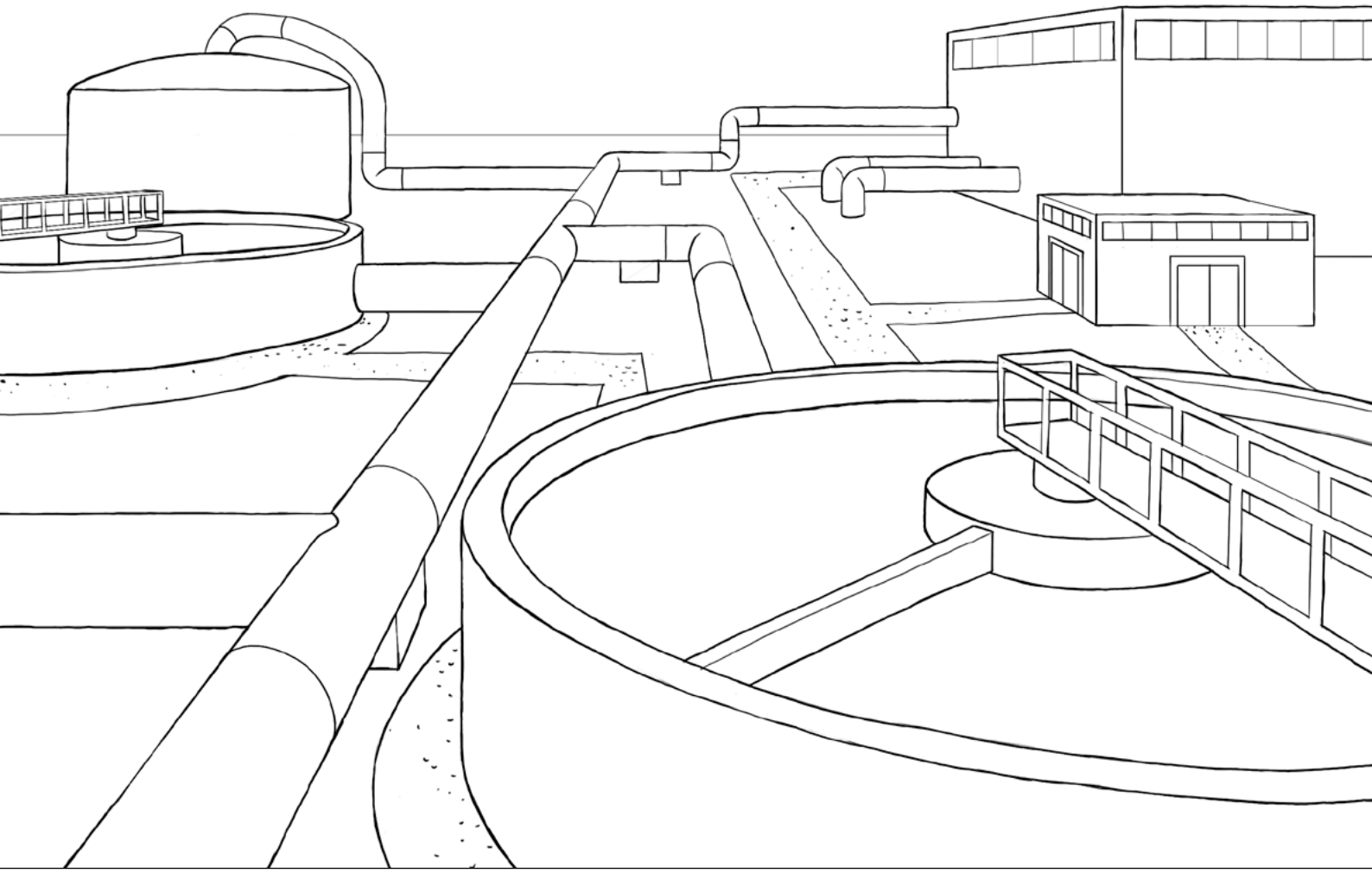
BEWOP

TOOL SERIES

Developing Quality Control Handbooks for Water and Wastewater Treatment

OPERATIONAL TOOL

GUIDELINES



GWOPA Global Water Operators' Partnerships Alliance

UN HABITAT FOR A BETTER URBAN FUTURE

UNESCO IHE DELFT

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BEWOP

Water Operators' Partnerships are peer support arrangements between two or more water and sanitation operators, carried out on a not-for-profit basis with the objective of strengthening operator capacity.

The Boosting Effectiveness of Water Operators' Partnerships (BEWOP) initiative is producing a series of guidance materials, tools and games to help WOP partners expertly plan and implement WOP partnerships and effectively learn and share knowledge with one another.

Two types of products feature in the second phase of this BEWOP initiative. Process Tools support WOP participants prepare for, design, implement and follow through with their WOPs. Operational Tools support in the transfer of knowledge on specific operational topics relevant for water utilities.

Find out more

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Foreword

This manual serves as a guide for the preparation of a Quality Control Handbook for processes related to water and wastewater treatment. A Quality Control Handbook describes activities and procedures necessary to ensure provision of quality products and services by a water utility. Proper documentation of the processes for water and wastewater treatment allows concerned employees to appropriately address, repair, and report to management any operational defects or deviations from standard operating procedures. Such a handbook also helps supervisors and managers to monitor the implementation of required procedures and offers information on the proper way of handling defects and deviations, once they occur. Moreover, the handbook serves as a document for resolving policy disputes on quality issues, as well as a platform for discussing ways to further improve operational efficiency and product/service quality.

The first chapter of this manual discusses the workshop format for developing the Quality Control Handbook. The workshop format is designed to be developed over four sessions. It follows a building block approach to formulate a holistic and comprehensive handbook for the provision of quality water. This approach follows standards of efficiency, safety, and environmental protection.

The second chapter provides a template for developing the handbook, with instructions on how to fill in the information required. The template also includes sections that already contain suggested wordings, which users may use as a whole, modify, or add to. Moreover, users of the template may include additional sections/information that they deem necessary for the purpose.

To assist users of this manual, copies of an actual workshop used for developing the Quality Control Handbook and two complete handbooks are provided in the annexes. These documents were developed by Waternet for their partner water utilities in South Africa, and provided the format and information necessary in developing this manual.

Contents

Chapter I
Developing a Quality Control Handbook

Introduction

This section provides a step by step discussion regarding the development of a Quality Control Handbook for a water or wastewater treatment plant. A workshop format has been chosen for the development of the handbook in order to channel the multiple knowledge inputs needed for it. For a proper. The workshop format targets participants coming from water or wastewater treatment facilities. These participants are expected to be knowledgeable of the operational activities of the plant and able to share their actual experiences. The successful implementation of this handbook depends on the creation of a setting in which the employees themselves act as both teachers and students.

Active participation is a key success factor, and practical demonstrations are necessary to supplement the theoretical aspects. The workshop format can be easily replicated and as such, helps facilitate the development of operating manuals in other water treatment facilities or water companies. Once completed, these manuals may be used to define the required skills of the operating personnel and may also be used for actual on-the-job training.

The handbook is to be finalized after successful completion of four group sessions. The first one aims at

Session 1

Objectives

- Define the main steps in the water-related process to assess
- Establish a realistic flow of work from the previously defined steps. This flow should describe in detail the procedures, tasks, and activities pertaining each step.
- Draft the structure of the handbook taking into account the tasks, means, maintenance, administration, and health, safety and environment requirements

Methodology

As a first activity, the participant will need to identify and define the different steps in the water or wastewater treatment process. These steps may be better defined by going to the plant and asking the process controller to perform each process step. These different steps form the bases for the workshop, as well as the chapters of the manual.

To better understand the methodology in developing the manual, the entire class will work as one group in defining a process step, preferably one of the more complicated steps in the process. In defining this process step, a “Brown Paper Session” will be used where the participants will be required to identify procedures, tasks, and activities that they consider important for the chosen process step. Each item will be written on a post-it paper, which will be posted on the wall. Next, the group will be required to classify the items into the following categories:

- *Tasks* – Required operational tasks; persons duty-bound to perform these asks, those responsible for overseeing such tasks are performed
- *Means* – Equipment, tools, and systems necessary in performing these tasks
- *Maintenance* – Maintenance concerns associated with each step; measures to address these concerns, responsible personnel
- *Administration* – Record keeping for different activities performed in each step, together with results; responsible personnel
- *Health, safety, and environment* – All environmental, health and safety concerns; measures to address these concerns; responsible personnel

Outcome

Based on the results of this session, the required activities for each selected step will be documented, and the complete draft will be reviewed in the next session.

This first session relates to sections 1.2-1.5 and 2.1-2.8 of the handbook template found in Chapter 2

Session 2

Objectives

- Revise and agree on the first draft of the selected steps of the handbook
- Describe and complement each step using in-depth information from the facility processes
- Include key additional information about laboratory testing, health and safety on the job, and any other topic deemed of importance

Methodology

The documentation for the selected step will be reviewed by the participants to allow them to check its accuracy and provide feedback. As much as possible, the draft should be in the participants' own words as this will allow them to recognize their inputs.

The participants will then be divided into smaller groups to work on the other process steps. Working in smaller groups helps ensures that everyone is able to participate actively. For each assigned step, the smaller group will again employ the Brown Bag Session to document the required tasks; means; maintenance; administration; and health, safety, and environment sections.

As an additional activity, laboratory tests for the different steps in the treatment process may be reviewed to compare how the different process controllers perform these tests. This activity offers the participants an opportunity to discuss the best practices for performing these tests and recording the results.

Without going into details yet about the method of holding a Toolbox Meeting, the group will be introduced to an interactive way of discussing health and safety on the job. (Guidelines for toolbox meetings will be discussed in Session 4). Possible topics for discussion may include the importance of personal protection equipment, use

of chemical data sheet, proper dosage of chemicals, and other important health and safety concerns. Actual on-site observation at the plant may help further explain the need to address these concerns.

Outcomes

Based on the results of this session, the required activities for each of the selected steps will be described in detail, and the complete draft will be finalized.

Session 3

Objectives

- Revise and update the previously defined draft handbook
- Introduce the principles of PDCA cycle and adapt them into the drafted handbook

Methodology

The session starts with a review of the drafts for the different steps that were examined in the previous session. Again, the sessions will be conducted in small groups to ensure everyone's participation in the discussions. Like before, the participants will be encouraged to decide for themselves as regards the best practices they will adopt and implement for the plant.

Following this activity, the participants will be introduced to the principles of "Plan-Do-Check-Act (PDCA)" to improve the quality of work related to the provision of water and sanitation services. Using examples from their daily work, emphasis will be made on the continuous application of the PDCA cycle and recording of the outcomes in data sheets to improve the quality of water in a more efficient way.

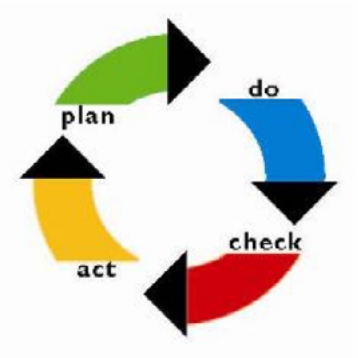
PLAN-DO-CHECK-ACT Cycle

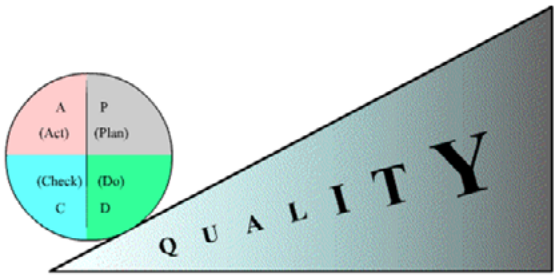
The steps in each successive PDCA cycle are:

PLAN	Make a plan including targets
DO	Carry out the plan
CHECK	Compare the results with the targeted results
ACT	Retain the results or make adjustments to reach targets

Note: Make sure to note the outcomes of each step in the datasheet.

The Deming (PDCA) Cycle





Outcomes

Using the small groupings again, the next activity involves reviewing and documenting the remaining steps of the water or wastewater treatment process. Similarly, the Brown Bag Session method will be used for this activity.

This first session relates to 1.2 Total Quality Management section of the handbook template found in Chapter 2

Session 4

Objectives

- Revise and update the previously defined draft handbook
- Introduce the guidelines for developing ToolBox meetings and include them into the drafted handbook

Methodology

The entire process, as documented during the last sessions, will be reviewed thoroughly by the entire group. Of particular interest would be the improvements that may be introduced throughout the whole process. The participants will be asked to engage actively in the discussions and think out of the box, especially when trying to decide on the best operating practices for their plant.

During this session, the guidelines for holding Toolbox Meetings will be explained. The discussion will answer the following questions:

- What is the Toolbox Meeting for?
- What subjects can be discussed during this meeting?
- How often is this meeting held?

Note that the Toolbox Meeting is an important component of the PDCA cycle.

Toolbox Meetings

A Toolbox Meeting is a group discussion, which enhances the awareness of the possible Health & Safety risks. The strength of the meeting lies in the direct link between work and the personal safety and health of the participants. The discussion is followed by an agreement on how to act on the subject.

Planning a Toolbox Meeting

When planning for a Toolbox Meeting, take the following into account:

1. One subject → on health & safety
2. Practical → directly applicable to the work
3. Short → 15 to 30 minutes
4. Interactive → stimulate group interaction
5. Instructive → educate and explain do's and don'ts
6. Agreement → on how to act and work together
7. Follow-up → check if agreements are met
8. Presence → preferably obligatory
9. How often → several times a year

A Toolbox Meeting should be short and deal with a clear subject on the health & safety of the participants. Each meeting starts with pointing out the risks and ends with making an agreement as a group on how to act on and avoid the risks.

When dealing with the subject, it is important to use facts (from reports, news articles, etc.). Make sure that correct information is given on the risks and procedures. But also emphasize behaviour. Is everything well prepared? Is it possible to work safely? Who can you reach if something goes wrong?

Outcomes

At the end of the workshop, certificates of participation may be awarded to the participants for their hard work in the upcoming effective quality control manual.

Chapter II
Quality Control Handbook Template

Foreword

This chapter provides a template for the preparation of a Quality Control Handbook for processes related to water and wastewater treatment. The template includes sections that are recommended to form part of the handbook, as well as explanations on how to fill in the information required for these sections.

Users of the template may include additional sections/information, which they deem necessary for operational improvement and quality control. Some sections already contain material, which the users may use as a whole, modify, or add to.

