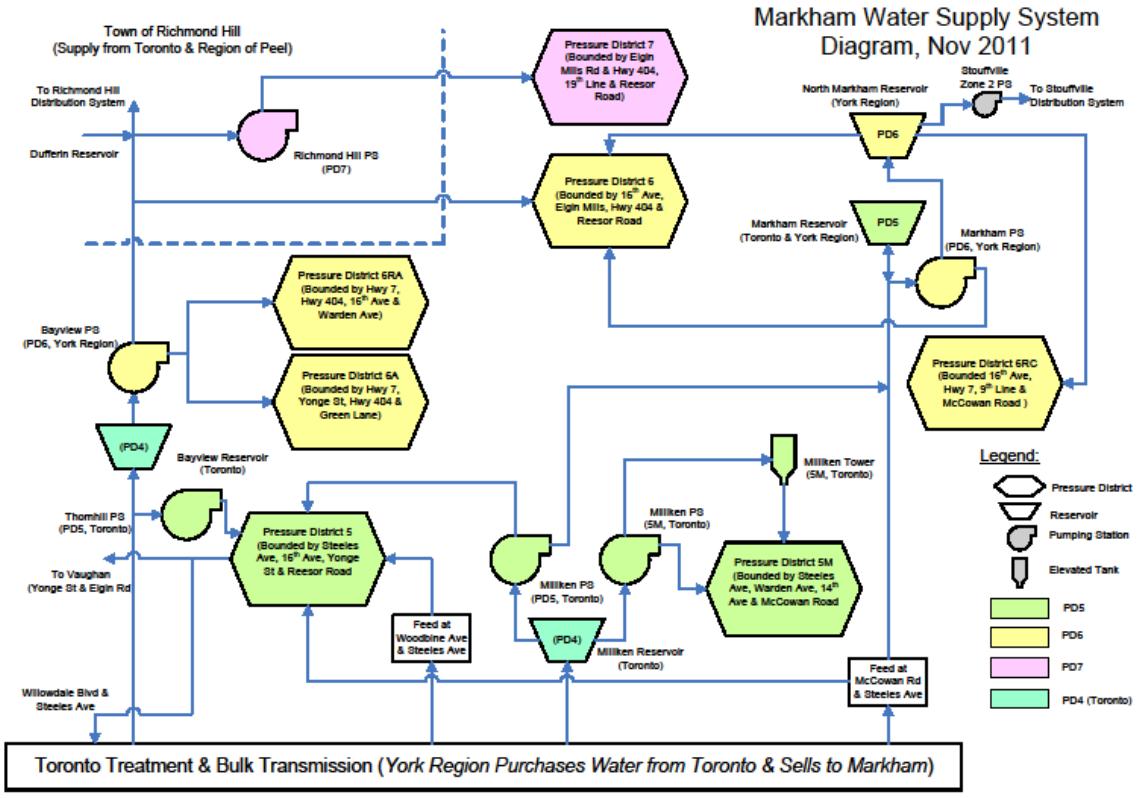
Common event-driven fluctuations, operational challenges and threats may include:

- Seasonal temperature changes which can impact settling and disinfection,
- Vertical lake turnover in spring and fall which can increase raw water turbidity,
- Algal blooms which can cause taste and odor issues, and
- Zebra mussels or debris which has the potential to block intakes.

System Infrastructure

The City of Markham operates and maintains its own watermains, valves, hydrants and water meters. In addition, in order to ensure the quality of the water, the City has a continuous chlorine analyzer, dead-end flushing stations and sampling stations throughout its distribution system. Figure 1 below shows the main components of Markham's water distribution system.

Figure 1



6.5 Associated System Level Document (SLD)

Not applicable.

6.6 References

Not applicable.

7. Element 7 - Risk Assessment

7.1 Purpose

To describe the methods and approaches taken by the City of Markham to identify, assess and where possible, mitigate and/or eliminate potential risks within the drinking water system.

7.2 Scope

This plan and associated procedures apply to the entire drinking water distribution system within the City of Markham. It also includes risks that relate to connecting systems.

