# TEMPLATE FOR ADVANCED WATER TREATMENT FACILITY

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(DELETE ABOVE TEXT BEFORE PRINTING)

INSERT AGENCY NAME

insert agency logo

HACCP PLAN

FOR

ADVANCED WATER TREATMENT FOR INDIRECT POTABLE REUSE

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# Scope

This plan covers product quality control for the (insert agency name) (insert facility name) from the entry of raw sewage into the plant to the advanced water treatment (AWT) system to indirect potable reuse sites. Indirect potable reuse may include:

1. Injection into seawater intrusion barrier
2. Groundwater basin recharge

# Background

Insert facility name is designed to treat an annual average daily volume of insert volume million gallons per day (mgd) of predominantly domestic sewage from the cities of insert name of cities and unincorporated areas of insert county name County. Insert facility name uses an AWT process to produce purified recycled water complying with the (insert state) regulations for indirect potable reuse.

Insert process description such as: Treatment consists of influent screening and grit removal, primary sedimentation followed by an activated sludge secondary treatment process prior to entering the AWT process. The AWT facility uses microfiltration (MF), reverse osmosis (RO), advanced oxidation/disinfection consisting of hydrogen peroxide addition and ultraviolet light exposure (UV/AOP), decarbonation, and lime stabilization to produce purified recycled water.

# Regulatory Compliance

## Insert Regulatory Agency Name Permit

Insert facility name’s final effluent quality is generally better than that required by the insert name of regulatory agency(s) standards for recycled water as established in the facility’s permit. The insert facility name treatment system complies with the *insert title of permit* as established by theinsert regulatory agency Order No. Insert permit number, National Discharge Pollutant Elimination System (NPDES) No. Insert permit number (if NPDES permit). The key water quality parameters and their permit limits for insert facility name are as follows.

Insert parameters specified in facility’s permit

| **Parameter Name** | **Units** | **Permit Limit** |
| --- | --- | --- |
| Electrical conductivity | µm/cm |  |
| Total dissolved solids (TDS) | mg/L |  |
| pH | units |  |
| Chloride | mg/L |  |
| Total nitrogen | mg/L |  |
| Arsenic | µg/L |  |
| N-nitrosodimethylamine | mg/L |  |
| 1,4-dioxane | µg/L |  |
| Total organic carbon (TOC), unfiltered | mg/L |  |
| Total coliform (multiple tube fermentation) | MPN/100 mL |  |
| Insert other parameters, if any |  |  |

Compliance with the permit limits is a minimum standard of quality. Insert facility name operates at optimum performance and produces recycled water of a higher quality than the permit requirements.

Because of the high level of treatment, the recycled water may be used for indirect potable reuse, including groundwater recharge. The recycled water may also be used to prevent the inflow of seawater into the groundwater basin.

## The Product Quality Strategy

Insert agency name has a history of producing recycled water since insert year. Insert agency service area information. The specifications for the quality of the recycled water are provided in insert point of truth for product specifications.

The insert agency name provides the highest level of treatment to produce purified recycled water that can be used for every purpose, including indirect potable, except for drinking. However, the quality of the effluent produced by insert facility name is consistently better than drinking water quality because of the advanced level of treatment.

Critical limits in this hazard analysis and critical control point (HACCP) plan have been set to trigger corrective action when the quality of the insert facility name’s effluent deviates from the optimal range. Deviation from the optimal range, in most cases, is not a permit violation, but the purpose of HACCP is to provide an additional level of preventive assurance to stop permit violations rather than guide the response to such violations.

# Roles and Responsibilities within insert facility name

Insert facility name’s insert title of person overseeing the facility (e.g., plant superintendent) oversees the insert facility name operations and reports to the insert title of person responsible (e.g., general manager of the agency). The facility is operated by insert titles of operations and maintenance staff (e.g., operators, maintenance technicians, and instrumentation and electrical technicians) insert hr of manned operation (e.g., 24 hr per day, 7 days per week).

An onsite laboratory is certified by the insert state agency that oversees laboratory accreditation program (e.g., Department of Public Health). Insert agency name regularly renews this certification, which includes onsite inspection audits conducted by insert state agency that oversees laboratory accreditation program. The lab is staffed with water quality experts.