1. Introduction

This Quality Control Handbook has been developed to provide information on quality and reliability matters related to the operation of the (state name of water or wastewater plant), located in (state location). Intended for internal use of the water utility, this handbook helps benchmark performance and define quality goals for (state name of water or wastewater plant).

1.1 Purpose of the Manual

The Quality Control Handbook describes the goals and procedures necessary to ensure provision of quality products and services by the water utility. Since actual conditions on the ground are constantly changing, the handbook will need to be updated from time to time.

Proper documentation of the processes for water and wastewater treatment allows concerned employees to appropriately address, repair, and report to management any operational defects or deviations from standard operating procedures. In turn, the Quality Control Handbook helps supervisors and managers to monitor the implementation of required procedures and offers information on the proper way of handling defects and deviations, once they occur. Moreover, the handbook serves as a document for resolving policy disputes on quality issues, as well as a platform for discussing ways to further improve operational efficiency and product/service quality.

1.2 Total Quality Management

Every water utility must be able to demonstrate its capability to consistently deliver products and services that meet the quality levels required by customers and regulators alike. Furthermore, water utilities should always strive for enhanced customer satisfaction through continuous systems improvement and conformity to customer needs.

Discuss briefly the process approach according to ISO 9001:2015 and the Plan-Do-Check-Act (PDCA) cycle.

Example #1

With the aid of a "process approach", the company should identify *management responsibility, resource management, product realization,* and *measurement, analysis and improvement* as the four major processes of the Quality Management System.

The process-based quality management system in the following figure illustrates the linkages of these major processes and how to transform the customer requirements into product.

Management responsibility

Policy on quality management

Business planning

Management review

Resource management

Education and training regulations

Personnel workmanship certification

Agility equipment management

Product realization

Customer requirement management

Advanced product quality planning

Validation of processes for treatment of wastewater and service provision

Operations procedure / Work instruction

Measurement, analysis and improvement

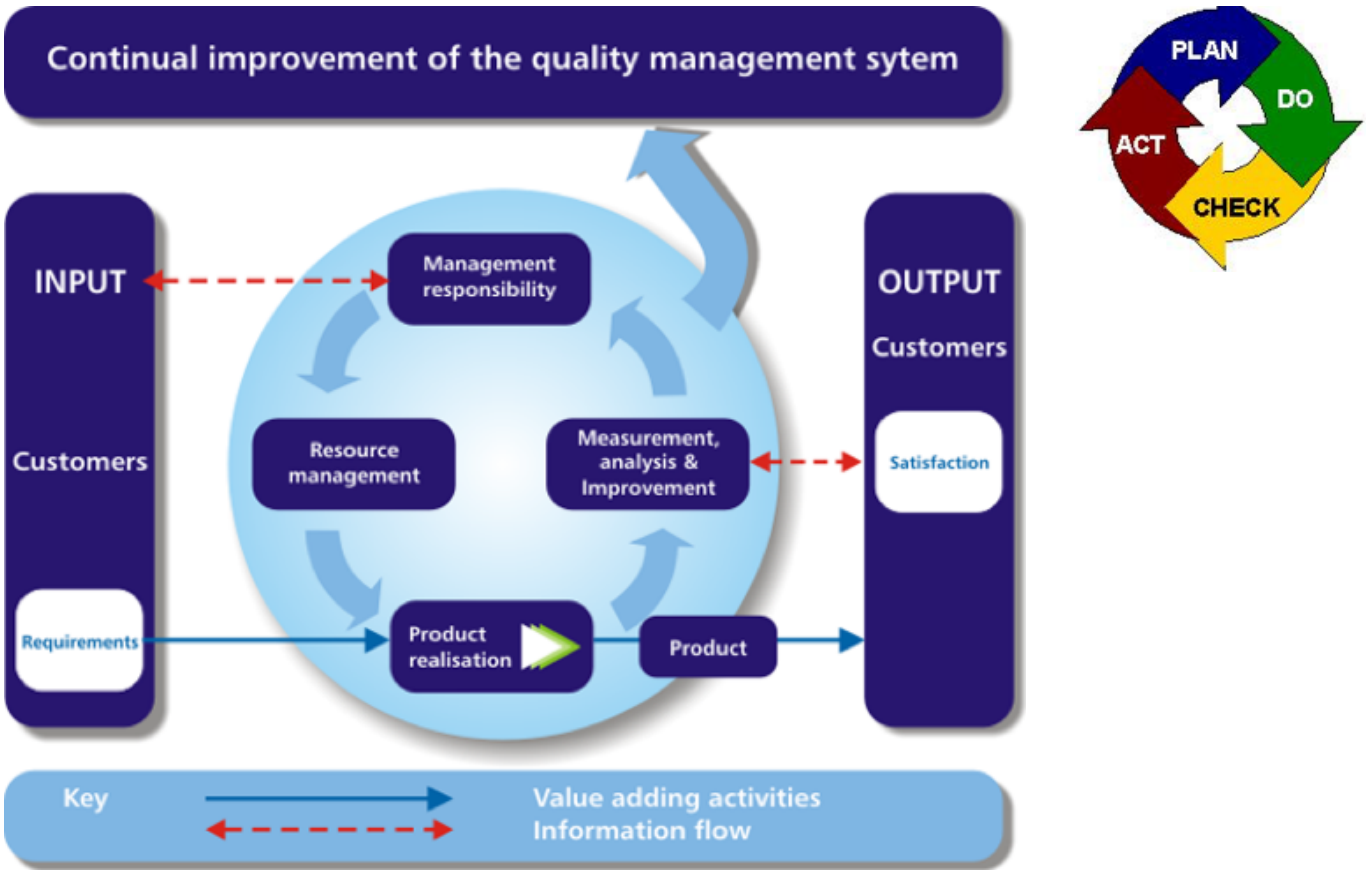
Customer satisfaction management

Internal audit

Process /Product monitoring

Quality improvement team

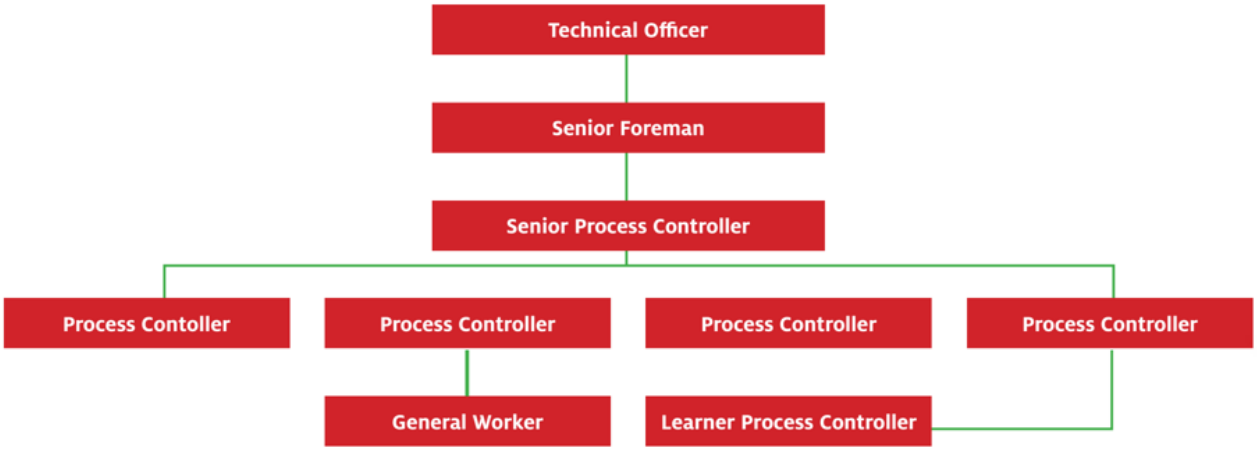
Quality Management System and Deming (PDCA cycle) for continuous improvement



1.3 Organization of the Water or Wastewater Treatment Plant

Show the organizational chart of the water or wastewater treatment plant, particularly in relation to the operational aspects.

Example #2



1.4 Background: *(State name of the city or municipality where plant is located / State name of water or wastewater treatment plant)*

Provide a brief description of the water or wastewater treatment facilities in the city or municipality.

Example #3

Theewaterskloof Municipality Water Service Areas

- 7 towns: Villiersdorp, Grabouw, Greyton, Caledon, Botriver, Riviersonderend, Genadendal
- 9 water treatment works
  - 2 conventional
  - 6 filtration
  - 1 borehole
- 7 waste water treatment works
  - 5 activated sludge systems
  - 2 pond systems
- Total population of 110,601 people

Note: You may use bullet points to provide information on the facilities.

Provide a brief description of the specific water or wastewater plant for which the quality control handbook is being created.

Example #4

Grabouw Water Treatment Work

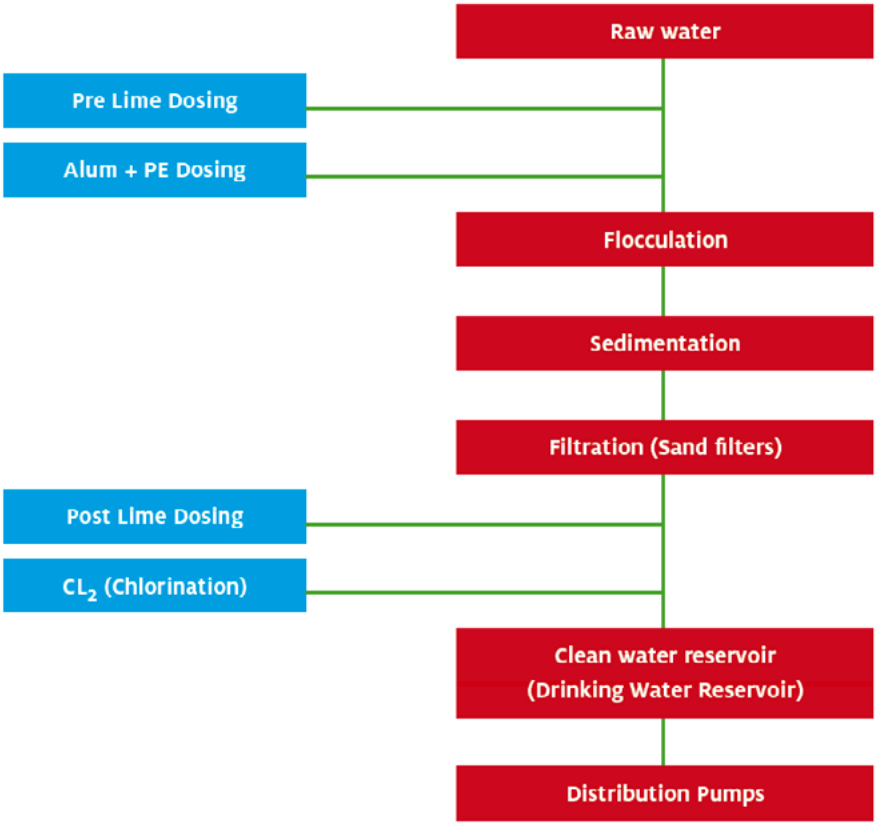
Production capacity:	15 Ml/day
Population served:	56,244 people
Water treatment plant:	Conventional

Note: You may use bullet points to provide information on the specific plant.

1.5 General Process Scheme

Draw the general process scheme for the water or wastewater treatment plant.

Example #5



2. Process Steps

For each step of the water or wastewater treatment process, provide the following information.

2.1 *(State Name of Process Step)*

State the procedure subject, procedure number, location of plant.

In tabular form, identify the person who prepared the procedures, the approving official, approval date, as well as the revision date (if necessary).

Example #6 Water Intake Pumping & Chemical Dosing

Procedure subject	Intake water
Procedure number	P 01
Location	Grabouw

Prepared by:	A. Guguian	Date: 20-08-2012	Approval date:
Approved by:	M. Schaap		
Procedure number:	P 01	Revision date:	Revision number:

2.1.1 Purpose

State the purpose of this particular step in the process.

Note: Pictures of actual operations may be included.

Example #7

The purpose is to pump raw water from the dam to the water treatment plant, to test the quality of raw water and to dose the right amount of chemicals.

2.1.2 Duties and Responsibilities

In tabular form, indicate the persons who are duty-bound to perform each task in the process step, as well as those who are responsible for overseeing that these duties are performed.

Example #8

Tasks		Technical Officer	Technical Foreman Drinkwater	Senior Process Controller	Process Controller	Learning Operator
D	Plant Start up (see checklist Start Up)				x	
R			x			
D	Plant Shut down				x	
R			x			

2.1.3 Means: Equipment, Information, Tools, Systems

Indicate the equipment, information documentation, tools, and systems used for performing the different tasks for each step of the process.

Example #9

Water Quality: pH meter, color meter, turbidity meter, measuring jar, jar tester, car (when SCADA system it's not working)
Chemical Dosing: gloves, goggles, face masks, working clothes, chemicals, stopwatch, safety boots

2.1.4 Environmental, Health, and Safety

All environmental, health, and safety concerns associated with each process step should be identified and the necessary measures to address these concerns properly laid out.

Example #10

- Ear protection when working in the pumping station
- PPE usage when working with chemicals (gloves, goggles, face masks, working clothes, safety boots)
- Good house keeping rules
- Extraction fan for the dust in the chemical room
- Safety data sheets for the chemicals (Alum, PE, Lime)

Safework procedures may also be presented in tabular form identifying what activities are necessary, who are responsible for them, how they should be done, and when.

Example #11

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Check Odour (container)	Process Controller	Check for odour problems and take action (check odour control unit, report)	Shift
Check Corroding on Bridge	Maintenance	Check for places with serieus corroding and take action (report and marking)	1x / month
Awareness of slippery surface	Everybody	Check for slipper walking pads and take action (cleanning and marking)	Always
Close cover on electric panels	Maintenance	Check for the closing of the covers of the panels.	Always

2.1.5 Maintenance Planning

All maintenance concerns associated with each process step should be identified and the necessary measures to address these concerns properly laid out. The same tabular format used in the previous section may be used.

Example #12

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Cleaning pump station	Pump inspection officer	Mark the activity in the log book in the pump station	When necessary
Greasing pumps	Pump inspection officer	Mark the activity in the log book in the pump station	Once a week
Turning on the gland packing	Process Controller	Call the handyman/ Mark the activity in the log book in the pump station	When necessary
Maintenance of the pumps	Pump inspection Officer	• Small failures – Handyman • Big failures – External Contractor • Mark the activity in the log book in the pump station	When necessary
Maintenance of the valves	Process Controller	Call the handyman to replace the valve if it's broken; Mark the replacement in the log book	When necessary
Switch the pumps	Process Controller	Rotate the pumps; Mark the rotation in the log book	Once a month
Flow meter calibration	Mechanical Officer	Call the Supervisor in order to announce the external contractor when flow meter needs to be calibrated; Mark the activity in the log book	When necessary
Open and close all the valves	Process Controller	Open and close all the valves periodically (otherwise the pumps will stuck)	Once a month

2.1.6 Administrative Handling

The same tabular format may be used for keeping the records on the different activities performed, as well results related to flow measurements, laboratory/chemical tests, and the like.