The risk assessment process considers, but is not limited to, hazard categories such as:

1. Biological,
2. Chemical,
3. Radiological, and
4. Physical.

7.3 Definitions

Not applicable.

7.4 Description

A risk assessment team is established to collectively identify, assess, rank and prioritize potential drinking water related hazards and risks. This risk assessment process is conducted at least once every 36 months.

The Risk Assessment and Risk Assessment Outcomes describe in detail the methodologies and approaches taken to conduct these assessments and activities.

Where appropriate, the team identifies critical control points and establishes control measures to help mitigate or eliminate identified risks.

The risk assessment team meets at least once per year to determine the currency and validity of the risk assessments and their associated assumptions.

7.5 Associated System Level Document (SLD)

SLD 7 – Risk Assessments

7.6 References

Not applicable.

8. Element 8 - Risk Assessment Outcomes

8.1 Purpose

To describe the approach taken by the City of Markham to document the outcomes of the risk assessment activities.

8.2 Scope

This plan and associated procedures apply to the risk assessments conducted as per Element 7 – Risk Assessments.

8.3 Definitions

Not applicable.

8.4 Description

The results of the risk assessments are documented on the Risk Assessment Table. This table lists all risks, their assessed values, control measures, critical control points and associated control limits. Responses to instances where control limits have been breached are identified in the Standard Operating Procedure (SOP).

8.5 Associated System Level Document (SLD)

SLD 8 – Risk Assessment Outcomes

SLD 8a – Markham Distribution System Risk Assessment Table

SLD 8b – Markham Critical Control Point Table

8.6 References

Not applicable.

9. Element 9 - Organizational Structure, Roles, Responsibilities and Authorities

9.1 Purpose

To outline the organizational structure of personnel associated with Markham's Drinking Water System.

9.2 Scope

The organizational structure includes the Waterworks Division and associated departments, Commissioners and Owner as well as their associated roles, responsibilities, and authorities.

9.3 Definitions

Not applicable.

9.4 Description

The structure of the organization is depicted in the City of Markham's Organizational Chart.

The Corporation of the City of Markham is defined as both Owner of the Markham Drinking Water System as represented by Council, and the Operating Authority, as represented by the Waterworks Division.

Top Management is represented by:

- Chief Administrative Officer (CAO),
- Commissioner, Community and Fire Services, and
- Director, Environmental Services

Roles and responsibilities of personnel as they relate to drinking water quality are summarized in the System Level Document for Organizational Structure, Roles, Responsibilities and Authorities.

9.5 Associated System Level Document (SLD)

Not applicable.

9.6 References

Waterworks Organizational Chart

City of Markham Organizational Chart

SOP 9 – Organizational Roles, Responsibilities, and Authorities

10. Element 10 - Competencies

10.1 Purpose

To identify how the City of Markham ensures that personnel whose roles and responsibilities affect drinking water quality remain competent in order to ensure the ongoing operation of its Quality Management System (QMS).

10.2 Scope

This plan and associated procedures apply to the performance and management of all personnel of the Waterworks Division.

10.3 Definitions

Not applicable.

10.4 Description

The Training Section has developed a Training Model to identify and manage the knowledge, skills, and abilities of personnel responsible for operating the drinking water system.

Awareness of the importance of employee responsibilities and its impact on drinking water quality will be promoted through the following activities:

a) Communication of relevant legislative and regulatory requirements,
b) Communication of roles and responsibilities (as outlined in the Organizational Structure, Roles, Responsibilities and Authorities Procedure),
c) Regular review and updates of relevant policies and procedures, and
d) Communication and Review of the Training Model.

10.5 Associated System Level Document (SLD)

SLD 10 – Competencies

10.6 References

Training Model

11. Element 11 - Personnel Coverage

11.1 Purpose

To identify how the City of Markham ensures that competent individuals are available to fulfill the responsibilities needed for the ongoing operation of the Markham Drinking Water System.

11.2 Scope

This plan and associated procedures apply to all personnel that affect drinking water quality.

11.3 Definitions

Not applicable.

11.4 Description

The City of Markham will ensure that competent personnel are available at all times to fulfill duties that affect drinking water quality.