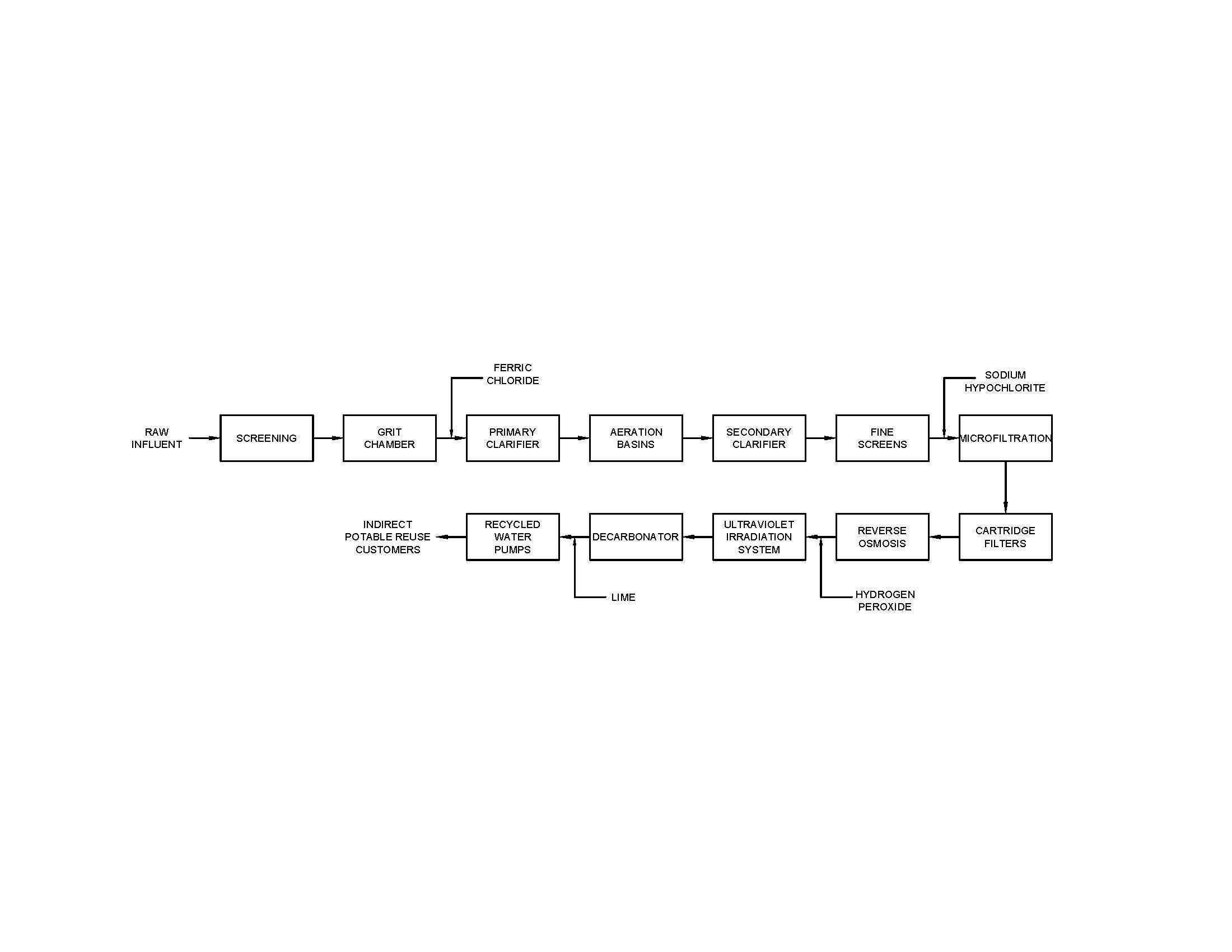
The facility’s organization chart is as follows:

Insert Agency Organization Chart

# Process flow diagram

INSERT PROCESS FLOW DIAGRAM SCHEMATIC

A SIMPLE PROCESS FLOW DIAGRAM IS SHOWN AS AN EXAMPLE, DIAGRAM CAN BE AS COMPLEX AS DESIRED AND WOULD IDEALLY SHOW ALL KEY PROCESS STEPS, CHEMICAL INPUTS, AND MAIN SAMPLING POINTS.



# Description of system

Insert facility name provides AWT consisting of insert process description.

## Headworks

Raw sewage flows into the headworks structure via insert brief description of the influent sewer(s) and/or pump station. Flow is normally distributed to X of Y channels. X channels contain mechanical screens, and the Y channel features a manual screen and serves as a bypass designed to handle the flow capacity of one of the mechanical screens for redundancy. Screenings are washed, compacted, and hauled to disposal at insert name of landfill.

Grit chambers remove rocks, sand, and primarily inorganic debris. Grit is washed and stored in a dumpster until it is hauled to disposal at insert name of landfill.

## Primary Sedimentation

After screenings and grit have been removed, ferric chloride is injected into the wastewater prior to entering primary sedimentation basins.

The ferric chloride is used as a coagulant and flocculant to remove not only suspended solids but also the soluble organic matter that makes up biological oxygen demand (BOD). Primary effluent is then conveyed to the flow equalization basins.

## Flow Equalization

The flow equalization facility provides diurnal equalization for primary effluent flows to deliver a fairly constant flow to downstream processes.

## Activated Sludge Treatment

The activated sludge system provides carbonaceous biochemical oxygen demand (BOD) removal, and nitrification and denitrification (NdN). The aeration basins are a key component of the activated sludge process and operate in a series of anoxic and oxic cells with recirculation and mixing to achieve NdN.

## Secondary Clarification

Secondary clarifiers are required to allow mixed liquor created in the activated sludge process to settle and produce a clear supernatant. A portion of the settled solids is returned to the activated sludge process; the excess, or waste activated sludge, is discharged to the solids treatment facilities.