Example #13

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Flow meter measurements	Process Controller	Two measurements: total flow and flow in liters per second	Every day
Water quality results	Process Controller	pH is written down on the lab sheet and copied one time per week in the log book	Every hour / one time per week
Activities regarding the maintenance	Process Controller / Handyman / Mechanical Officer / Pump inspection Officer	Write down the activities in the log book of the pump station	When you have completed the activity

2.1.7 Description of Procedures / Instructions / Time Frame

For process step under consideration, identify the required procedures, provide the instructions necessary to carry out the procedures, and state the time frame for each procedure.

Example #14

Process description	Instruction	Time frame
Start up procedure		
Dosage of chemicals	Poly-electrolyte dosage: switch the key on control panel and then press start (green) button; Alum dosage: switch the key on control panel and then press start (green) button; Lime dosage: switch the key on the control panel and then press start button at the panel near the lime mixing	At start up of the plant
Go to pumpstation Worcester	Press start (black) button on controll panel OR start the pump of Worcester on the telemetry at the water treatment plant	At start up of the plant
Go back from the pump station Worcester to the water treatment plant and wait for flow of raw water		30 minutes
Check dosage of chemicals	Use a stopwatch and measurement cilinder(1000 ml); Alum (10 seconds – 90 ml); Poly-electrolyte (10 seconds – 120 ml); Lime dosage is determined by pH: if pH<5,2, then you dose lime, if pH > 5,6 no dosage of lime is necessary	After one hour the plant starts Every hour
Flow	Read the flow meter of raw water of the new plant, in control panel space; write the measurement in log book - total flow and flow(l/sec)	Every shift
Sample raw water with chemicals	Take sample of raw water on the roof of the new sedimentation tank, at the lid	Every hour
pH measurement in lab of a sample of raw water with chemicals	Switch on the pH meter; Put the meter in Buffer 4, wait until the meter is stable, ph = 4; Flush the meter; Put the meter in Buffer 7, wait until the meter is stable, pH = 7; Flush the meter; Put the meter in Buffer 4 again until is stabile; pH = 4; Flush the meter; Put the meter in a sample of raw water with chemicals, wait until the meter is stable, pH 5,2 - 5,6; write down measurement on labsheet; Flush/ clean the meter; Leave the meter in the buffer (4 or 7).	Every hour

2.1.8 for Other Steps of the Water and Wastewater Treatment Process

Repeat the exercise for all steps in the process. Make sure that all vital activities, tasks information, and documentation are included. However, also make sure that the users are not subjected to information overload, and may easily follow the instructions and recommendations provided in the manual. Examples of operation manuals for water and wastewater treatment plants are provided in the next section.

Annex 1
Actual Workshop: Water Treatment Plant – Grabouw, Theewaterskloof, South Africa

Introduction

The purpose of the workshop for the Municipality of Theewaterskloof was to deliver an operational manual and checklists for and by the employees of the drinking water plant of Grabouw. However, one of the objectives was also to improve the quality of the water through skills development.

The method used to produce the manual is by means of a workshop. The workshop took place in four days, in which participants were exposed to specific knowledge and experience on the treatment of water. Most of all, the participants could share knowledge and their experience, thus creating a setting in which the employees themselves were both teacher and student. In this form of training, active participation is key. While a subject is explained in theory, it is also demonstrated in practice.

The workshop can be repeated for the same purpose at the other water treatment plants of the Municipality of Theewaterskloof. Thus improving the quality of both drinking and waste water, as well as producing up-to-date manuals and checklists. The manuals and checklists can be used to define the required skills development per plant and can be used for training purposes on the job.

The Workshop – Day by Day

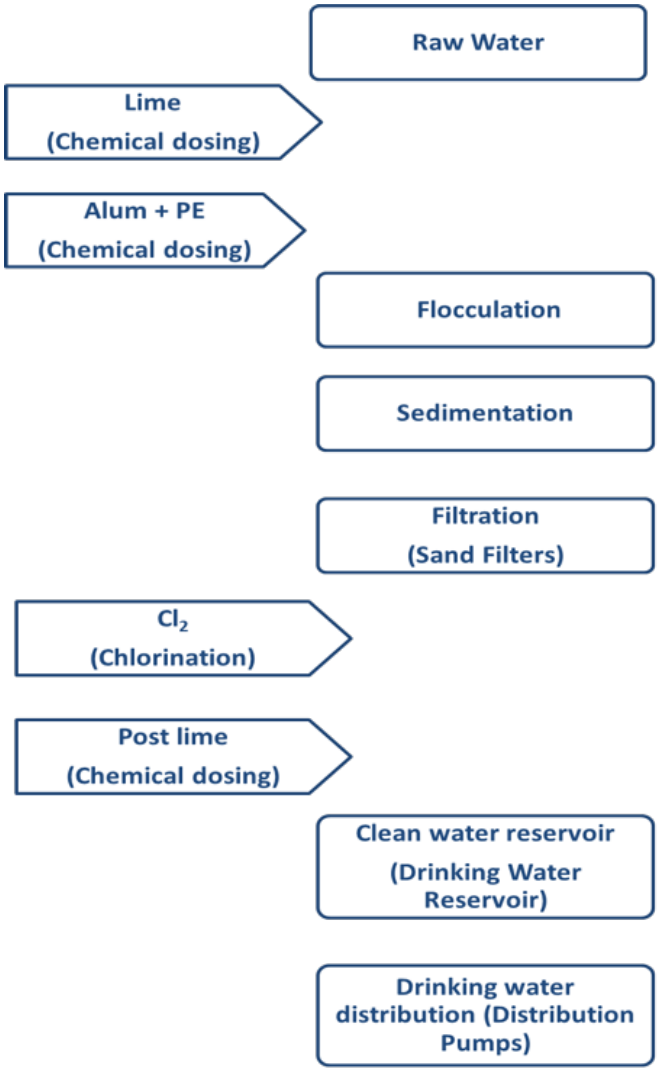
As the workshop took place on the premises of the plant, the group kicked-off with a tour of the plant. One of the more experienced process controllers hosted the kick-off and showed the group around. This created a setting in which the main goal of the week became clear: a manual by and for the employees of Theewaterskloof.

Day 1

Define the Process

First, the different steps in de process to make drinking water were defined. These steps were defined by actually going to the plant and having a process controller perform the process step.

These different steps defined the basis of the workshop and the chapters of the manual.



In order to explain the method used during the workshop, the first process step was dealt with as a group together. To have all participants understand the method and to be able to repeat during the rest of the week, one of the more complicated steps was chosen.

Here, the moderator has to make sure that everyone understands the instructions and feels free to participate.

Work out one of the Process Steps by a Brown Paper Session

When using this 'brown paper' method, make sure that all participants can write!

The participants were asked to write down all the steps and activities necessary for **sedimentation** on post-its. One item per post-it. Items that they personally found of importance.

If participants hesitate to write down something, the moderator or specialist can give some examples by writing down a task on a post-it.

The next step was to put all post-its on a large sheet on the wall. Originally this sheet was brown wrapping paper, hence the name "Brown Paper Session".

Make sure the sheet is big enough, in order to be able to move the post-its around and form groups.

Then, the group (with the help of the moderator and specialists) categorized the post-its into five categories:

1. Tasks
2. Means (equipment)
3. Maintenance
4. Administration
5. Health, Safety & Environment

While doing this exercise, it was noted that some of the positions in the "organization chart" had been vacant for some time or were unknown. The employees explained that they worked in three shifts and that they operated the plant, during that shift, alone. Being there alone, they could not perform all the required tasks and duties as they should. To overcome this problem, they simplified some of the proceedings, in order to be able to operate the plant. During some of these discussions, it was recognized that it would be useful to add checklists to the manual of several of the main tasks on the plant. This way, less experienced process controllers will have reference charts to use when operating the plant alone and when having to deal with new situations.

Day 2

Feedback on the draft Manual

The participants were shown the draft manual of the sedimentation step the group worked on the day before. At this time the participants were given the opportunity to give feedback on the manual and check if all the steps are correct. The group also decided on having the manual and the checklists translated into Afrikaans, as the employees speak Afrikaans as a first or second language.

The manual should be in the participants' own words and they should be able to recognize their input.

Proceed with Process Steps

To make sure that all participants were able to give their full input, the group was split up into three smaller groups. Each group looking into one of the process steps, under the supervision of one of the specialists from Groningen Water Company or Waternet. The smaller groups went through different steps, using the same 'brown paper session' as the day before.

The following steps of the process where looked into on day 2:

- Flocculation
- Filtration (Sand filters)
- Raw Water Intake
- Chemicals (Lime, Alum, Poly Electrolyte)

Again the five categories were taken into account and if checklists were needed, they were also looked into. The method for drawing up the checklists was also by means of performing the tasks step by step on the plant or in the lab, so nothing could be overlooked.

The lab tests of the different steps of the process were also performed. Here the participants could see how the other process controllers performed the tests. They were able to talk about best practice and discuss why certain procedures should be done. The need for a format datasheet was stated and also the need for better knowledge on how to perform the lab tests, next to the need of having all the proper equipment and agents for the tests in the lab.

Introduction of Toolbox Meeting

On day 2 the group elaborated on Health, Safety & Environment. Without emphasizing the method of a "Toolbox Meeting", the group was introduced to an interactive way of talking about Health & Safety on the job. Later in the week the method was repeated and explained.

The Dutch specialists gave a short lecture on the importance of Personal Protection Equipment, why one should read the chemical data sheets and what is the correct place to have them. Special attention was given to the dosing of the chemicals. Why are the chemicals used? How do they react? What Health & Safety issues should be taken into account?

A small group went over the plant and pointed out some safety issues. Some of these issues were taken care of on the spot, by showing how one can fix things easily, with personal safety as the main objective.

Day 3

Feedback on the draft Manual

Again, the day started with the participants commenting on the added steps to the manual and the checklists of the day before. This morning the feedback was given in smaller groups, so all participants were able to give their input and to improve the manual and checklists. Again, discussions took place amongst the participants, in which they decided on best practice.

Introduction of PLAN-DO-CHECK-ACT

In a short lecture given by the moderator, the principles of PLAN-DO-CHECK-ACT were introduced, in order to improve the quality of work and the quality of the water. The principle was explained by illustrating the proceedings of the lab tests. The participants were explained that they already do a lot of the work by the PLAN-DO-CHECK-ACT principle. By using the cycle consciously and writing down the outcomes in a datasheet, they are able to develop their skills as process operators and improve the quality of the water in a more efficient way.

Proceed with Process Steps

Next, the last steps for the manual and checklists of the process were dealt with in the three groups under the supervision of one of the specialists from Groningen Water Company or Waternet. Again, the 'brown paper' method was used.

Toolbox Meeting on Chlorination

As Chlorination is one of the most dangerous steps of the process, a lecture was given on all the facets of working with this gas by one of the Dutch specialists. Also, a checklist was made, focusing on Health & Safety and the consequences of not properly performing the necessary proceedings. During the group discussion on the Chlorination, it was stated that a lot of improvements should occur on the PPE. For instance, it became clear that the filter on the gasmask had been expired for a long time and was in need of replacement.

Day 4

Finalizing the Process Steps and Improvements

The group went through all the process steps and the checklists in order to give their final comments. While doing this, the group aimed to have a discussion on possible improvements to the process. One of the improvements, which was already suggested by one of the Dutch specialists earlier in the week, was performing the backwashing differently. At this stage, the group was open to suggestions and initiated an experiment. All saw the advantage and seemed eager to find a way to incorporate this improvement in the process.

As a result of the discussions of today and earlier this week, the participant from the Overberg Water Company invited the process controllers to his plant. This plant is more advanced and all process controllers gladly accepted the invitation from Overberg. This invitation is a wonderful spin off to the workshop, as the effectiveness of working on skills and operational development with other local plants is much higher and more likely to sustain.

Explanation Toolbox Meetings

During this session, also the principles of a Toolbox Meeting were explained. What is it for? What subjects can you discuss? How often can you do it? Again the Plan-Do-Check-Act cycle was explained in this context.

Certificates

The workshop was finalized by a motivational speech by Conrad van Heerden, Director of Technical Services. Conrad van Heerden emphasized that this manual is not just a paper, but it is made and owned by the process controllers. By taking part in this workshop, they also developed the skills to update their own manual and to take responsibility for making healthy water for the people of Theewaterskloof.

At the end of the workshop all participants were handed a certificate and a token of appreciation from the Dutch delegation. The certificate was signed and handed out by Conrad van Heerden, Director of The Technical Services of Municipality of Theewaterskloof, Mark Schaap, Waterbedrijf Groningen and Milla van Kempen, Waternet Academy.

Suggestions on using the manual and checklists on a regular basis

- Go over the manual and the checklists at least once a year with all the employees of the plant. Improve the manual and checklists if necessary annually.
  - This can be done by a senior process controller or the technical officer, under the supervision of one of the managers of Theewaterskloof.
- Have Toolbox Meetings several times a year on subjects such as chemicals, PPE, lab testing etc.
  - This can be done under the supervision of the Health & Safety Officer, presided by the technical officer.
- Make sure the new part of the plant is handed over WITH a proper implementation training for all the employees and add instructions to the Operational Manual.
- Share best practice with other local treatment plants.

Suggestions on improving operations in relation to Blue Drop Requirements

While making the manual, it became clear that some of the tasks could not be performed as needed, due to ambiguities in the administrative of managerial process. For instance, the testing of the aluminum levels was not performed for some time, as it was assumed that there was no officer responsible for procurement of the aluminum agents. According to the Blue Drop Requirements, the aluminium testing is one of the most important tests to perform for this particular plant.

As the process controllers work the shift alone, it is necessary to have well-functioning reporting lines. At the moment reports are made per shift, but problems or questions remain unanswered, as it is not clear who to turn to or who is responsible to solve the issue. This can be overcome if, for instance, the Technical Officer is on the plant every day to talk to the process controller on duty, go through the reports and data sheets and personally look into any problem which cannot be solved by the process controller. Furthermore, he can monitor the level of the aluminium in the datasheets in relation to the Blue Drop Requirements.