Competent personnel are available during normal hours of operation and on stand-by to perform work after hours and during emergencies.

The City of Markham shall ensure that all personnel included in the coverage schedules have the necessary skills and knowledge to perform the required responsibilities.

11.5 Associated System Level Document (SLD)

SLD 11 – Personnel Coverage

11.6 References

Personnel Coverage / Stand-by Schedule

12. Element 12 - Communications

12.1 Purpose

To identify the process for communicating information related to the Quality Management System (QMS) Operational Plan to appropriate internal and external parties, and outline the method for receiving and processing related communication.

12.2 Scope

This plan and applicable procedures apply to all internal and external communication related to the City of Markham's QMS.

12.3 Definitions

Owner and Operating Authority:
The Corporation of the City of Markham is defined as both the Owner of the Markham Drinking Water System as represented by Council, and the Operating Authority, as represented by the Waterworks Division.

12.4 Description

Internal Communication

The QMS Operational Plan will be made available to all staff of the City of Markham. Access to the Operational Plan will be provided through the intranet.

For Waterworks new hires, QMS awareness training will be provided by the QMS Representative. Existing Waterworks staff will be notified of changes to the QMS.

Internal training sessions will also be organized to identify and review all applicable QMS documentation and ensure that required personnel understand the content. Attendance will be documented through sign-in records.

Communication between the Operating Authority and the Owner will be managed by the QMS Representative. Information documented as a result of Management Review Meetings will be forwarded to the Owner in the form of a formal report.

External Communication

The QMS Policy and the QMS Operational Plan will be communicated to the public via the City of Markham's website. The QMS Policy will also be communicated to all suppliers and service providers during the formal tender process.

Responsibility

The QMS Representative will be responsible for ensuring that QMS related information is communicated to the appropriate internal and external parties.

12.5 Associated System Level Document (SLD)

Not applicable.

12.6 References

Element 2 – Quality Management System Policy

SLD 13 – Essential Supplies & Services

13. Element 13 - Essential Supplies and Services

13.1 Purpose

To describe the approach taken by the City of Markham to ensure that all supplies and services deemed essential for the delivery of safe drinking water are available and provided for when and where required.

13.2 Scope

This plan and associated procedures apply to all supplies and services considered essential to the supply of safe drinking water through the Waterworks Division.

13.3 Definitions

Suppliers:
Externally sourced vendors providing products or services, including sub-contracted services, related to drinking water safety and quality. The terms 'Vendors' and 'Suppliers' are used interchangeably within this document.

Quality Expectations/Specifications:
Any characteristic of essential supplies and services, including its timely delivery, deemed critical by the user department, for the provision of safe drinking water.

13.4 Description

Waterworks maintains a list of Essential Supplies & Services which describes and/or references methods for:

i) procurement of essential supplies and services,
ii) establishing and communicating quality expectations, and
iii) ensuring quality expectations are met accordingly.

For all supplies and services listed, Waterworks attempts, where possible, to multi-source and have an established, pre-approved supplier on call in cases of emergency.

In addition to the Essential Supplies and Services list, Waterworks is also subject to the policies and procedures set forth in the City of Markham Purchasing By-law.

13.5 Associated System Level Document (SLD)

SLD 13 – Essential Supplies & Services

13.6 References

City of Markham Purchasing By-law

14. Element 14 - Review and Provision of Infrastructure

14.1 Purpose

To identify the processes for the Waterworks Division to annually review the adequacy of the existing and planned infrastructure needed to ensure the ongoing supply of safe drinking water as per the Quality Management System (QMS).

14.2 Scope

This policy and procedure applies to the City of Markham's drinking water system.

14.3 Definitions

Not applicable.

14.4 Description

The review of the adequacy of existing infrastructure to supply safe drinking water for the City of Markham's drinking water distribution system is conducted as a four-tiered process:

i. The first review level is conducted in conjunction with the Region of York and the City of Markham, including Waterworks.
ii. The second review level is conducted in conjunction with Waterworks, Engineering and Planning Departments, which includes a review of servicing plans and growth site plans.
iii. The third review level is considered the Annual Review where capacity, life-cycles, conditions and general adequacy are examined. This is conducted by members of Waterworks.
iv. The fourth review level considers ancillary infrastructure adequacy including the review of vehicles/fleet, workspace, computer servers, etc.