## Advanced Water Treatment

Secondary effluent enters the fine screens, which remove neutrally buoyant fine and suspended solids to protect and extend the life of MF equipment. The screened secondary effluent flows from the screening facility to the MF facilities. Solids are dewatered and stored in bins for disposal.

MF is used to remove suspended and colloidal solids including bacteria and protozoa from the secondary effluent. MF is a pretreatment step before the RO. Secondary effluent is conveyed to MF cells. Filtrate pumps continuously draw water through the MF membranes using a piping manifold and discharge the filtrate, or MF effluent, to a break tank. The MF cells are periodically backwashed to clean the membranes. The MF membranes are cleaned in place using citric acid and sodium hydroxide with a proprietary chemical to remove foulants and restore membrane performance. Waste backwash and cleaning solutions are returned to the primary treatment process.

Chemical systems at the facility generally consist of bulk storage containers, chemical handling and preparation equipment, and delivery systems capable of metering the appropriate amount of chemicals to their application points. Chemicals used in the AWT facility include ferric chloride, sodium hypochlorite, sodium hydroxide, sulfuric acid, threshold inhibitor, citric acid, a proprietary chemical from the MF manufacturer, hydrogen peroxide, and hydrated lime.

The RO process is used for demineralization and removal of inorganics and organics and provides an additional barrier to viruses, protozoa, bacteria, and other contaminants. MF effluent is pumped from the break tank to the RO system. The RO process features pretreatment chemical addition (sulfuric acid and threshold inhibitor), cartridge filtration, and high pressure feed pumps that supply the pressure vessels containing the RO membranes. The RO system features (insert number of trains or units) trains, each rated at X mgd permeate capacity each. Concentrated brine from the RO process is disinfected and then discharged.

The AOP consists of two steps: hydrogen peroxide addition and UV light treatment. Hydrogen peroxide exposed to UV irradiation produces hydroxyl radicals that result in advanced oxidation. This process is used to destroy organic contaminants that pass through RO membranes (e.g., 1,4-dioxane). Because of the UV resistance of some of these substances, such as N-nitrosodimethylamine, the AOP includes both UV irradiation and hydrogen peroxide working together to produce a range of potent oxidizing agents. The closed, in-vessel type UV system uses low pressure, high output lamps.

(Insert #) forced draft decarbonators remove residual carbon dioxide from the RO system permeate in order to help stabilize the finished product water. The decarbonation system treats approximately X mgd, and the remaining flow bypasses the decarbonators and is blended with the decarbonator effluent. A pump station conveys decarbonated product water to lime saturators and the lime slurry mix tanks.

Hydrated lime is added to neutralize the remaining carbon dioxide. The lime system includes storage silos, slurry mix tanks, pumps, and saturators that prepare and deliver a saturated lime solution to the finished product water. Polymer is added to the saturators as a coagulant aid. Lime sludge is pumped to disposal.

## Product Water Pumping Facilities

The purified recycled water is conveyed to points of reuse using product water pumps. Each pump has a maximum capacity of X mgd. Variable-speed drives enable the facility to operate over a wide range of flow rates to serve variable flow conditions. Surge tanks are installed to protect the pump stations against extremely high and low pressures that may be experienced during the operation of the pumps.

# HACCP team and workshops

At a HACCP workshop, a hazard analysis of each step in the process flow diagrams was carried out, and the critical control points (CCPs) were reviewed. The people who attended the workshops were experienced personnel with multidisciplinary knowledge and are listed in Appendix 1.

The workshop covered:

* general information on the HACCP approach
* CCCPs
* critical limits

The ongoing HACCP team for insert facility name will be:

|  |  |  |
| --- | --- | --- |
| Member | Position | Expertise |
| Enter members of the HACCP team | Enter position of team members. | Enter team members’ expertise |
|  |  |  |
|  |  |  |

The HACCP team will meet once per year or when there is a major change in the process.

# The Hazard analysis

The purpose of the hazard analysis is to look at each step in the treatment process and identify;

* the main hazards (i.e., what are we trying to achieve at this step?)
* the components that can give rise to failure (i.e., what can go wrong at this step?)

## Critical Control Points

A risk ranking was undertaken for each of the identified hazards, including pathogens and chemical and radiological toxicants. At insert agency name, a decision tree (shown in Appendix 2) is used to determine whether the process step is considered a CCP or a quality control point (QCP). The HACCP guidance provides a generic definition of a CCP. Generally, a process step would be considered critical if, among other things:

* Failure at that point is irreversible (e.g., disinfection).
* The step reduces risk to an acceptable level (e.g., denitrification).

Characteristics of a CCP include:

* measured continuously (e.g., using an online monitoring instrument in most cases)
* activity that controls one or more significant hazards
* is monitored in such a manner that failure to perform as intended would be detected, usually immediately downstream of the process
* corrective action for failure (e.g., manual response to alarms or automated responses, such as interlocks)
* records management (logged and retained as part of a formal system)

For each CCP there will be some type of critical limit that the process step must meet (e.g., a contact time for disinfection with chlorine [CT] or an ammonia–nitrogen concentration; in this illustrative plan, free chlorine wasn’t used as a disinfection process, therefore, a CT isn’t given). The setting of these limits must be valid. That is, the limits must be based on scientific data or a regulation or have an empirical justification.