The current Technical Officer has a lot of knowledge and understanding of the plant, which is of great use. The overall performance of the plant can increase, and thus meet up to the Blue Drop Requirements, if he can focus more on the operations of the plant. He can do this together for instance with a more experienced process controller.

APPENDIX 1

Moderator of a Workshop or Toolbox Meeting

A moderator is the person who leads the workshop or Toolbox Meeting. He or she determines the programme and makes sure that the group and specialists stick to the subject. He stimulates interaction between the participants and specialists. A moderator intervenes when necessary and stimulates a positive setting. This can be done for instance by changing the form used of the workshop or changing the formation or size of the group. Above all, a moderator is responsible for creating a safe setting, in which participants feel free to interact.

As a moderator, make sure to

- Set a clear goal (what is the purpose of the workshop or meeting)
- Make a timeframe and a clear programme
- Interact with all participants
- Stimulate input, also from less talkative participants
- Intervene when necessary (in a respectful manner)
- Alternate between giving information and inquiring
- Actively inquire about the experience and opinions of the participants
- Help to turn objections into possibilities
- Listen, summarize and inquire
- Visit the venue before the session
- Check if all you need is present well before starting (flip over, markers, post-its….)

APPENDIX 2

Toolbox Meetings

A Toolbox Meeting is a group discussion, which enhances the awareness of the possible Health & Safety risks. The strength of the meeting lies in the direct link between work and the personal safety and health of the participants. The discussion is followed by an agreement on how to act on the subject.

Planning a Toolbox Meeting

When planning a Toolbox Meeting, take the following into account

1. One subject → on health & safety
2. Practical → directly applicable to the work
3. Short → 15 to 30 minutes
4. Interactive → stimulate group interaction
5. Instructive → educate and explain do's and don'ts
6. Agreement → on how to act and work together
7. Follow-up → check if agreements are met
8. Presence → preferably obligatory
9. How often → several times a year

A Toolbox Meeting should be short and deal with a clear subject on the health & safety of the participants. Each meeting starts with pointing out the risks and ends with making an agreement as a group on how to act on and avoid the risks.

When dealing with the subject, it is important to use facts (f.i. use reports, news articles, etc.). Make sure that correct information is given on the risks and procedures. But also emphasize behaviour. Is everything well prepared? Is it possible to work safely? Who can you reach if something goes wrong?

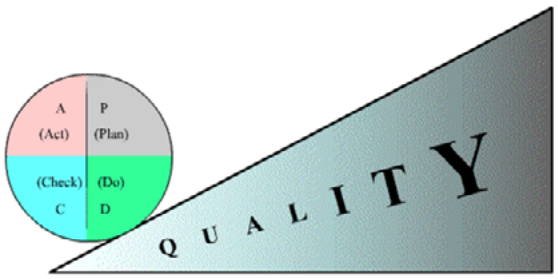
APPENDIX 3

PLAN-DO-CHECK-ACT CYCLE

The steps in each successive PDCA cycle are:

PLAN	make a plan including targets
DO	carry out the plan
CHECK	compare the results with the targeted results
ACT	retain the results or make adjustments to reach targets

Make sure to note the outcomes of each step in a datasheet.



Annex 2
Actual Quality Control Handbook: Water Treatment Plant – Grabouw, Theewaterskloof, South Africa

1

Operational Manual Grabouw
Quality Control Handbook

Project name	**WOP South Africa - Netherlands**
Date	**31 August 2012**
Status	**Final**
Authors	**Grabouw**

Theewaterskloof Municipality

Table of content

1 Introduction

3

This handbook has been developed to provide information on the quality and reliability aspects of the operations of drinking water production plant located in Grabouw.
These quality-related materials are created for internal use as a benchmark for performance, and internally they define Grabouw water productions plant's quality goals. The handbook does not constitute plant specification. The employees of Grabouw water production location must work hard to follow these procedures and internal "requirements," and seeks to provide to customers acces to safe and reliable water.

1.1 Purpose of the Manual

The Quality Control Handbook contains the procedures and goals pertaining to quality needed in creating services and products. The Quality Control Handbook has to be constantly updated and improved to meet changing needs.
Each and every one is responsible for repairing or reporting to management defects in processes of production, or for deviating from the instructions stated in the handbook. Supervisors are responsible for handling deviations or defects according to instructions.
The manager, or other nominated person, sees to it that employees abide by the instructions set forth in the handbook and (s)he also interprets, searches for and provides guidance in solutions pertaining to quality. The manager also ensures that possible changes meet the demands of the clients, authorities, and other external bodies. When making changes, issues concerning productivity, occupational safety and obligations must be taken into consideration.
The manager is also a key person in solving disputes, and (s)he is responsible for the company's quality policies. Issues pertaining to quality and the measures arising from them are discussed together with the staff.

1.2 Blue Drop Requirements / Benchmarking

Long term planning is improved by introducing the "Blue Drop Report". Water safety plans and monitoring programs are now required.
The Integrated Development Plan (IDP) is the municipality's principal strategic planning document. The "Financial Plan", the "Spatial Development Framework" and the "Performance Management System" of the municipality form the basis for the IDP

Structure

Section 27 of the Bill of Rights: "Everyone has the right to have access to sufficient food and water."
Water Services Act (108 of 1997):

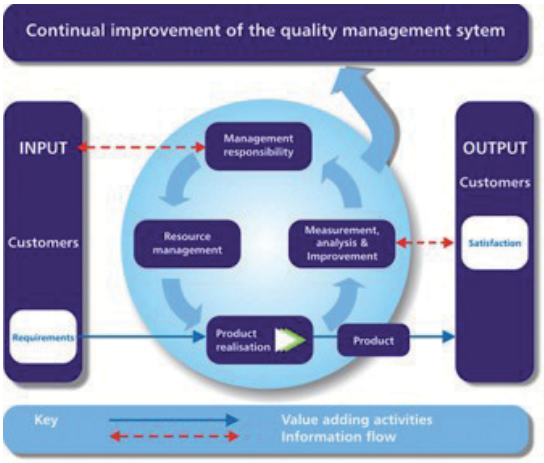
- Water services authority (Municipality or Metropolitan) is responsible for ensuring acces to water.
- Water service provider physically provides the water supply to consumers
- Water board provides water services to other water services institutions.

The Department of Water Affairs of initiated the drinking water quality (DWQ) regulation program (Blue Drop Report). The objective is to ensure drinking water quality by means of compliance monitoring. Currently, each municipality has its own payment system, with different rules, standards and pricing.

1.3 Total Quality Management

4

Every water company should demonstrate its ability to consistently provide products and services that meet customers and applicable regulatory requirements and to enhance customer satisfaction through the effective application of the system including processes for continual improvement of the system and the assurance of conformity of customer requirements.
With aid of "process approach", the company should identify "Management responsibility", "Resource management", "Product realization", "Measurement, analysis and improvement" as its 4 major processes of the Quality Management System.
The process-based quality management system in the following figure illustrates the linkages of the 4 major processes and how to transform the customer requirements into product.



Management responsibility

- Policy on Quality Management
- Business Planning
- Management Review

Resource management

- Education and Training Regulations
- Personnel Workmanship Certification
- Agility equipment management

Product realization

- Customer Requirement Management
- Advanced Product Quality Planning
- Validation of processes for production and service provision
- Operations procedure & Work instruction

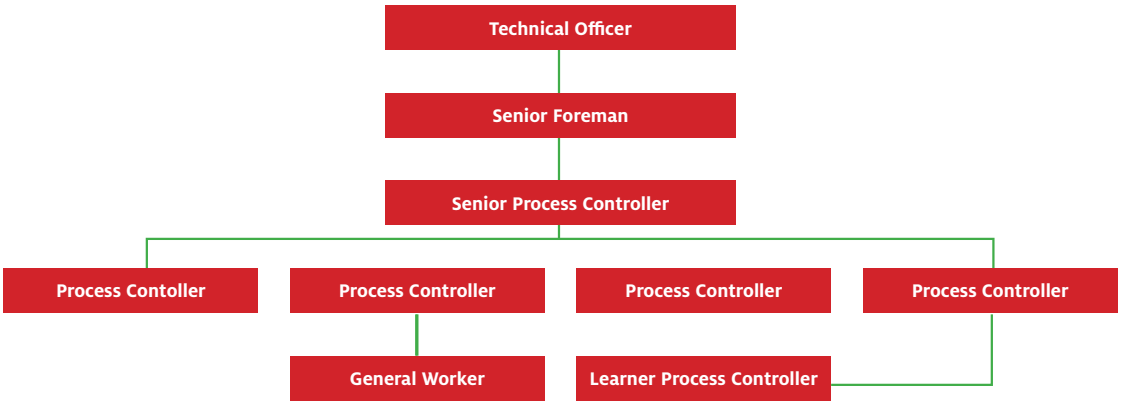
Measurement, analysis and improvement

- Cutomer Satisfaction Management
- Internal Audit
- Process / Product Monitor
- Quality Improvement Team

5

Deming (PDCA cycle) for continuous improvement

1.4 Organization of the Drinking Water Plant



1.5 Background Grabouw

Theewaterskloof Municipality Water Service Areas

- 7 Towns: Villiersdorp; Grabouw; Greyton; Caledon; Botrivier; Riviersonderend; Genadendal
- 9 Water Treatment Works (WTW)
  - 2 Conventional
  - 6 Filtration
  - 1 Borehole
- 7 Waste Water Treatment Works (WWTW)
  - 5 Activated Sludge systems
  - 2 Pond systems
- Total population of 110,601 people

Grabouw Water Treatment Work

Production capacity	15 Ml/day
Population served	56.244 People
Type Water treatment Plant	Conventional

1.6 Process scheme

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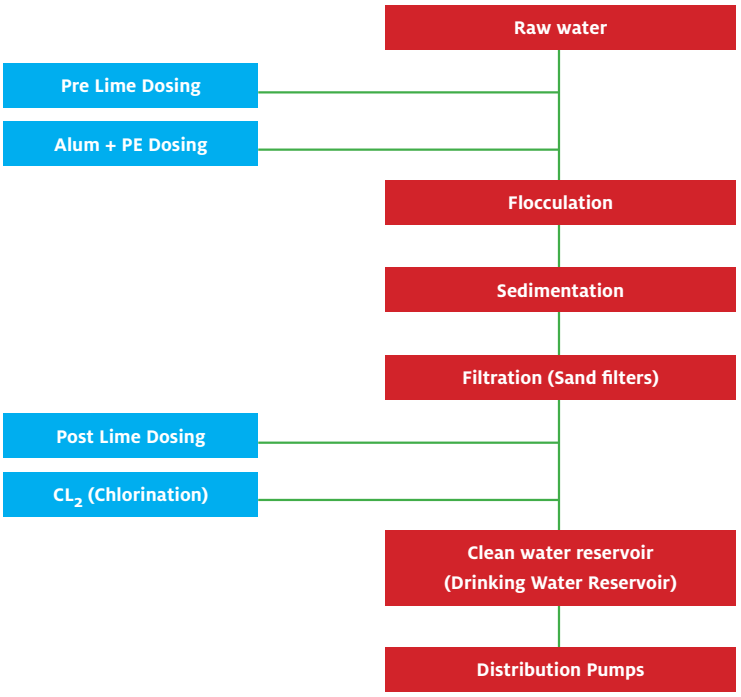

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P 01. Process Step Water Intake Pumping Station and Chemical Dosing

Procedure subject	Intake water
Procedure number	P 01
Location	Grabouw

Prepared by:	A. Guguian	Date: 20-08-2012	Approval date:
Approved by:	M. Schaap		
Procedure number:	P 01	Revision date:	Revision number:

P 01.1. Purpose

The purpose is to pump raw water from the dam to the water treatment plant, to test the quality of raw water and to dose the right amount of chemicals.

P 01.2. Application

This instruction applies to all responsible for the intake of raw water.

P 01.3 Duties and responsibilities

Tasks		Technical Officer	Technical Foreman Drinkwater	Senior Process Controller	Process Controller	Learning Operator
D	Plant Start up (see checklist Start Up)				x	
R			x			
D	Plant Shut down				x	
R			x			

P 01.4 Means: information, tools, systems 8

Water Quality: pH meter, color meter, turbidity meter, measuring jar, jar tester, car (when SCADA system it's not working)
Chemical Dosing: gloves, goggles, face masks, working clothes, chemicals, stopwatch, safety boots

P 01.5 Environment, health and safety

- Ear protection when working in the pumping station
- PPE usage when working with chemicals (gloves, goggles, face masks, working clothes, safety boots)
- Good house keeping rules
- Extraction fan for the dust in the chemical room
- Safety data sheets for the chemicals (Alum, PE, Lime)

P 01.6 Maintenance planning

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Cleaning pump station	Pump inspection officer	Mark the activity in the log book in the pump station	When necessary
Greasing pumps	Pump inspection officer	Mark the activity in the log book in the pump station	Once a week
Turning on the gland packing	Process Controller	Call the handyman/ Mark the activity in the log book in the pump station	When necessary
Maintenance of the pumps	Pump inspection Officer	• Small failures – Handyman • Big failures – External Contractor • Mark the activity in the log book in the pump station	When necessary
Maintenance of the valves	Process Controller	Call the handyman to replace the valve if it's broken; Mark the replacement in the log book	When necessary
Switch the pumps	Process Controller	Rotate the pumps; Mark the rotation in the log book	Once a month
Flow meter calibration	Mechanical Officer	Call the Supervisor in order to announce the external contractor when flow meter needs to be calibrated; Mark the activity in the log book	When necessary
Open and close all the valves	Process Controller	Open and close all the valves periodically (otherwise the pumps will stuck)	Once a month

P 01.7 Administrative handling

9

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Flow meter measurements	Process Controller	Two measurements: total flow and flow in liters per second	Every day
Water quality results	Process Controller	pH is written down on the lab sheet and copied one time per week in the log book	Every hour / one time per week
Activities regarding the maintenance	Process Controller / Handyman / Mechanical Officer / Pump inspection Officer	Write down the activities in the log book of the pump station	When you have completed the activity