Analyses and reports from the activities related to the maintenance, rehabilitation and renewal programs referenced in Element 15 serve as input into these regular reviews. The results and corresponding recommendations of these reviews are communicated to the Owner through the Management Review process.

14.5 Associated System Level Document (SLD)

SLD 14 – Review and Provision of Infrastructure

14.6 References

Not applicable.

15. Element 15 - Infrastructure Maintenance, Rehabilitation and Renewal

15.1 Purpose

This policy and associated procedures identify the maintenance, rehabilitation, and renewal programs that the City of Markham has in place for its drinking water system infrastructure.

15.2 Scope

This policy and procedure applies to the City of Markham's existing and planned water distribution system infrastructure.

15.3 Definitions

Planned Preventive Maintenance:
Scheduled maintenance of an infrastructure element.

Rehabilitation:
The process of repairing or refurbishing an infrastructure element.

Renewal:
The process of replacing the infrastructure element with new elements.

KPI:
Key Performance Indicator.

Unscheduled Maintenance:
Unplanned/emergency maintenance of an infrastructure element.

15.4 Description

The City of Markham's infrastructure maintenance program includes both preventive maintenance activity as well as unscheduled maintenance.

Planned Preventive Maintenance

The Operations and Maintenance Manager is responsible for ensuring that planned maintenance work is carried out according to associated standard operating procedures and/or work instructions.

Waterworks Supervisors are responsible for planning and administering the planned maintenance programs related to the City of Markham's Drinking Water System.

The areas of infrastructure that affect water quality and require inspection and preventive maintenance are identified below:

- Mainline valve,
- Air release valve,
- Check valve, and
- Pressure reducing valve.

The instructions and methods for this inspection and preventive maintenance program can be found in the corresponding procedures.

The nature and frequency of planned preventive maintenance conducted for each area of infrastructure is based, where appropriate, on manufacturer's recommendations,

industry standards, equipment manuals and output from Key Performance Indicators (KPI) analysis.

The adequacy and effectiveness of the planned preventive maintenance program is assessed at the annual Review of Infrastructure, where KPI's are reviewed and analyzed. KPI's are analyzed from data recorded in the Computerized Maintenance Management System. The Operations and Maintenance Management Team is responsible for the collection and analysis of data.

Unscheduled Maintenance

The Operations & Maintenance section is responsible for ensuring that unscheduled maintenance work is carried out according to the associated system level documents, standard operating procedures and/or work instructions.

Unscheduled Maintenance is done in reaction to system failure and/or reported or identified deficiencies.

Waterworks Supervisors are responsible for arranging unscheduled maintenance work.

Unscheduled maintenance is monitored for trends (KPI's) and assessed during the annual Infrastructure Review.

Rehabilitation and Renewal Program

The Waterworks Infrastructure Section is responsible for managing the rehabilitation and renewal programs and is also responsible for planning and budgeting.

The Waterworks Infrastructure Section utilizes the Water Reserve Study that identifies plans and capital requirements for a 25 year time horizon/model. Waterworks prioritizes requirements and determines the capital budget needs for rehabilitation and/or renewal of infrastructure, primarily based on this study.

Components of infrastructure renewal programs include:

- Watermain Cement Lining (One-Time Program),
- Cathodic Protection (20 year lifespan),
- Renewal of Watermains, and
- Renewal of Appurtenances, Service Connections, Valves, Hydrants, etc.

Maintenance Program Effectiveness

Data collected through the Computerized Maintenance Management System is extracted to analyze KPI's of the maintenance program. This is the responsibility of the Operations and Maintenance Manager.

At a minimum, annual reports are generated summarizing KPI performance.

KPI's for maintenance program effectiveness include:

- Number of Corrective Maintenance Work Orders for:
    - Main Breaks, and
    - Valves (All Types).

Results that indicate a lack of effectiveness and efficiency in the programs will be addressed through the Continuous Improvement process.