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## The Multiple Barrier Approach

The multiple barrier approach is adopted as an augmentation to HACCP. The principal meaning of this term is in reference to multiple barriers used to control the same hazard (e.g., MF, RO, and UV all provide pathogen reduction). In addition, the term refers to barriers such as process steps that are not critical (QCP) but are also operated in an efficient or optimal manner to further reduce the risk of downstream failure.

## Hazard Analysis and Risk Assessment

| Insert Agency Name | | | | **WATER QUALITY MANAGEMENT & HACCP PLAN** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **INSERT FACILITY NAME** | | | | | | | | | | | |
| **Activity or**  **Process Step** | **Decision Tree** | | | | | **CCP**  **or**  **QCP** | **Potential Hazards** | **Control Issues** | **Critical or Operational Limits** | **Monitoring and Control Measures** | **Corrective Actions** |
| **Q1** | **Q2** | **Q3** | **Q4** | **Q5** |
| 1. Headworks (screening and grit removal) | Y | Y | Y |  |  | CCP | damage to pumps and transfer equipment from blockage and abrasion by physical hazards |  |  |  |  |
|  |  |  |  |  |  |  | deterioration in influent quality caused by untreatable wastes, typically chemical hazards; potentially radiological hazards | Monitor incoming sewage and approved industrial discharges. | pH between 6 and 9 | pH analyzer online | automated pH adjustment |
|  |  |  |  |  |  |  | interferences to biological process and deterioration of effluent/recycled water because of chemical hazards | Investigate illegal dumping sources and contamination events. |  |  |  |
|  |  |  |  |  |  |  | high flow rate physically disrupting the process | wet weather procedures | If peak flow rate exceeds X mgd for  X hr, report and alarm. | flow metering | Utilize standby channel and equipment. |
| 1. Primary sedimentation | Y | Y | N | Y | Y | QCP | high overflow rate, high weir loading rate, and low detention time in primary clarifiers  higher BOD and total suspended solids (TSS) loading on downstream secondary processes | Monitor flow rate.  Maintain proper solids removal. | If peak overflow rate <X gpd/sf for X hr, report.  If hydraulic detention time <X hr for  X hr, report. | Refer to procedure. | Refer to procedure.  Utilize standby basin(s). |
| 1. Flow equalization | Y | Y | Y |  |  | CCP | peak flow and loadings on downstream processes,  failure of pumps or flow control devices | operational procedures to control flow stored in and released from flow equalization basins | equalized flow X mgd to downstream processes | flow metering | Refer to procedure.  Utilize standby pumps, mixers, flow control devices. |
| 1. Aeration basins (oxic/anoxic—NdN system) | Y | Y | Y |  |  | CCP | deterioration of effluent quality because of suboptimal biological process. | operational procedures to control, interpret, and manipulate the activated sludge process in the aeration basins to achieve nitrogen removal, BOD reduction, and optimal settling | Maintain dissolved oxygen concentration in oxic cells.  Maintain mixing and recirculation in anoxic cells.  If NH3>X mg/L for  >X hr, report.  If NO3->X mg/L for  >X hr, report.  If BOD>X mg/L, report. | Refer to procedure.  Maintain mixed liquor suspended solids and recirculation rate. | Refer to procedure.  Utilize standby blowers, mixers, recirculation pumps. |
| 1. Secondary clarification | Y | Y | Y |  |  | CCP | deterioration of effluent quality caused by poor solids settling, flow control, and solids management | operational procedure to cover issues of flow control, solids control, and settling | If effluent TSS>X mg/L, report.  Inspect clarifiers daily. | Refer to procedure. | Refer to procedure. |
| 1. Fine screens | Y | Y | Y |  |  | **CCP** | damage to downstream equipment | monitoring of process and cleaning of equipment | Inspect and clean daily. |  | Clean fine screens to protect downstream equipment. |
| 1. Sodium hypochlorite injection | Y | Y |  |  |  | QCP | biofouling of downstream MF membranes |  | Inspect daily. |  | Refer to operations and maintenance (O&M) manual. |
| 1. MF system | Y | Y | Y |  |  | CCP | fouling of RO membranes and poor effluent quality | monitoring of process and cleaning of equipment | Feed chlorine residual should be in the range of X and Y mg/L as chloramines.  if MF feed turbidity  >X NTU  ≥X NTU (membrane warranty) >X NTU for >4 hr  >X NTU at any time  if MF TMP <X psi (calculated) >X psi (calculated)  if MF effluent>X NTU |  | Check chlorine residual meter for proper operation.  Determine cause of problem.  Check sodium hypochlorite system.  Check turbidimeter for proper operation.  Determine cause of high secondary effluent turbidity.  Shut down MF unit and clean cell.  If the TMP is out of the operational range, shut down the MF unit and perform a cleaning.  If necessary, perform pressure decay test (PDT)/air leak testing to locate problem.  Refer to O&M manual. |