P 01.8 Process description / instruction / time frame

Process description	Instruction	Time frame
Start up procedure		
Dosage of chemicals	Poly-electrolyte dosage: switch the key on control panel and then press start (green) button; Alum dosage: switch the key on control panel and then press start (green) button; Lime dosage: switch the key on the control panel and then press start button at the panel near the lime mixing	At start up of the plant
Go to pumpstation Worcester	Press start (black) button on controll panel OR start the pump of Worcester on the telemetry at the water treatment plant	At start up of the plant
Go back from the pump station Worcester to the water treatment plant and wait for flow of raw water		30 minutes
Check dosage of chemicals	Use a stopwatch and measurement cilinder(1000 ml); Alum (10 seconds – 90 ml); Poly-electrolyte (10 seconds – 120 ml); Lime dosage is determined by pH: if pH<5,2, then you dose lime, if pH > 5,6 no dosage of lime is necessary	After one hour the plant starts Every hour
Flow	Read the flow meter of raw water of the new plant, in control panel space; write the measurement in log book - total flow and flow(l/sec)	Every shift
Sample raw water with chemicals	Take sample of raw water on the roof of the new sedimentation tank, at the lid	Every hour
pH measurement in lab of a sample of raw water with chemicals	Switch on the pH meter; Put the meter in Buffer 4, wait until the meter is stable, ph = 4; Flush the meter; Put the meter in Buffer 7, wait until the meter is stable, pH = 7; Flush the meter; Put the meter in Buffer 4 again until is stabile; pH = 4; Flush the meter; Put the meter in a sample of raw water with chemicals, wait until the meter is stable, pH 5,2 - 5,6; write down measurement on labsheet; Flush/ clean the meter; Leave the meter in the buffer (4 or 7).	Every hour

P 02. Process Step Flocculation

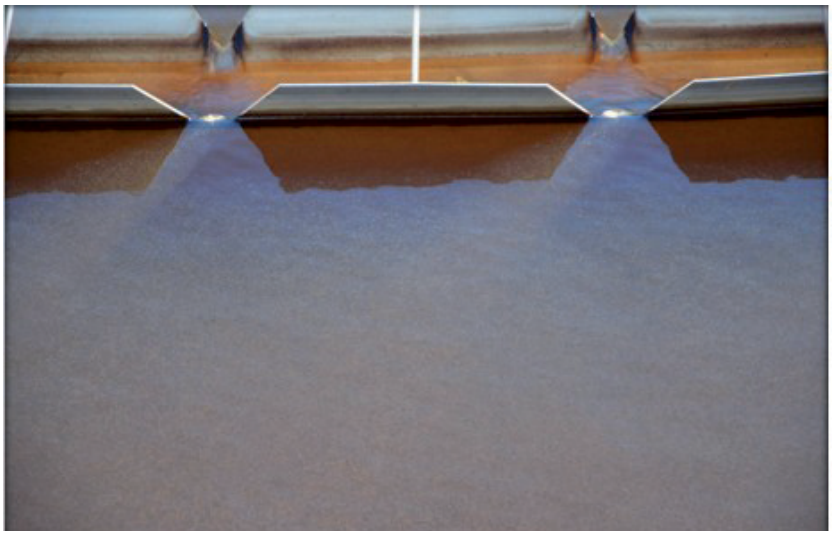
10

Procedure subject	Flocculation
Procedure number	P 02
Location	Grabouw

Prepared by:	A. Guguian	Date: 20-08-2012	Approval date:
Approved by:	M. Schaap		
Procedure number:	P 02	Revision date:	Revision number:

P 02.1 Purpose

The purpose of flocculation is to form flocks to settle in the tank. This can be done by dosing the right amount of chemicals.



P 02.2 Application

This instruction applies to all responsible for flocculation.

P 02.3 Duties and responsibilities

	Tasks	Technical Officer	Technical Foreman Drinkwater	Senior Process Controller	Process Controller	Learning Operator
D	Check the water quality before flocculation zone				x	
R			x			
D	Prepare the chemical dosing				x	
R			x			

P 02.4 Means: information, tools, systems

11

Water Quality: pH meter, colour meter, turbidity meter, measuring jar, jar tester
Chemical Dosing: gloves, goggles, face masks, working clothes, chemicals, stopwatch, safety boots
Cleaning of the flocculation tank: high pressure hose, extension ladder, walkie-talkie (two way radio)

P 02.5 Environment, health and safety

- PPE usage when working with chemicals (gloves, goggles, face masks, working clothes, safety boots)
- Good house keeping rules:
- Once a month clean the chemical dosing room, remove the empty bags
- Clean the area when you have a spill
- Walkie –Talkie (two way radio) is necessary when you clean the tank, so staff from municipality can be contacted when an accident occures
- Extraction fan for the dust in the chemical room
- Safety data sheets for the chemicals (Alum, PE, Lime)

P 02.6 Maintenance planning

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Big Problem	Process Controller	Call the Supervisor. He will contact the contractors and discuss the problem with the Technical Officer; Make a note of the activity in the log book	ASAP (as soon as possible)
Small problem	Process Controller	Try to repare yourself. If this is not possible, call the handyman. The Supervisor is allowed to order materials up to R1000; Make a note of the activity in the log book	ASAP
Cleaning the flocculation zone (also cleaning the settling tank)	Process Controller	• Switch off the pump • Lock the pump • Drain the flocculation tank • Put the ladder in • Clean the tank with high pressure hose • Fill the flocculation tank and immediately start the chemical dosing • Before the water goes into the filters, you have to flush 10% of the water (drain last remaining sludge); • Make a note of the activity in the log book	Once a year
Cleaning the pipes of lime, PE, aluminium sulphate	Process Controller	• Cleaning and declogging the lime pipes with water • Cleaning the aluminium sulphate pipes with water • Cleaning and declogging the PE pipe with water • Make a note of the activity in the log book	Every week, untill is properly cleaned Replace when broken (curative)
Replacement of the dosing pumps equipment	Technical Officer	Replace the equipment	Replace when broken (curative)

P 02.7 Administrative handling

12

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Water Quality Measurements	Process Controller	Write down the measurements in the log book	Every hour
Compare Certificate of analysis with own lab measurements	Process Controller	Compare	Every month
Chemical Dosing	Process Controller	Put the data of the measurements in the log book	Every hour
Special Observations	Process Controller	Make a remark in the log book when a deviation is observed	When observed
Maintenance	Process Controller	Make a note in the log book every time you do maintenance	Every time you do it

P 02.8 Process description / instruction / time frame

Process description	Instruction	Time frame
Water Quality Measurements	Take a sample at the beginning of the flocculation tank, 500 ml	Every hour
	• Color: 10ml; range: 0-30 PtCo • pH: 100ml Check if its calibrated; calibrate the pH meter if necessary; when the reading is stable, make a note in the log book; Range: 5.2 – 5.6; • Temperature: on the pH meter, showed automatically; • Check with a jar tester if the chemical dosing is right; check the color and the size of flocks, or any other observations; • Put the data of the measurements in the log book	
Chemical Dosing	Adjust the chemical dosing (lime, Alum and PE) depending on the outcome of the water quality tests. (see checklist Chemical Dosing)	When necessary

P 03. Process Step Sedimentation

13

Procedure subject	Sedimentation
Procedure number	P 03
Location	Grabouw

Prepared by:	A. Guguian	Date: 20-08-2012	Approval date:
Approved by:	M. Schaap		
Procedure number:	P 03	Revision date:	Revision number:

P 03.1 Purpose

The purpose of this process is to settle the flocks formed in the coagulation tank.

P 03.2 Application

This instruction applies to all responsible for the sedimentation.

P 03.3 Duties and responsibilities

	Tasks	Technical Officer	Technical Foreman Drinkwater	Senior Process Controller	Process Controller	Learning Operator
D	Check the water quality (checklist Start UP)				x	
R			x			
D	Sludge draw off				x	
R			x			

P 03.4 Means: information, tools, systems

14

Water Quality: PH meter, color meter, turbidity meter, measuring jar, jar tester
Cleaning of the tank: Extension ladders, high pressure hose, goggles, waterboots, face-shield, working clothes

P 03.5 Environment, health and safety

- PPE requirements: Waterboots, goggles, face-shield
- Good House keeping

P 03.6 Maintenance planning

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Check Valves	Process Controller	• Does it close properly • Does it open properly • Check the seal (is it leaking?) • When it's leaking, check if something is stuck between the valves	Once a day, when the sludge is drain off Replace when broken (curative maintenance)
Clean Sedimentation zone	Process Controller	• Switch off the pump • Lock the pump • Drain the sedimentation tank • Empty the sludge • Put the ladder in • Clean the tank with high pressure hose • Fill the sedimentation tank without chemical dosing • Flush the tank once • Start production with the chemical dosing	Once a year (one month before the rain season)

P 03.7 Administrative handling

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Sludge drawn	Process Controller	Make a note in the log book every time you drain the sludge	One time per day (the day shift)
Water quality checking	Process Controller	Put the data of the measurements in the log book	Every hour
Maintenance	Process Controller	Make a note in the log book every time you do maintenance	When you do it
Special Observations	Process Controller	Make note in the log book when a deviation is observed	When observed

P 03.8 Process description / instruction / time frame 15

Process description	Instruction	Time frame
• Check the water quality at the end of the sedimentation zone: • Turbidity • pH • Color • Temperature • Visual check	• Take a sample at the end of settlement tank, • 500 ml • Color: 10ml; range: 0-30 ptco; • Tubidity: 10 ml turbidity meter; • pH: 100ml Check if its calibrated; calibrate the pH meter if not calibrated; when the reading is stable, put data in the log book; Range: 5.2 – 5.6; • Temperature: on the pH meter, automatically; • Visual check: color, smell, size of flocks; • Put the data of the measurements in the log book	Once an hour
Sludge draw off	Open the valve very slowly until 15 %, in 3 steps and draw sludge off until the water becomes clear	20 min / 10 min, depending on the raw water quality

P 04. Process Step Sand Filters

16

Procedure subject	Sand Filters
Procedure number	P 04
Location	Grabouw

Prepared by:	A. Guguian	Date: 20-08-2012	Approval date:
Approved by:	M. Schaap		
Procedure number:	P 04	Revision date:	Revision number:

P 04.1 Purpose

The purpose of the sand filter is to filter out the carry over flocks of the sedimentation.

P 04.2 Application

This instruction applies to all responsible for sand filters.

P 04.3 Duties and responsibilities

17

Tasks		Technical Officer	Technical Foreman Drinkwater	Senior Process Controller	Process Controller	Learning Operator
Sand Filters						
D R	Check the filtrated water quality (visual check: color)		x		x	
D R	Check the flow meters		x		x	
D R	Check the blower		x		x	
D R	Backwashing		x		x	
D R	Check air distribution during back-washing		x		x	

P 04.4 Means: information, tools, systems

Not applicable

P 04.5 Environment, health and safety

- Good House keeping rules
- Place hands and body in the correct position to turn the handwheel for opening and closing the valves

P 04.6 Maintenance planning

18

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Sand filters			
Change the sand and the nozzles	External contractor	• Close all valves • Lock the inlet valve • Lock the backwash water valve • Remove the sand • Remove the nozzles • Replace the nozzles and sand	When necessary, otherwise once in 10 years
Check the inlet and outlet valves	Process Controller	Visual check if the valves are leaking or if they are not opened or closed properly	Every backwash
Check the float	Process Controller	Check if it's working properly	Every backwash
Check the nozzles	Process Controller	You have to dig a hole in the sand filters in order to see the nozzles and to replace them if necessary	When you see the air bubbles unevenly distributed over the surface during backwashing
Check the blower	Process Controller	• Once a week you have to check the pressure of the blower and the safety valve; • Replace the blower filter • Check the V belt from the blower	Once a week Once a year Once every 6 months

P 04.7 Administrative handling

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Sand filters			
Backwash	Process Controller	Make a note in the log book every time you perform the backwashing. Register the time of the process	When you do the backwashing
Blower turning hours	Process Controller	Make a note in the log book about which blower is working and on the operational hours (you can read the counter)	Every shift
Maintenance	Process Controller	Make a note in the log book every time when maintenance is done	Every time you do it
Special Observations	Process Controller	Make a remark in the log book when a deviation is observed	When observed

P 04.8 Process description / instruction / time frame 19

Process description	Instruction	Time frame
Sand filtration		
Check the filtrated water quality (visual check: color)	If the water is colored, it is a sign that the filters are not working properly and that you have to do the backwashing.	Every hour
Check the blower	Check the emergency stops; Check the oil level; Check the counters of the blowers; if the difference is more than 15 hours, you must switch the button to the other blower, close the valve for the working blower and open the valve for the standing one; Check if there is power on the blower by switching it to "manual" and start it briefly; When it's running, after starting briefly, stop the blower and turn the switch to "remote".	One time per shift before backwashing
Backwashing	**Current situation (one process controller):** Close the inlet to the tile bucket; Close inlet valve to the filter; Open the discharge valve; Start blower; Listen if the blower starts and then open the air valve; Open backwash water valve until you see 2 cm of flow over the wall (because the flow meter is not always working properly); wait for clean water to flow over the wall; Stop the air valve and stop the blower; Stop the backwash water valve; Open the inlet valve to the filter; Close discharge outlet valve; When water is flowing over the wall, open inlet valve to the tile bucket. **Proper situation (at least two persons):** Close the inlet valve to the filter; Wait until the water level reaches the top of the wall; Open the discharge valve; Close the inlet valve to the tile bucket; Open backwash water valve to break the sand from the filter until you see 2 cm of flow over the wall; Start the blower; Open the air valve; Wait for clean water to flow over the wall; Stop the air valve and stop the blower; Open the backwash inlet valve until the flow is higher; Wait until very clean water is poaring over the wall and the filter has no air in it anymore; Close the backwash inlet valve; Close the discharge valve; Open the inlet valve to the filter; Wait until the level is above the wall; Open the inlet to the tile bucket.	Depending on the color of the filtrated water
Check the nozzles while backwashing	When you are backwashing with air, you have to see bubbles evenly distributed over the surface of the filter; If the bubbles are not spread evenly, then you have to check the nozzles;	

P 05. Process Step Chemical Dosing and Distribution

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Procedure subject	Chlorination & Lime Dosing and Distribution Pumps
Procedure number	P 05
Location	Grabouw

Prepared by:	A. Guguian	Date: 20-08-2012	Approval date:
Approved by:	M. Schaap		
Procedure number:	P 05	Revision date:	Revision number:

P 05.1 Purpose

The purpose of the chlorination and post lime dosing is to bring the water to the required quality level. Chlorine is added to desinfect and post lime is added to adjust the pH. The purpose of the distribution pumps is to fill the reservoirs from which the water is distributed to the customers.

P 05.2 Application

This instruction applies to all responsible for chlorination and lime dosing and distribution pumps.