Communication to Owners

The Director of Environmental Services will communicate these findings to the Owner as per procedures outlined in the Management Review.

15.5 Associated System Level Document (SLD)

SLD 14 - Review and Provision of Infrastructure

15.6 References

Water Reserve Study

16. Element 16 - Sampling, Testing and Monitoring

16.1 Purpose

To describe the sampling, testing and monitoring program for drinking water quality.

16.2 Scope

These procedures apply to all sampling and testing, conducted either internally or by third party accredited laboratory.

The categories of sampling and monitoring activities in the City are:

- Regulatory Sampling, Testing and Reporting,
- Chlorine Residual Testing, and
- Regulatory Sampling, Testing and Reporting for System Interruption.

16.3 Definitions

Not applicable.

16.4 Description

The City of Markham Waterworks is responsible for establishing and maintaining sampling, testing and monitoring program that, at a minimum, meet regulatory requirements.

Regulatory Sampling, Testing and Reporting

There are sampling stations located throughout the distribution system where water samples are collected.

Frequency and location of sampling is determined to comply with regulatory requirements by designated Waterworks staff.

The samples are sent to an accredited laboratory for testing.

System Chlorine Residual Testing

System chlorine residual samples are collected and analyzed to comply with regulatory requirements at designated locations throughout the City.

Regulatory Sampling, Testing and Reporting for System Interruption

City of Markham Waterworks is responsible for provision of testing in special circumstances such as:

i. Emergency Repairs, and
ii. Scheduled Repairs.

16.5 Associated System Level Document (SLD)

SLD 16a – Sampling

SLD 16b – Testing

SLD 16c – Monitoring

16.6 References

Inter-Municipal Communication Protocol in Response to Operational and Water Quality Issues (maintained by The Regional Municipality of York)

17. Element 17 - Measurement and Recording Equipment Calibration and Maintenance

17.1 Purpose

To describe the calibration program for all water sampling, monitoring and/or testing equipment and devices.

17.2 Scope

These procedures apply to all devices, tools or equipment used by City of Markham's Waterworks staff for water quality samples and testing.

17.3 Definitions

Not applicable.

17.4 Description

Waterworks uses the following list of equipment for sampling and testing activities:

i. Colorimeter
ii. pH Meter
iii. Turbidity meter
iv. Fluoride Meter
v. Continuous chlorine analyzer

Equipment is uniquely identified by a serial number either on the item itself or on its container.

Equipment is subject to formal calibration and testing where appropriate. The calibration methods are unique to each item and performed as per manufacturer's recommendation and based on the Sampling and Testing Equipment chart in SLD 17.

17.5 Associated System Level Document (SLD)

SLD 17 – Calibration and Maintenance of Measurement and Recording Equipment

17.6 References

Manufacturers Maintenance Instructions

18. Element 18 - Emergency Management

18.1 Purpose

To describe the process used by the City of Markham Waterworks Division to identify emergency situations and to manage its response to these events.

18.2 Scope

The program relates to emergencies that directly relate to the safety of drinking water and the drinking water distribution system.

18.3 Definitions

Emergency:
Is a potential situation or service interruption that may result in the loss of the ability to maintain a supply of safe drinking water to consumers.

Emergency management:
Means identifying events related to drinking water quality or supply that could lead to emergencies, and having procedures and processes to prepare for, respond to and recover from those emergencies.

Emergency response:
Refers to the effort to mitigate the impact of an emergency on consumers.

18.4 Description

The City of Markham will use the risk assessment process to identify potential emergencies and consider specific emergency preparedness activities. These assessments will be reviewed on an annual basis and reassessed at least once every 36 months.

Waterworks Emergency Response Plan is a multi-level-emergency approach and for each potential situation identified, the appropriate Emergency Level Rating is assigned.

Each Emergency Level Rating requires a prescribed response protocol including the identification of roles and responsibilities. These protocols and responsibilities are detailed in the Emergency Management System Level Document, Standard Operating Procedure, and Process Flow Chart.