| 1. Sulfuric acid injection | Y | Y | N |  |  | QCP | scaling of membranes resulting in possible poor effluent quality |  |  |  | Check sulfuric acid feed system and adjust as necessary. |
| 1. Threshold inhibitor injection | Y | Y | N |  |  | QCP | scaling of membranes resulting in possible poor effluent quality |  |  |  | Check threshold inhibitor feed system and adjust as necessary. |
| 1. Cartridge filters | Y | Y | N |  |  | QCP | fouling of RO membranes and poor effluent quality |  |  |  | Check RO transfer pumps  and cartridge filtration equipment; clean filters as necessary. |
| 1. RO system | Y | Y | Y | Y | N | CCP |  |  | feed chlorine residual<X mg/L  effluent turbidity X NTU to X NTU  effluent conductivity <X µS/cm  effluent total organic carbon (TOC) X to  X mg/L |  | Check chlorine residual meter. Determine cause of high chlorine residual.  Check turbidimeter. Determine cause of out of range turbidity.  Check conductivity meter. Determine cause of high conductivity.  Check TOC meter. Use portable TOC meter to locate problematic RO train. |
| 1. UV/AOP system | Y | Y | Y | Y | N | CCP |  |  | UV transmittance>X% (at 254 nm)  UV intensity>X%  calculated UV dose per train>f X mJ/cm2  average UV train power>X kW per train |  | Check the number of failed lamps and power usage for each train. Replace failed lamps. Shut down the affected UV train and switch flow to standby UV train.  Check UV transmittance panel and calibration of UV transmittance meter. Verify ROP turbidity.  Verify UV reactors have automatically increased to 100% power (lamp output).  Check number of reactors in service for each UV train.  Verify reactor lamp output and ballast power level.  Check flow rate to each UV train. Refer to O&M Manual. |
| 1. Decarbonator and post treatment (lime addition) | Y | Y | Y |  |  | CCP |  |  | pH of the final effluent should be in the range of X to X units (continuous monitoring). |  | Check pH meter to confirm proper operation.  Check lime feed system for proper operation.  Divert flow if unable to achieve pH within target range. Refer to O&M manual. |
| 1. Computer control system |  |  |  |  |  | supportprogram | deterioration in effluent quality caused by failure of the computer control system | access to expert system advice  manual operation  backup systems |  | internal technicians used for routine tasks | outside expertise available for complex problems |
| 1. Infrastructure |  |  |  |  |  | supportprogram | deterioration of effluent quality caused by condition or design of infrastructure | condition of structure  suitability of processes  plant capacities |  | Two yearly process inspections include infrastructure condition report.  Process audits carried out by engineers.  Review the adequacy of process steps.  Daily flow rates are monitored. | Process audits are followed up regularly.  Recommendations for process modifications may be made following audits.  Infrastructure services consider flow trends in planning expansion. |
| 1. Staff |  |  |  |  |  | supportprogram | deterioration in effluent quality caused by staff problems | availability and suitability of operational procedures  relevant qualifications  staff numbers  adequate competencies and training |  | Procedures are available for all major process steps. Technical manuals are available for more detail.  All operators are certified.  External competency assessments are carried out. | Reporting of HACCP excursions, SIN notices, and audits ensure procedures are reviewed. |
| 1. Calibration and maintenance |  |  |  |  |  | supportprogram | inaccurate data leading to poor operational decisions  deterioration in effluent quality caused by mechanical and electrical failure of system components | suitable care and calibration regimes for process and lab instruments  inspection and maintenance schedules |  | Relevant instruments are calibrated according to manufacturers’ specs.  O&M staff maintain equipment according to service level agreement. | Product quality carries out random checks using reference instruments.  Refer to Service Level Agreement. |
| 1. After-hours control |  |  |  |  |  | supportprogram | deterioration in product quality caused by after-hours failure of plant processes | adequate alarming  on-call roster |  | Various failure alarms generate callouts.  on-call roster in place |  |