P 05.3 Duties and responsibilities 21

Tasks		Technical Officer	Technical Foreman Drinkwater	Senior Process Controller	Process Controller	Learning Operator
D	Dosing chlorine				x	
R			x			
D	Dosing post-lime				x	
R			x			
D	Check the water quality				x	
R			x			
D	Fill reservoirs to the required level				x	
R			x			

P 05.4 Means: information, tools, systems

Water Quality: pH meter, color meter, turbidity meter, measuring jar, jar tester, free chlorine

P 05.5 Environment, health and safety

Chlorination & Post Lime

- Good house keeping: clean the pumping room and chlorine storage room; remove the empty bottles of chlorine
- More than one person have to be present when replacing chlorine bottles; the chlorine bottles are changed once a week in the summer time and once every two weeks in the winter time (at day time). As Chlorine gas is heavier than air, you need a suction fan installed at floor level. Chlorine gas is very corrosive. You cannot enter the room without a gas mask and gloves. There has to be an alarm which detects chlorine gas leakage installed at floor level. For safety reasons a second person has to wait outside the room, when the chlorine gas bottle is replaced.
- The chlorine gas is disolved in water and the solution (chlorine gas+water) will be dosed in the drinking water.
- When transported, chlorine bottles have to be secured in the car and transported with care.
- In combination with water, the chlorine gas produces hydrochloric acid, which is very corrosive.
- **The gas mask filter has to be changed at regular intervals of time.** (it has an expiring date sticker on it). After usage (when there is a spill), the gas mask filter has to be changed immediatly.
- PPE: Use personal safety equipment (gloves, gas mask, amoniac test: if there is a chlorine gas leakage, you will see a white cloud) when entering the chlorine dosing room.
- Emergency shower

P 05.6 Maintenance planning 22

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Clean the tank (100m3)	Process Controller	Clean the tank with the help of a pressure hose and an extension ladder.	Once at 10 years
Check the Level Transmitor	Technical Officer	Switch off the pump; put a note: “Out of order”; Change the level transmitor	When necessary
Check distribution Pump	Process Controller	Check the pump visually and for noise, gland burning smell, vibrations, leakage, temperature	Once a shift
Grease the pump and check the oil of the pumps	Process Controller	Check the oil level of the pump visually and grease the pump	Once a week; depending on the running hours as well
Check of the gland packing	Pump inspection Officer	Make a note in the log book when activity is completed	Every day
Replace the turning screw of the lime dosing	Pump inspection Officer	Make a note in the log book when activity is completed	When necessary
Clean the lime room	Process Controller	Clean the room; remove the palets	Once a week (once every three months)
Change the chlorinator	Technical Officer	Make a note in the log book when activity is completed	When necessary (curative maintenance)

P 05.7 Administrative handling 23

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Check the stockpile of chlorine cylinders and order new	Process Controller	Inform the Technical Officer to order new stockpile when necessary	When necessary
Check the amp meters of the pumps	Process Controller	Make a note in the log book with the reading of the amp meters	Every shift
Check the running hour of the pumps	Pump inspection officer	Make a note in the pump sheet	Every shift
Special Observations	Process Controller	Make a remark in the log book when a deviation is observed	When observed
Maintenance	Process Controller	Make a note in the log book every time you do maintenance	Every time you do it
Flow meter measurements (final water reading)	Process Controller	Make a note with the readings of the flow meter	Every shift
Water Quality	Process Controller	Write down the water quality measurements in the log book (lab sheet)	Every hour

P 05.8 Process description / instruction / time frame

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Process description	Instruction	Time frame
Manual start up the pumps	• Check water level in clear well • Check if the plant is running • Check the reservoir level • Start the pump • When the reservoir level is high, stop the pump • When the production is stopped, stop the pump • When SCADA is off, you have to drive to the reservoirs to check the level	
Automatic start up the pumps	• Fully automated start and stop • 90% - 30% clear well • Level transmittor from the reservoir; start - stop	
Dosing chlorine	• Chlorine readings from the reservoirs must be received once a week (because there is no car available on the plant, the samples are hard to obtain from the reservoirs); • Adjust the chlorine dosage, when necessary;	When necessary (depending on the readings)
Dosing post-lime	Dose the post lime	Every hour
Check the water quality	Check the water quality	Every hour
Compare data from external laboratory with own data	Compare	Once at two months
Fill reservoirs to the required level	Goes automatically; If SCADA is out of order, the process must be made manually	Handyman/pump inspector checks the reservoirs at regular intervals of time (every day)

1.7 Grabouw team

South African parties

Water Treatment Plant Grabouw

- Engineer: Andre Meyer
- Technical Foreman: Anthony Holland
- Technical Officer: Marius August
- Process Controllers: Tommy Lesley, Arnold Gertse, William Monoana, Hans Boois
- Learning Process Controller: Charlene van der Riet

Theewaterskloof Municipality

- Health and Safety Manager: Collin Julies
- Technical Director: Conrad van Heerden
- Manager Civil services: Denver Damons

Water Treatment Plant Villiesdorp

- Supervisor Drinking and Waste Water: Ernest Joseph

Water Treatment Plant Overberg:

- Senior Process Controller: Albie Visagie

RSE

- Supervisor Drinking and Waste Water: Willie Steyn

Greyton

- Paul Swart

Dutch parties

Wereld Waternet Amsterdam

- Specialist Waste Water: Karin Dijkstra
- Specialist HR Development: Milla van Kempen

Waterbedrijf Groningen

- Specialist Drinking Water: Mark Schaap
- Specialist Drinking Water: Rene van't Land
- Workshop Facilitator: Andreea Guguian

APPENDIX 1

CHECK LIST START UP

1 Dosage of chemicals

a Poly-electrolyte dosage: switch key on control panel and then press start(green) button
b Alum dosage: switch key on control panel and then press start(green) button
c Lime dosage: switch on the control panel and then press start button at the panel near the lime mixing.

2 Go to pump station Worchester

a press start (black) button on control panel à pump 3 will start
or
b start the pump of Worchester on the telemetry at the water treatment plant

3 Go back from pump station Worchester to water treatment and wait for flow of raw water

4 Check dosage of chemicals

a use a stopwatch and graduated cylinder (1000 ml)
b alum (10 seconds - 90 ml)
c Poly-electrolyte (10 seconds - 120 ml)
d Lime is controlled by pH; when pH<5,2, you have to dose lime; when pH > 5,6 you don't have to dose lime

5 Flow

a read flow meter of the raw water in the new plant, in control panel space.
b write measurement in log book (total flow and flow(l/sec))

6 Sample raw water with chemicals

a take sample of raw water on the roof of new sedimentation tank, by the lid

7 pH measurement in lab of the raw water with chemicals sample

a switch on the pH meter
b put meter in Buffer 4, wait until the meter is stable, pH = 4
c flush meter
d put meter in Buffer 7, wait until meter is stable, pH = 7
e flush meter
f put meter in sample raw water with chemicals, wait until the meter is stable, pH 5,2 - 5,6
g write measurement in lab sheet
h flush/clean meter

APPENDIX 2

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CHECKLIST CHEMICAL ADJUSTMENT

1 Start with making the jar test

a Use a 1000 mL graduated cylinder, add 1000 mL of raw water to be coagulated to each of the jar test beakers.

b Use a prepared coagulant stock solution (Alum), dose each beaker with increasing amounts of solution. (50, 55, 60, 65, Etc)

c Add lime to solutions until you reach a pH level between 5.3 -5.8.

d Use the pH meter to help determine the reading.

NB: If you reached the level of 5.4 in one beaker, then you have to reach this level for every beaker.

e Place the jars on the stirrer and switch the stirrer at 100 r/ min for 2 minutes.

f Reduce the speed of the stirrer at 60 r/min for 6 minutes.

g Reduce the speed of the stirrer at 20 r/min for 2 minutes. Switch off the stirrer.

h It's not necessary to switch off the stirrer while the speed ranges.

i During the rotation process, make a note in the labsheet on the time of flock formation, as well as on the observation regarding caves and other nature of particles.

j During the settlement process you must observe how fast the flocks sink and check the brightness of the treated water.

k Let the samples rest for 30 minutes before analyses

l After 30 minutes approximately 250 ml of the treated water must be subtracted for the determination of turbidity, color and aluminum.

m Filter the treated water through a paper filter, before the measurments are taken.

n The jar with the best results (color and aluminum) indicates the best dosage of chemicals.

2 Adjust the chemical dosing in accordance to the results of the jar test.

APPENDIX 3

CHECKLIST BACKWASHING

1 **Check the filtrated water quality (visual check: color)**
If the water is colored, it's a sign that the filters are not working properly and that you have to do the backwashing.

2 **Check the blower**
a Check the emergency stops;
b Check the oil level;
c Check the counters of the blowers; if the difference is over 15 hours, you must switch the button to the other blower and also close the valve for the working blower and open the valve for the standing one;
d Check if there is power on the blower by switching it to "manual" and start it briefly. When it's running, after starting briefly, stop the blower and turn the switch to "remote".

3 **Backwashing Current situation (one process controller):**
a Close the inlet valve to the tile bucket;
b Close inlet valve to the filter;
c Open the discharge valve;
d Start blowe. Listen if the blower has started and then open the air valve;
e Open backwash water valve until you see 2 cm of flow over the wall, because the flow meter is not always working properly;
f Wait for clean water to flow over the wall;
g Close the air valve and stop the blower;
h Close the backwash water valve;
i Open the inlet valve to the filter;
j Close discharge outlet valve;
k When water is flowing over the wall, open inlet valve to the tile bucket.

4 **Backwashing Proper situation (at least two persons):**
a Close the inlet valve to the filter;
b Wait before the water level reaches the top of the wall;
c Open the discharge valve;
d Close the inlet valve to the tile bucket;
e Open backwash water valve for breaking the sand from the filter until you see 2 cm of flow over the wall;
f Start the blower;
g Open the air valve;
h Wait for clean water to flow over the wall;
i Close the air valve and stop the blower;
j Open the backwash inlet valve until the flow is higher;
k Wait until clean water is flowing over the wall and the filter has no air in it anymore;
l Close the backwash inlet valve;
m Close the discharge valve;
n Open the inlet valve to the filter;
o Wait until the level is above the wall; Open the inlet to the tile bucket.

5 **Check the nozzles while backwashing**
When you are backwashing with air, you have to see bubbles evenly distributed over the surface of the filter; If the bubbles are not spread evenly, then you have to check the nozzles.

APPENDIX 4

BLOCK DIAGRAM, PFD and P&ID's

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Annex 3
Actual Quality Control Handbook: Wastewater Treatment Plant – Borcherds Quarry, Cape Town, South Africa

Process Control Manual Borcherds Quarry Quality Control Handbook

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

Project name	WOP South Africa - Netherlands
Date	18 Feb 2014
Status	Version 2.0
Authors	Team WWTP City of Capetown

Version

Version	Date	Author	Status
1	14 Feb. 2014	E. Beekman J. de Danschutter K. Dijkstra M. van Kempen G. Verwoert	95 % concept
2	18 Feb. 2014	J. de Danschutter K. Dijkstra	Small adjustments, including some remarks by Mr. Rossle
3			Final 2014
4			Up-date 2015

Table of content

1. Introduction

This handbook has been developed to provide information on the quality and reliability aspects of the operations of waste water treatment plant Bocherds Quarry, located in Capetown.

These quality-related materials are created for internal use as a benchmark for performance, and internally they define Borcherds Quarry waste water treatment plant's quality goals.

1.1 Purpose of the Manual

The *Quality Control Handbook* contains the procedures and goals pertaining to quality needed in creating services and products. The *Quality Control Handbook* has to be constantly updated and improved to meet changing needs.

Each and every one is responsible for repairing or reporting to management defects in processes of production, or for deviating from the instructions stated in the handbook. Supervisors are responsible for handling deviations or defects according to instructions.

The manager, or other nominated person, sees to it that employees abide by the instructions set forth in the handbook and (s)he also interprets, searches for and provides guidance in solutions pertaining to quality. The manager also ensures that possible changes meet the demands of the clients, authorities, and other external bodies. When making changes, issues concerning productivity, occupational safety and obligations must be taken into consideration.

The manager is also a key person in solving disputes, and (s)he is responsible for the company's quality policies. Issues pertaining to quality and the measures arising from them are discussed together with the staff.

1.2 Green Drop Requirements / Benchmarking

Long term planning is improved by introducing the "Green Drop Report". Waste water treatment plans and monitoring programs are now required.

The Integrated Development Plan (IDP) is the municipality's principal strategic planning document. The "Financial Plan", the "Spatial Development Framework" and the "Performance Management System" of the municipality form the basis for the IDP

Structure

The Department of Water Affairs of initiated the waste water quality (WWQ) regulation program (Green Drop Report). The objective is to ensure waste water quality by means of compliance monitoring.

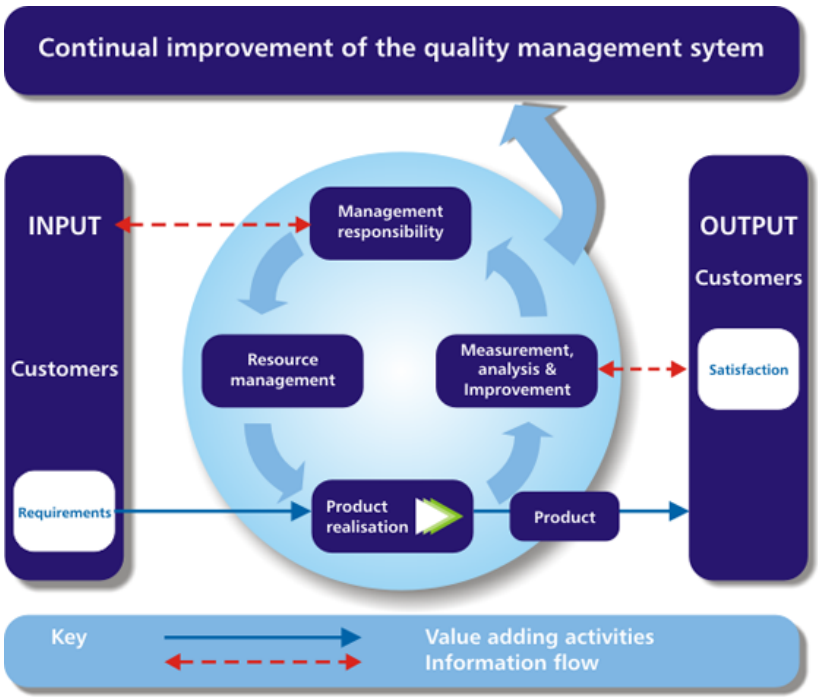
Currently, each municipality has its own payment system, with different rules, standards and pricing.