Employee training is conducted annually to ensure that the Emergency Response Plan is well-understood by those responsible for carrying out response activities. Through this training, the City of Markham Waterworks Division will ensure that all Waterworks staff is aware of:

a) Individual roles and responsibilities,
b) All relevant procedures,
c) Existing threats and hazards, and associated protective actions, and
d) Details and location of emergency equipment.

Training is in the form of classroom information sessions, desktop exercises, and where possible, mock emergency situation exercises.

In the event of an actual Waterworks emergency, the results of the response will be reviewed through the Management Review process.

An emergency contact list has been developed as part of the City of Markham's Waterworks Emergency Response Plan to ensure that the appropriate individuals will be contacted in the event of an emergency and that the necessary actions are taken to respond to the situation. This list is reviewed at a minimum on a yearly basis to ensure that it remains current.

18.5 Associated System Level Document (SLD)

SLD 8a – Markham Distribution System Risk Assessment Table

SLD 18 – Emergency Management

18.6 References

Corporate Emergency Management Plan

Waterworks Emergency Management Flow Chart

Waterworks Emergency Fan Callout Document

19. Element 19 - Internal Audits

19.1 Purpose

This plan outlines the methods for performing internal audits of the City of Markham's Quality Management System (QMS) to ensure that it has been properly implemented and conform to the requirements of the Drinking Water Quality Management Standard (DWQMS).

19.2 Scope

This plan applies to all 21 elements of the City of Markham's QMS.

19.3 Definitions

Non-Conformance is determined:

- When a procedure is not being followed as prescribed;
- Where objective evidence is not sufficient to support a claim that a procedure is followed accordingly; or
- Where the Operational Plan does not meet the requirements of the DWQMS.

19.4 Description

The City of Markham conducts internal audits on a regular basis to ensure that it is in conformance with established policies and objectives. The audit purpose is to evaluate the performance of the QMS against the specific requirements of DWQMS.

Details of Internal Audits program are described in the Internal Audits System Level Document.

19.5 Associated System Level Document (SLD)

SLD 19 – Internal Audits

19.6 References

Drinking Water Quality Management Standard

20. Element 20 - Management Review

20.1 Purpose

To identify the process by which the City of Markham periodically reviews the performance of the Quality Management System (QMS).

20.2 Scope

This policy and associated procedures apply to all Management Review meetings conducted by the City of Markham and any documentation associated with these meetings.

20.3 Definitions

SE:
System Engineering Section

O&M:
Operations & Maintenance Section

IMS:
Information Management System Section

INF:
Infrastructure Section

BC:
Business Compliance Section

DIR:
Director of Environmental Services

Top Management:
Chief Administration Officer, Commissioner of Community & Fire Services, and Director of Environmental Services

QMS:
Quality Management System

20.4 Description

Management Review is the process where Top Management considers various indicators within the QMS. The Management Review shall provide Top Management with appropriate and sufficient data to make decisions about the QMS, and record decisions or action items to prompt changes and improvements in the QMS.

At a minimum, one Management Review Meeting, covering the minimum agenda items (see below), will be conducted every twelve months to provide Top Management of the City of Markham with the information required to review and evaluate the continued suitability, adequacy, and effectiveness of its QMS.

The QMS Representative is responsible for scheduling and coordinating the Management Review and to ensure each agenda item (see below) is covered. The required attendees of the Management Review include: Top Management, the QMS Representative, and applicable Environmental Services Managers or designated Section Leads.

Management Review Meeting Agenda

The following Management Review agenda must be addressed, and the Sections responsible for each agenda item are listed in bracket below:

a) Incidents of non-compliance with applicable regulations (SE);
b) Incidents of adverse drinking-water tests (SE);
c) Deviations from critical control point limits and corresponding actions taken (SE, O&M);
d) The effectiveness of the risk assessment process (SE, BC);
e) Findings from internal and external audits (BC);
f) Emergency preparedness and response based on annual mock emergencies (BC);
g) Operational performance (O&M & IMS);
h) Trends in the quality of raw water supply and drinking-water (SE);
i) Previous Management Review meeting action items (BC);
j) Updates on action items identified between Management Review meetings (BC);
k) Changes to services, activities, regulations, etc. that could impact the QMS (BC);
l) Consumer feedback (IMS);
m) Resources needed for QMS maintenance (DIR);
n) Results of the infrastructure review (INF);
o) The currency of the Operational Plan (BC) and ;
p) Comments and suggestions made by personnel (IMS).