## Insert Agency, Insert Facility: Critical, Operational, and Reporting Limits

| **Process Step** | **Critical or Operational Limit** | **Comments** |
| --- | --- | --- |
| **Headworks (screening and grit removal)** | **Peak flow rate** should be  <X mgd.  **pH** should be between 6 and 9. |  |
| **Primary sedimentation** | **Peak overflow rate** should be <X gpd/sf.  **Hydraulic detention time** should be between X and Y hr. | Poor quality primary effluent increases organics loading on secondary treatment processes. |
| **Flow equalization** | **Flow** sent to downstream processes should be fairly constant at approximately  X mgd. | impacts downstream processes |
| **Aeration basins (oxic/anoxic NdN system)** | **Ammonia–nitrogen** should be <X mg/L.  **Nitrate–nitrogen** should be  <X mg/L.  **BOD** should be <X mg/L. | Impaired nitrogen and organics removal could result in poor recycled water quality. |
| **Secondary clarification** | **Effluent TSS** should be  <X mg/L. | impacts dual media filters and final effluent quality |
| **Fine screening** | should be inspected daily and cleaned as required | impacts MF system and may impact final effluent quality |
| **Sodium hypochlorite injection** | should be inspected daily |  |
| **MF system** | **Feed chlorine residual** should be in the range of X mg/L and  X mg/L as chloramines.  **Feed turbidity** should be  ≤X NTU optimum, >X NTU for ≤4 hr, and <X NTU at all times.  TMP should be in the range of X to X psi (calculated).  **PDT** should be ≤X (to be based on validated critical limit derived from challenge testing, usually supplied by the membrane supplier).  **Effluent turbidity** should be  <X NTU. | impacts RO system and final effluent quality |
| **Sulfuric acid system** | should be inspected daily | impacts RO membrane |
| **Threshold inhibitor system** | should be inspected daily | impacts RO membrane |
| **Cartridge filtration** | should be inspected daily | impacts RO membrane |
| **RO system** | **Feed chlorine residual** should be <X mg/L.  **Effluent turbidity** should be in the range of X to Y NTU.  **Effluent conductivity** should be <X µS/cm.  **Effluent total organic carbon (TOC)** should be in the range of X to Y mg/L (continuous monitoring). | impacts RO membranes and final effluent quality |
| **UV/AOP system** | **UV transmittance** should be a minimum of X% (at 254 nm).  **UV intensity** should be >X%.  **Calculated UV dose per train** should be ≥X mJ/cm2.  **Average UV train power** should be ≥X kW per train. | impacts final effluent quality  Hydrogen peroxide in a treated wastewater solution is very short-lived, so standards are not generally placed on maximum doses of this oxidant. |
| **Post-treatment system** | **pH** of the final effluent should be in the range of X to X units (continuous monitoring). | impacts final effluent quality |

## Supporting Programs

Essential activities to support product quality include:

* Operation and maintenance manual
* Standard operating procedures
* Insert other supporting programs

# Monitoring, Control, and Corrective Action

The monitoring, control, and corrective action for each process step are mentioned briefly in the hazard analysis. More detailed information is contained in the following. Update sections to apply to the facility being evaluated. Sections 9.1 through 9.14 are examples of processes.)

## Calibration of Instruments

Control: Instruments will be calibrated according to manufacturers’ instructions. Online measuring equipment is calibrated to a traceable standard by utility services.

Corrective action: staff will recalibrate equipment and call manufacturer if needed.

## Influent Monitoring

Control: Operational staff visits the headworks regularly. If staff notices that the influent has unusual characteristics (color, odor, appearance), sampling and testing of the influent are conducted. Influent characteristics are monitored regularly in accordance with the permit requirements. Insert more detail about this facility as needed.

Corrective action: Staff will collect sample, place the sample in the refrigerator, and call the Source Control Management Team. If deemed necessary, Source Control will characterize the sample. Otherwise, the sample can be discarded. Insert more detail about this facility as needed.

## Headworks (Influent Screening and Grit Removal)

Control: Large solids, rags, and grit have the potential to damage or adversely impact downstream equipment and ultimately the quality of recycled water. To ensure the removal system is working efficiently, it will be physically inspected daily. Insert more detail or replace with text about how the process is controlled at this facility.

Corrective action: Staff will perform regular maintenance on equipment. Clean out any clogged equipment. Place standby units into service as needed. Insert specific corrective actions if the control levels are exceeded.

## Primary Sedimentation

Control: Observe the operation of the primary sedimentation tanks daily and monitor the quality of the primary effluent and solids. Review the flow records and compare with design overflow rates, weir loadings, and hydraulic retention times. Look for rising or bulking sludge that would indicate anaerobic conditions, aging sludge, and improper solids removal rates. Review primary solids pump operating records. Insert how the process is controlled at this facility.

Corrective action: Adjust weir gates to ensure flow is distributed equally among tanks in service. Clean overflow weirs, scum collection equipment, and any inlet/outlet ports that may be clogged. Insert specific corrective actions if the control levels are exceeded at this facility.

## Flow Equalization

Control: Inspect and wash down flow equalization storage basins. Observe aeration and mixing in basins. Maintain flow meters, pumps, and valves to maintain a constant design flow rate to the membrane bioreactor (MBR) facilities and an operator-adjusted set point flow to the NdN activated sludge facilities. Confirm that the set point maintains a balanced equalized flow over the 24 hr period such that the flow equalization gradually stores excess primary effluent during the day when plant flows are greater than average and then releases the stored primary effluent during the night when plant flows are lower than average. Insert specifics about how the process is controlled at this facility.

Corrective action: Adjust set point flow to the NdN activated sludge facilities to balance the daily diurnal flow to the downstream processes such that the flow equalization basins store and drain primary effluent within a 24 hr period, resulting in an equalized flow. Insert corrective actions if the control levels are exceeded at this facility.

## Activated Sludge Treatment

Control: Observe oxic and anoxic basins for proper mixing and aeration (in oxic cells) with confirmation using dissolved oxygen (DO) meters. Observe color of mixed liquor and extent of foam and scum. Conduct microbiological sampling to determine the consistency of the sludge floc and any issues with filamentous organisms caused by insufficient DO levels. Monitor pH levels that may indicate low alkalinity issues. Monitor process performance by sampling secondary effluent from the clarifiers for BOD, TSS, ammonia, and nitrate levels. Insert how the process is controlled at this facility and add specific targets and ranges for proper operation.