1.3 Total Quality Management

Every municipality, responsible for waste water treatment should demonstrate its ability to consistently provide products and services that meet customers and applicable regulatory requirements and to enhance customer satisfaction through the effective application of the system including processes for continual improvement of the system and the assurance of conformity of customer requirements.

With aid of "process approach", the company should identify "Management responsibility", "Resource management", "Product realization", "Measurement, analysis and improvement" as its 4 major processes of the Quality Management System.

The process-based quality management system in the following figure illustrates the linkages of the 4 major processes and how to transform the customer requirements into product.



Management responsibility

- Policy on Quality Management
- Business Planning
- Management Review

Resource management

- Education and Training Regulations
- Personnel Workmanship Certification
- Agility equipment management

Product realization

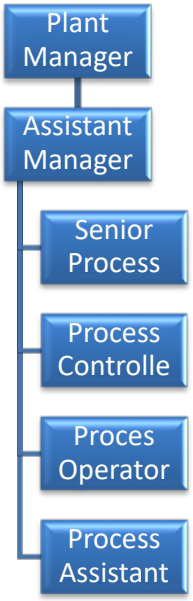
- Customer Requirement Management
- Advanced Product Quality Planning
- Validation of processes for treatment of wastewater and service provision
- Operations procedure & Work instruction

Measurement, analysis and improvement

- Cutomer Satisfaction Management
- Internal Audit
- Process / Product Monitor
- Quality Improvement Team

Deming (PDCA cycle) for continuous improvement

1.4 Organization of the Waste Water Treatment Plant



1.5 Background City of Capetown: Borcherds Quarry

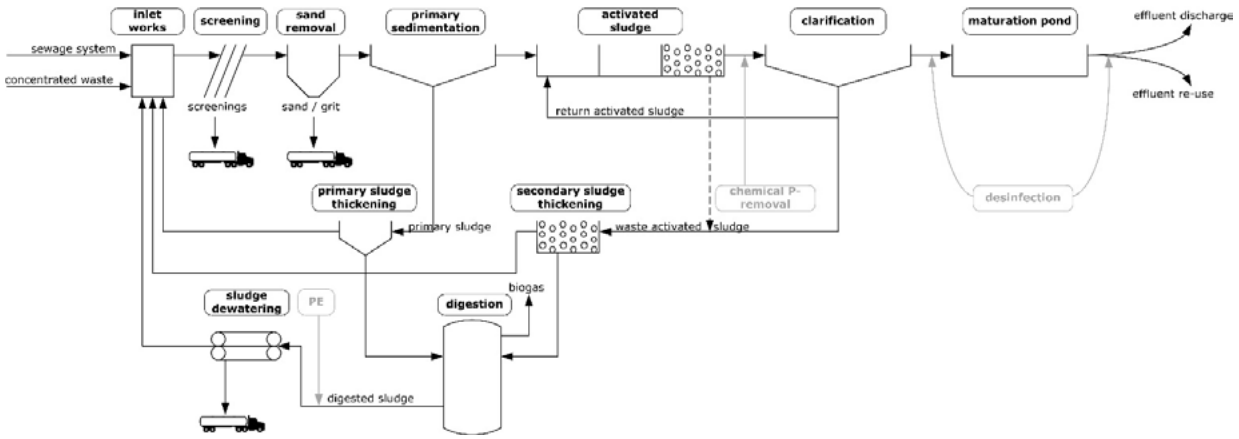
Municipality City of Capetown Waste Water Treatment

- Whole area of greater Capetown
- 27 Waste Water Treatment Works (WWTW)
  - Activated Sludge systems
  - Pond systems
  -
- Total population of 3.8 million people

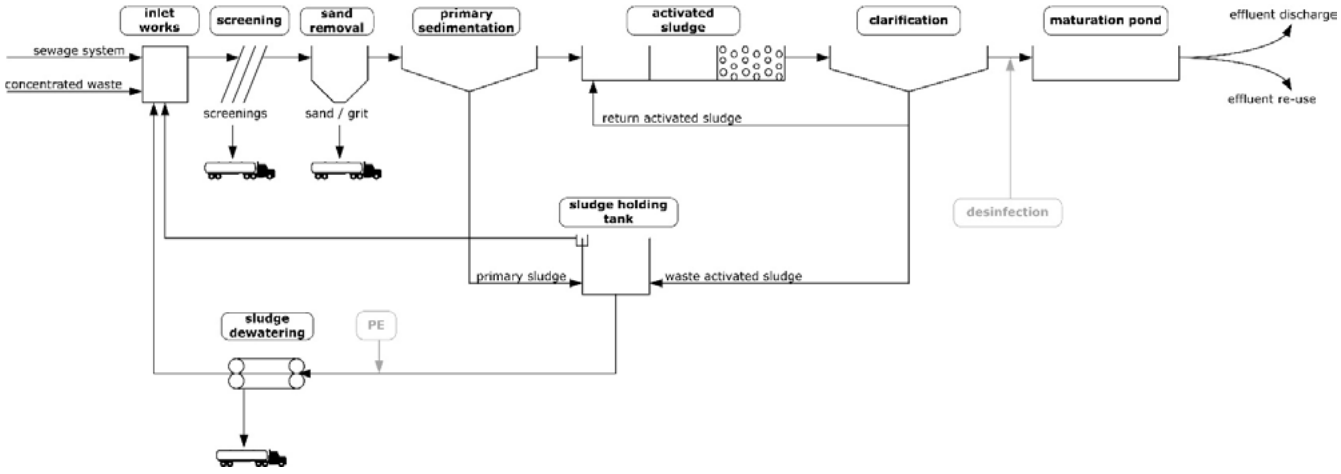
Borcherds Quarry Wastewater Treatment Work

Treatment capacity	:	33	Ml/day
Population served	:		People
Type Water treatment Plant	:	Conventional	

1.6 General Process scheme



1.7 Process scheme Borcherds Quarry



2 Processteps

P01. Sewage System and night soil

P 01.1. Purpose

The purpose of the processtep Sewage system and night soil is collecting the waste water, that is treated at WWTP.

P 01.2 Duties and responsibilities

Tasks	Plant Manager	Assistant Manager	Senior Process Controller	Process Controller	Process Assistant
Taking samples			R	D	
Taking measurements			R	D	
Checklist, shift report, malfunction report, week/month report	 R R	 R 	R D D	D D 	
cleaning instruments			R		D
Work safe	R	R	R	R	R

P 01.3 Means: equipment, information, tools, systems

checklist , portable H2S meter, samplingbottle, bucket, lifting equipment, BA set, torch, wader, safety harness.

P 01.4 Environment, health and safety

- Everybody is responsible for their own safety
- Employees should wear portable gasmonitor H2S when necessary???.
- The employees should wear protective clothing, shoes and optional masks(independent breath control)
- The empoyees should have innoculations, while working on a WWTP.
- For the risk of falling, around the works or pumps there should be a small fence or a rail.
- The plantmanager is responsible that all the employees are facilitated with protective clothing, shoes and masks.
- The empoyees should wear a safety harness, have a work permit, H2S meter, while they are working in confined space.
- A hazard indentification risk assesment(HIRA) should be done of the inlet. The plantmanger is responsible for the HIRA and the implementating of the HIRA.
- Follow the Safework procedure.

P 01.5 Maintenance planning

Activity (What?)	**Responsible (Who?)**	**Workflow (How?) – for Process Controller**	**Timeframe (When?)**
Cleaning instruments and sump	Controller	Cleaning the eye of the ultrasone measurement	Monthly
Mechanical/electrical/ Proces controlsystem	EAM(engineering assetmanagement		

P 01.6 Administrative handling

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Checklist(paper)	Controller	Checking the items on the checklist(eg. level, odeur, fat) Checklist is added in the appendix.	Every shift
Readings(paper/data logger)	Controller	Flow, hours, rainfall, level	Every shift
Sampling(hand/automatic)	controller	Grab or composite	Daily
Interpreting the labresults	(assistant)Plant manager	Checking with the licence and/or permit and take action if needed Daily(labresults take 3 days(email), important abnormality in 1 day(phonecall/textmessage)	Daily
Weekly/Monthly report	Sen. Procescontroller/ Plantmanager	Time, date, type of malfunction, number notification, equipment number, when + who?, lock out procedure Report is added in appendix.	Every week/month
Shiftreport/logbook	Plantmanager	Trucks in/out, content trucks in/out, time trucks in/out, contractors on site, public complains, malfunctioning /specials / changes, workpermits (lockout procedures).	Every day

P 02. Process step influent screening, degritting and by-pass with barscreen

P 02.1 Purpose

The main purpose of the influent screening is to remove large solids such as rags, plastics, synthetic fibres, strings, hair, and other such as debris from the influent waste water and press the large solids and transport this with a conveyor to a binch.

The main purpose of the degritting is, as an essential element between the screening and primary treatment, to ensure removal of all waste water grit materials and collect the grit in a grit binch.

The screening and grit removal can be by-passed and is provided with a barscreen.

P 02.2 Duties and responsibilities

Tasks	Plant Manager	Assistant Manager	Senior Process Controller	Process Controller	Process Assistant
Remove materiaal by blocking the screening compactor			R		D
Cleaning the screen and remove fat and other materiaal			R		D
Cleaning the by-pass screen by hand			R		D
Checklist screening during operation			R		D
Chechlist degritting during operation			R		D
Make malfunctreport		R		D	
Make daily logsheet screening.		R		D	
Make daily logsheet degritting		R		D	
Make screening process inspection sheet		R		D	
Make Degritting process inspection sheet		R		D	

P 02.3 Means: equipement, information, tools, systems

Portable H2S meter, protective clothing, gloves, lifejacket, safety harness if required.

P 02.4 Environment, health and safety

- There is a dangerous situation when scraper and chain are turning by removing the covers from the machine frame.
- There is always a odour problem in the screening building beware of biological infection / contamination and gases when cleaning the srceens and teeth.
- The Ergonomics around inlet must be right.
- Goodhouse keeping and safety environmental.
- The safework procedures should be follwed at all times!

P 02.5 Maintenance planning

Activity (What?)	**Responsible (Who?)**	**Workflow (How?) – for Process Controller**	**Timeframe (When?)**
Lubrications	EAM	Standard workflow	Every month
Screening channels drainage system	EAM	Maintenance report	Reaction on notification
Unjamming the Rake screens	EAM	Maintenance report	Reaction on notification
No wash water supply or pressure is to low	EAM	Maintenance report	Reaction on notification
Screen teeth bending	EAM	Maintenance report	Reaction on notification
Rake Chains brake are broken	EAM	Maintenance report	Reaction on notification
Conveyor needs maintenance	EAM	Maintenance report	Reaction on notification

Blower not working proper grit removal Degrit jet pump not providing enough presure to make suficient vacuum at the venturi	EAM	Maintenance report	Reaction on notification
Standby generator capacity is failing	EAM	Maintenance report	Reaction on notification
Turnaround time too slow	EAM	Maintenance report	Reaction on notification
Spare parts	EAM	Not available locally	

P 02.6 Administrative handling

Activity (What?)	**Responsible (Who?)**	**Workflow (How?) – for Process Controller**	**Timeframe (When?)**
Checklist (paper)	(senior)controller	Checking the items on the checklist The checklist is added in the appendix	Every shift
Readings (paper/data recording logger)	(senior)Controller		Every shift
Binchs is full	(senior)Controller		Every shift
Weekly / Monthly report	Senior Procescontroller Plantmanager	Time, date, type of malfunction, number notification, equipment number, when + who?, lock out procedure Report is added in appendix.	Every week/month

Shiftreport / logbook	Plantmanager	Trucks in/out, content trucks in/out, time trucks in/out, contractors on site, public complains, malfunctioning/specials/changes, workpermits (lockout procedures).	Every day

P 03. Process Step Primary Sedimentation Treatment (PST)

P 03.1 Purpose

The main purpose of the Primiary sedimentation is to fuhter separate the solid and liquid fractions of the influent wastwater.

P 03.2 Duties and responsibilities

Tasks	Plant Manager	Assistant Manager	Senior Process Controller	Process Controller	Process Assistant
Measurement of inflow (hydraulic load)			R	D	
Measurement of sludge removed			R	D	
Equally dividing of the inflow (splitterbox) to the number of PST's			R	D	
Check the opening/closing of the desluding valves (time regulated)			R	D	
Sampling of the PST inflow: pH, Ammonia, measuring	R	R		D	
The lab (D) should analyse the sample of the inflow: COD, NH4, PO4, NO3, NO2, Chloride, settable solids, TSS, pH, alkalinity, conductivity CHECK	R	R			
Check the retetion time (low / high) due to capacity of sludge storage or high inflow (low/high COD load)			R	D	
Check if there's proper drainage of sludge, no bulking / belching or carry over			R	D	
Check if the pipelines of the desluding, the hoppers, aren't blocked			R	D	
Check and Clean the wheels on the bridge, the scraper and the surface scum layer (excessive fat)			R		D

P 03.3 Means: equipement, information, tools, systems

flowmeter (Magneticflowmeter), portable TSS meter, Safety equipment (protective clothing, gloves, lifejacket, safety harness), work instruction (opearting and safety), cleaning cloth (for cleaning the instruments). For emtying and cleaning the PST: 6 inch pump, coupling pipes, high pressure cleaner

P 03.4 Environment, health and safety

If there is a risk of falling into the Primiary sedimentation (PST) (eg checking the bridge or removing the scum layer on the PST), the follwing steps are necessary:

- buddy system;
- safetyharness;
- lifejacket.

The safework procedures should be follwed at all times!