For each agenda item, reports are generated and presented by the responsible section. Minutes of the Management Reviews are documented, and shall include, at a minimum, the:

- List of attendees,
- Summary of issues discussed and decisions made, and
- Record of new and outstanding action items including an indication of responsibility and proposed timeline.

An information report outlining the results of the Management Review process will be submitted to the Owner by the QMS Representative or designate.

20.5 Associated System Level Document (SLD)

Not applicable.

20.6 References

Not applicable.

21. Element 21 - Continuous Improvement

21.1 Purpose

To outline the processes by which the City of Markham identifies, develops, and implements improvements to the Quality Management System (QMS).

21.2 Scope

The components of continuous improvement include:

1. Corrective and Preventive Actions, and
2. Opportunities for Improvement.

The entire QMS is subject to Continuous Improvement Procedures.

21.3 Definitions

Non-Conformance:
An instance where an aspect of the QMS has not been met according to specified standards and/or procedures.

***Corrective Action*:**
Actions taken to identify the root cause of a problem and apply actions to fix the identified problem.

Preventive Action:
Actions taken to identify the root cause of a problem and apply action to prevent the problem from recurring.

Opportunities for Improvement:
Ideas, suggestions or programs that serve to improve upon a process that has had a history of stability with few or no identified non-conformances.

21.4 Description

1. Corrective and Preventive Actions

Non-conformances can be identified outside the scope of the internal audit process (ref. Internal Audits).

All City of Markham Waterworks Division staff have the responsibility and authority to report when a QMS non-conformance has been identified.

When a non-conformance has been found, a Corrective Action Request (CAR) is issued by the person (or the person's supervisor) who identified the problem, or the QMS Representative is informed to issue the CAR. The CAR describes the problem and identifies the staff responsible to address the problem.

Upon receiving a CAR, the staff responsible for addressing the problem shall first validate the existence of the problem.

Root cause analysis is conducted to identify why the problem occurred. This is done using a team-approach, including any staff member that could have insight as to the problem's root cause. The root cause is recorded on the CAR.

Once the root cause has been identified, both *corrective* and *preventive actions* and measures are identified, documented and implemented by the team.

2. Opportunities for Improvement

All personnel are also empowered to offer suggestions and identify opportunities for improvement to the QMS and its performance. Ideas and suggestions can be generated and reviewed through the following methods:

1. After-Action Reviews, and
2. Environmental Services Staff Suggestions.

21.5 Associated System Level Document (SLD)

Not applicable.

21.6 References

Not applicable.

History of Changes

Revision	Date of Issue	Descriptions
1.0	April 16, 2008	Original issue
2.0	July 3, 2009	Changes in all sections of the Operational Plan to address: (1) Recommendations made from an audit in Feb. 2009, to provide better linkage of the Operational Plan and the System Level Documents (2) To clarify weak areas in the Operational Plan (3) Modify wordings used throughout the Operational Plan to make the document flow better
3.0	November 8, 2011	Changes to relevant sections of the Operational Plan to address: (1) Organizational Change in August, 2011. (2) Corrective Actions and Opportunities for Improvement provided by CGSB for the 2010 Surveillance Audit. (3) Opportunity for Improvement from the Mock QMS Audit and Annual Document Review
4.0	December 18, 2012	Changes to relevant sections of the Operational Plan to address: (1) Element 3 – Edited & Summarized information. (2) Corrective Actions provided by CGSB for the 2011 Surveillance Audit. (3) Organizational name change on July 1, 2012. (4) Opportunity for Improvement from the Mock QMS Audit and Annual Document Review.
5.0	April XX, 2015	Changes to relevant sections of the Operational Plan to address: (1) Opportunity for Improvement provided by NSF for the 2014 Surveillance Audit. (2) Opportunity for Improvement from the Full Scope DWQMS Audit, Internal Audits and Annual Document Review.