Corrective action: Adjust aeration rates, mixer speeds, recirculation pump rates, and return and waste activated sludge pumping rates to improve secondary effluent quality by adding more oxygen to oxic cells, and more nitrates to anoxic cells and mixing to promote homogeneous conditions and eliminate dead zones and short-circuiting. Excessive foam and scum levels can be controlled with sprays and mixing. Add methanol if an additional carbon source is needed for denitrification. Insert corrective actions if the control levels are exceeded at this facility.

## Secondary Clarification

Control: Observe the operation of the secondary clarifiers periodically during the day. Monitor the quality of the secondary effluent, especially for BOD, TSS, turbidity, ammonia, nitrate, and waste solids. Coordinate with the operation of the activated sludge (NdN) system because the secondary clarifiers are an important component of the secondary treatment process. Review the flow records and compare with design overflow rates, weir loadings, and hydraulic retention times. Look for rising or bulking sludge that would indicate anaerobic conditions, aging sludge, and improper solids removal rates. Review waste solids pump operating records. Insert specific information about how the process is controlled at this facility.

Corrective action: Adjust weir gates to ensure flow is distributed equally among the clarifiers in service. Clean overflow weirs, scum collection equipment, and any inlet/outlet ports that may be clogged. Adjust return and waste sludge pumping rates to maintain mixed liquor suspended solids concentration in oxic cells and provide a nitrate source for anoxic cells. Insert corrective actions if the control levels are exceeded.

## Fine Screens

Control: Observe operation of the fine screens periodically during the day. Confirm that automatic backwashing cycles are occurring at proper intervals. Damage may be caused to the downstream process equipment if the screens are not operating properly.

The screens can be placed in manual, remote, or auto modes of operations. In manual operating mode, the operator manually controls the fine screens in slow or fast mode. In remote operating mode, the screens will operate when the inlet and outlet screen gates are open. In auto mode, each screen alternates operation for a preset time period before the next screen operates. Screen cleaning cycles are actuated on a preset time basis. The system may also automatically initiate a cleaning based on the level differential between the influent and effluent screening channels. Insert specific details about how the process is controlled at this facility.

Corrective actions: Inspect and clean the screens daily to protect downstream equipment from damage. If the screens do not respond when placed in the manual or auto command, an alarm will be activated to notify the operators to resolve the problem. If the level differential between the influent and effluent channels of each fine screen reaches approximately 1 ft, confirm initiation of a cleaning cycle of the corresponding screen. Insert other corrective actions if the control levels are exceeded for this facility.

## Microfiltration System

Control: Observe MF system for proper operation. Monitor influent for pH, oxidation potential (ORP), chlorine residual, and turbidity. Monitor the differential pressure or TMP between the feed side (water level in the cell) and the filtrate side of the system. Monitor system effluent temperature, and use it to calculate the corrected permeability or resistance of the membranes. Monitor combined filtrate turbidity continuously to meet recycled water turbidity standards. Maintain citric acid and sodium hypochlorite storage and feed pumps for intermittent MBR (MF membrane) cleaning. Observe MF cell during air scour for uneven bubbles that could indicate fiber breaks. Insert specific details about how the process is controlled at this facility.

Corrective actions: Maintain MF system equipment. Make adjustments as necessary. Influent pH values above or below the set points will trigger high or low pH alarms and result in a plant shutdown. Similarly, ORP above a predetermined set point will trigger a high ORP alarm and result in a plant shutdown. Check the pH and ORP meters to confirm proper operation. If the meters are working properly, determine the cause of the alarm.

High levels of chlorine residual will raise a feed water high chlorine residual alarm and result in a shutdown of the system. Upon receiving the alarm, check the chlorine residual meter. If the meter is working properly, check sodium hypochlorite injection system to determine the cause of the alarm.

Influent turbidity levels above a predetermined set point will trigger a high turbidity alarm. Check the turbidimeter. If the turbidimeter is working properly, determine the cause of the high turbidity in the secondary effluent.

The control system will trigger warnings and shutdown alarms depending on the TMP value. The TMP is used to calculate permeability and the resistance of the membranes. Various process sequences are triggered on a value of permeability or resistance, such as a backwash or clean-in-place sequence. Adjust cleaning intervals if required.

Warning and shutdown alarms are triggered when the combined filtrate turbidity is above a set point for a predetermined duration. Check the turbidimeters. If the meters are working properly, perform a membrane cleaning as necessary, investigate a possible membrane breach, and perform a PDT. Insert other corrective actions if the control levels are exceeded for this facility.

## Reverse Osmosis System

Control: Observe the operation of the cartridge filtration units upstream of the RO system periodically. Observe operation of the RO system. Monitor for chlorine residual in influent flow. Monitor the permeate for turbidity, conductivity, and TOC. Insert specific details about how the process is controlled at this facility.