Activity (What?)	**Responsible (Who?)**	**Workflow (How?) – for Process Controller**	**Timeframe (When?)**
Check Odour (container)	Process Controller	Check for odour problems and take action (check odour control unit, report)	Shift
Check Corroding on Bridge	Maintenance	Check for places with serieus corroding and take action (report and marking)	1x / month
Awareness of slippery surface	Everybody	Check for slipper walking pads and take action (cleanning and marking)	Always
Close cover on electric panels	Maintenance	Check for the closing of the covers of the panels.	Always

P 03.5 Maintenance planning

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Structural damage (Tank)	Main	Check for places with serieus damage and take action (report and marking)	1x/week
Corrossion of metal structure (Bridge)	Main	Check for places with serieus corroding and take action (report and marking)	1x/week
Sludge valve failure	Main	Check for failures in the valve operation and take action (report and make notification)	1x/day
PLC problems	Main	Check for program errors and take action (report and make a notification)	1x/day
Instrument Calibration (pH, flow, DO, ..)	Main	Check for serieus in instrument readings and take action (report and make a notification)	1x/6 month
Check mechanical equipment (scraper, bridge, valve, ..)	SPC	Check for failures in the mechanical equipment and take action (report and make notification)	1x/week

P 03.6 Administrative handling

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Checklist (paper)	Assistant Manager	Checking the items on the checklist (eg. Online measurements, odor, scumlayer). The checklist is added in the appendix	Every shift
Readings (paper/data logger)	(senior)Controller	inflow, online measurement, sludge removal, retentiontime measurement	Every shift
Sampling for the lab analysis (hand)	(senior)controller	Sampling of the PST: pH, Ammonia Sample of the inflow for: COD, NH4, PO4, NO3, NO2, Chloride, settable solids, TSS, pH, alkalinity, conductivity CHECK	Weekly
Interpreting the labresults	Assistant Manager / Plant manager	Checking with the licence and/or permit and take action if needed Daily(labresults take 3 days(email), important abnormality in 1 day(phonecall/textmessage)	Weekly
Weekly/Monthly report	Assistant Manager / Plantmanager	Time, date, type of malfunction, number notification, equipment number, when + who?, lock out procedure Report is added in appendix. - Equipment Report - Malfunction Report - Incident Report - Logsheet	Every week/month
Shiftreport/ logbook	Assistant Manager / Plantmanager	Trucks in/out, content trucks in/out, time trucks in/out, contractors on site, public complains, malfunctioning/specials/changes, workpermits(lockout procedures).	Daily

P 04. Process Step Activated Sludge & Clarification (SST)

P 04.1 Purpose

The main purpose of the actived sludge tanks (biological reactors) and the SST's is the biological removal of organic pollution and nutrients and the retention of biomass.

P 04.2 Duties and responsibilities

Tasks	Plant Manager	Assistant Manager	Senior Process Controller	Process Controller	Process Assistant
Measurement of incoming flow of pre-settled wastewater			R		D
Take DO measurements (portable) in order to check the online measurement			R	D	
Take MLSS measurments (portable) in order to check the online measurement			R	D	
Sampling (grab sample) of the pre-settle wastewater	R			D	
Sampling (grab sample) of the RAS	R			D	
Sampling (grab sample) of the settled treated effluent	R			D	
The lab (D) should analyse the sample of the pre-settle wastewater for: COD, NH4, PO4, Chloride, setteble solids, TSS, pH, alkalinity, conductivity	R				
The lab (D) should analyse the sample of the RAS for: setteble solids, TSS, SVI, DSVI, pH, SS	R				

	The lab (D) should analyse the sample of the settled treat effluent for: COD, NH4, PO4, NO3, NO2, Chloride, settable solids, TSS, pH, alkalinity, conductivity	R				
	Check if the cyphones of the secundarysludge pumps aren't blocked					
	Cleaning the overflow of the SST (launder)					
	Checking the correct working of the weels of the SST bridge					
	Checking if the vains of the blowers are correcty open			R	D	
	Checking the sludgeblanketlevel in the SST's			R	D	
	Taking sample from the biological reactor and execute a settleablility test (SVI) on site					
	Taking sample from the biological reactor and execute a NH_4 test on site					
	Check the electrical and mechanical condition of all the equipment and check (report) for mal functioning					
	Measure the flow of RAS					
	Caculate the WAS amount (monthly) based on concentration and fow of RAS					
	Checking for floating debries on the biological reactors and clarifiers					
	Checking the color and smell of the sludge					

P 04.3 Means: equipement, information, tools, systems

Portable DO meter, portable TSS meter, portable sludgeblanket meter, onsite quicktests (reagens) for NH_4, protective clothing, gloves, lifejacket, lifebuoy, safety harness, 30 minutes settleability test, stainer scoop, broom.

P 04.4 Environment, health and safety

If there is a risk of falling into the biological reactors or the SST's (eg removing the scum layer on the SST), the follwing steps are necessary:

- buddy system;
- safetyharness;
- lifebuoy;
- lifejacket.

The safework procedures should be follwed at all times!

P 04.5 Maintenance planning

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Cleaning the probe of the DO meters	(senior) process controller	Taking the probe out of the biological reactor, cleaning the probe with a wet cloth (quick cleaning, because damage of the probe by UV light) Taking off all fibers/debris/scum etc.	At least once a week (depending on the built up of dirt/scum etc.)
Checking the mechanical/electrical condition of the blowers, mixers etc. (all moving equipment)	(senior) process controller	Checking for irregularities	daily
Removing debris from the reactors and SST	(senior) process controller	Using a strainer scoop	daily

Cleaning the overflow canal of the SST's	(senior) process controller	Using a broom	Once a week
Checking the syphones for blockages and unblocking if necessary	(senior) process controller	Checking if there is sufficient flow Using air or water to unblock the syphones	Daily
Quick check of NH_4	(senior) process controller	Using a quick test with reagents in order to adjust the aeration if necessary	daily
Checking the sludgeblanket level in the SST's	(senior) process controller	Using the sludgeblanket level meter/test/plate in order to adjust the amount of RAS and WAS	At least daily
30 minute settleability test	(senior) process controller	Taking sludge sample from BR, put in a 1000 ml measuring cylinder, wait 30 minutes, record level → adjust the amount of RAS and WAS if necessay	daily
Checking the online DO measurement	(senior) process controller	Checking the online DO measurement using the portable DO measurement If there is a big discrepancy → notification for EAM	Daily
Checking the online TSS measurement	(senior) process controller	Checking the online TSS measurement using the portable TSS meter If there is a big discrepancy → notification for EAM	Daily

P 04.6 Administrative handling

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Checklist (paper)	(senior)controller	Checking the items on the checklist (eg. Online measurements, odor, scumlayer). The checklist is added in the appendix.	Every shift
Readings (paper/data logger)	(senior)Controller	Pre-settled wastewater flow, online DO measurement, online MLSS measurement	Every shift
Sampling for the lab analysis (hand)	(senior)controller	Grabsample from the pre-settled wastewater, RAS and treated settled effluent.	Daily
Interpreting the labresults	(assistant)Plant manager	Checking with the licence and/or permit and take action if needed Daily(labresults take 3 days(email), important abnormality in 1 day(phonecall/textmessage)	Daily
Weekly/Monthly report	Sen. Procescontroller/ Plantmanager	Time, date, type of malfunction, number notification, equipment number, when + who?, lock out procedure Report is added in appendix.	Every week/month
Shiftreport/logbook	Plantmanager	Trucks in/out, content trucks in/out, time trucks in/out, contractors on site, public complains, malfunctioning / specials / changes, workpermits (lockout procedures).	Every day

P 05. Effluent Treatment (ponds), Chemical Dosing (Cl), Effluent Discharge

P 05.1 Purpose

The pupose of the procestep post treatment is to guarantee a good quality of the effleunt, that compies with the licence. It is the final step to check the discharge of the WWTP.

P 05.2 Duties and responsibilities

Tasks	Plant Manager	Assistant Manager	Senior Process Controller	Process Controller	Process Assistant
Visual checks	D/R	D	D	D	D
Taking samples			R	D	D
Cleaning(small maintenance)			R	D	D
Cl changing chips			R	D	
Administration	R	(R)		D	
Analyses	R	D	D	D	
Defining Cl dosage			R	D	

P 05.3 Means: equipement, information, tools, systems

Sampling bottle, maintenance for grass, holes, etc.(a lot is done by contractors), checklist, gloves, goggles, mask, procedure dosing chips(SOP), emergency shower/eye wash.

P 05.4 Environment, health and safety

- The employee schould know en implementate the safety procedure or SOP.
- There should be a signage.
- With the filling of the chips Cl, the employees should know the safety procedure and wear gloves and goggles and mask.
- The employee should know the data-safety sheet of Cl.

(plant with Cl gascilinders, not on Borcherds Quarry)

- On the building there schould be a gasalarm Cl and safety signs
- On the building should be an extracting fan, connected to a scrubber, which is discharging to the air.
- Need of a windsock, so you know the direction of the wind by an emergency
- The employees shoud know the safety procedure and SOP.
- The "buddy to buddy" proces should be implemented
- BA sets
- The employees should have a training for changing cilinders and handling Cl gas. The training should not be older than two years.
- Use of ammonia solution for the check of leakage at the cilinder
- Leakage kit should be available

P 05.5 Maintenance planning

Activity (What?)	**Responsible (Who?)**	**Workflow (How?)- for Process Controller**	**Timeframe (When?)**
Cleaning	Sen. procescontroller	Good housekeeping	Every day
Grass/holes	Checking process controllers Contractors(R:Sen. Process controller)		Once a month
Calibrating flowmeter	EAM(PCS) Contractors(R:EAM)		Once a year
Sludge buildup removal	Plantmanager	According to a plan	Every ? years
Fencing	Checking sen. Process controllers Contractors(R:plantmangers)		Every day

P 05.6 Administrative handling

Activity (What?)	Responsible (Who?)	Workflow (How?) – for Process Controller	Timeframe (When?)
Checklist	Sen. procescontroller	Checking the list Appendix	Every day
Weekly/Monthly report	Sen. Procescontroller/ Plantmanager	Time, date, type of malfunction, number notification, equipment number, when + who?, lock out procedure Report is added in appendix.	Every week/month
Shiftreport/logbook	Plantmanager		Every day

P 06. sludge thickening, sludge digestion, sludge dewatering / drying, sludge discharge, chemical dosing PE

P 06.1 Purpose

The purpose of the sludge treatment is to manage and control the sludge volumes on the plant.

P 06.2 Duties and responsibilities

Tasks	Plant Manager	Assistant Manager	Senior Process Controller	Process Controller	Process Assitant
Check overloading the belt			R	D	
Check sludge carry over/overflow back to inletworks			R	D	
Check working of the beltpress			R	D	
Making PE solution			R	D	
Change compressors			R	D	
Cleaning of the belts, PE unit, sludge building			R	D	D
Sampling			R	D	
Check the filling the silo			R	D	
Check the dedrying of filters and pumps			R	D	
Taking measurements			R	D	
Chekcing level and mixing of the holdingtank			R	D	

Checking the larvaecide dosage			R	D	
Checking odeur controll			R	D	
Contacting the contractor for the discharge of the dewatered sludge	R			D	
Checking amount of solids in the filtrate			R	D	

P 06.3 Means: equipement, information, tools, systems

Mixing, high calorimeter, high pressure device, several tools, TSS meter, moisture contant analyser, PPE, EDR equipment, gasdetector, polly hoppers

P 06.4 Environment, health and safety

- Good instruction and training for the (sn.) procescontrollers(SOP) and workinstruction of the PE dosage and beltpress.
- The employee shoud wear boots, while cleaning PE leakages.
- The employee should wear an P3 mask, near the beltpress
- The employee should wear an portable H2S device.
- There should be a signage
- The moving parts of the belt should be sufficiently covered.
- On the sludgebuilding there should be signs for H2S.
- Cleaning of PE leakage should be done with an sulfunt, that absorbs the water in the PE mixture, so there is nog slippery hazard of PE mixted with water.
- The employee shoud be aware of a good dosing of larveacide, to prevent breeding of flies, what can cause diseases.
- Signs of the MSDS for the PE should be near the PE dosage

P 06.5 Maintenance planning

Activity (What?)	Responsible (Who?)	Workflow (How?)- for Process Controller	Timeframe (When?)
Inspections of walls and tankstructures	Sn. Proces Controller	checking	Every day
Belt alignment	AEM		Preventive and by malfunctioning
Wornout belt	AEM		Preventive and by malfunctioning
Design de- efficiency	AEM/Projects		Preventive
Cleaning the beltpress	Sn. Proces controller	Working with the backwash system, use of proper chemicals	
Automatic systems, meters of valves	AEM, PCS		Preventive and by malfunctioning
Greasing of bearing and valves(oilchecking)	Sn. Proces controller of AEM	Maintenance planning	Preventive
Changing Belt	AEM	Maintenance planning	Preventive, 4000 of 8000 houres
Dry air in pneumatisch system	Sn. Controller/AEM	Carefull with cleaning	Instruction

P 06.6 Administrative handling

Activity (What?)	**Responsible (Who?)**	**Workflow (How?) – for Process Controller**	**Timeframe (When?)**
Operation procedures for equipment use (orginal manual of the equipment)	Plantmanager	To give the information to sn. And proces controller an d check the implementation	Once a month
Training in equipment	Head/Plantmanager	To do training on new equipment and do an update every year of specific topics	
Lists and checklist	Sn. procescontroller	To check things on the lists and checklist	Every day
Contacting the truckcontractor for the discharge of sludge	Sn. Procescontroller/ plantmanager	Communicate about the number of trucks and times	Every day
Calculations of sludgeproduction and PE dosage	Sn. Proces controller	Taking readings, doing calculations en do settings accordenly	Every day

3 Workshop team

South African parties

Werner Rossle	Head Operations North
Micheal Toll	Head Operations South
Judith Oliphant	SPO Support and Logistics
Ntokozo Floyd Mdluli	Plantmanager Bocherds Quarry
Nosisa Zincume	SPC Borcherds Quarry
Jacques Basson	Plantmanager Wesfleur
Emile Kotzé	PPC Scotsdene
Clint Kleynhans	SPC Scotsdene
Mohammed Brink	PPC Kraaifontein
Daisy Legodi	As. Manager Bellville
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Morne Gericke	PPC Wildevoelvlei
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Roland Petersen	Superintendent Simons Town
Emily Matlala	SPC Cape Flats
Rozario Stephens	SPC Mitchells Plain
Abraham Karolus	PPC Wesfleur

Dutch parties

Wereld Waternet Amsterdam
- Specialist and Manager Waste Water: Karin Dijkstra
- Specialist, Programme Manager Waste Water and Innovation: Jacqueline de Danschutter
- Manager and Moderator Waternet Academie: Milla van Kempen
- Projectleader and Counselor: Ger Verwoert

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- Msc Chemical Science: Erwin Beekman

Appendix

- Daily checklist
- Malfunction report
- Weekly report
- Monthly report
- QMS procedures

Created under

BEWOP

Supporting the implementation of

SUSTAINABLE DEVELOPMENT GOALS

IMPLEMENTING THE NEW URBAN AGENDA

GWOPA Global Water Operators' Partnerships Alliance

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