Corrective actions: High levels of chlorine residual will trigger an alarm and result in a plant shutdown. Check the chlorine residual meter. If the meter is working properly, determine the cause of the alarm. Warning and shutdown alarms are triggered when the permeate turbidity is above a set point for a predetermined duration. Warning and shutdown alarms are also triggered when the permeate turbidity or TOC is out of a preset range. Check the meters to confirm proper operation. If the meter is working properly, investigate the cause of the alarms. Insert other corrective actions if the control levels are exceeded for this facility.

## UV/AOP System

Control: Observe and monitor operation of the UV/AOP system. The UV system is designed to operate automatically. The control system maintains optimal UV intensity based on flow rate, process water temperature, UV transmittance, and lamp age.

Each UV reactor responds to a power level signal, which automatically adjusts the lamps to the correct power level as determined by the control system. Insert specific details about how the process is controlled at this facility.

Corrective actions: Check for UV lamps that are not working and replace if necessary (check if expected lamp life has been exceeded). Clean UV lamps if intensity is low but lamp is working. Check sensor for UV intensity and train power. Check turbidity of RO permeate and confirm that the percentage of UV transmittance is within target operating range. Check flow rate to each UV train, and adjust flow as necessary. Insert other corrective actions if the control levels are exceeded for this facility.

## Decarbonation/Post Treatment

Control: Monitor the pH of the finished product water stream following lime addition. Check that all decarbonators are in service. Monitor operation of the decarbonator centrifugal blowers. Monitor operation of the lime addition system. Insert specific details about how the process is controlled at this facility.

Corrective actions: If the pH of the product water, after lime addition, is below a predetermined set point, an alarm will be triggered, and the system will be shut down. Confirm that the pH meter is working properly. Check operation of decarbonator blowers. Confirm operation of lime saturators and pumps. Make adjustments as necessary. Insert other corrective actions if the control levels are exceeded for this facility.

## Chemical Storage and Feed Facilities

Control: Observe operation of the chemical feed systems, including sodium hypochlorite, sulfuric acid, threshold inhibitor, MF and RO system cleaning chemicals, and post-treatment lime. During the filling process, monitor the storage tank level and fill flows to ensure proper filling during the chemical delivery process. Check that transfer and feed pumps are working properly. Insert specific details about how the process is controlled at this facility.

Corrective actions: Perform regular maintenance on chemical feed systems. Make sure that chemical deliveries are scheduled. Insert other corrective actions if the control levels are exceeded for this facility.

## Recycled Water Pumping System

Control: Maintain pumps to operate at the proper design flow rate and discharge pressure. Monitor final effluent (recycled water) quality per permit requirements. Insert specifics about the pumping facilities at the facility.

Corrective action: Utilize standby pump if duty pump is out of service. Notify regulatory agencies if recycled water quality does not comply with the permit requirements, and inform them as to the reasons for the excursion and corrective measures taken. Notify recycled water customers of quality problems and provide information regarding when service will be reinstated or how alternative water supplies will be available. Insert specific information for this facility and agency.

## Excursion Reports

Excursion reports are 1-page templates that are automatically emailed to certain senior managers and the general or executive manager at insert name of agency. They must be submitted if any of the following occur:

* Permit violation of any kind
* BOD in the effluent exceeds X mg/L.
* Ammonia in the effluent exceeds X mg/L for more than X hr.
* Nitrate in the effluent exceeds X mg/L.
* Suspended solids in the effluent exceed X mg/L (grab sample).
* Turbidity in the effluent exceeds X NTU for more than X hr.
* Chlorine residual is less than X mg/L or more than Y mg/L for more than X minutes.
* TOC in RO product is less than X mg/L or more than Y mg/L.
* Average UV train power is less than X kW per train.
* UV dose is less than X mJ/cm2 for X minutes.
* Total coliform of the effluent exceeds X MPN/100mL.
* pH of the effluent is lower than 6.5 or higher than 8.5 units.

## Standard Operating Procedures

Plant operators and maintenance personnel have access to the following operation and maintenance manuals: Modify for facility being evaluated, list is only an example

* headworks system
* primary clarifiers system
* primary skimming and pumping system
* primary sludge pumping system
* primary effluent pumping system
* flow equalization system
* activated sludge system
* aeration basin dewatering pump station system
* secondary skimming and pumping system
* secondary sedimentation basin dewatering pump station system
* fine screening facilities
* MF system
* RO system
* AOP system
* decarbonation/post-treatment system
* chemical storage and feed systems
* product water pump station system
* substation/switchgear system
* process control system

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# Awareness of HACCP

## Staff Awareness

The insert name of agency lead operator was given HACCP awareness training, All new staff are required to have HACCP training.

## Contractor Awareness

Contractors must obtain permission from the lead operator before commencing work. The lead operator will ensure contractors are managed to comply with the HACCP plan.

## Planning Representation

During the planning of upgrades or major retrofitting, the design team must include at least one person familiar with HACCP.

# Communication

## Internal

The insert title of person overseeing the facility (e.g., plant superintendent) will inform the insert title of person responsible (e.g., general manager of agency) of any changes in operation that may impact recycled water quality.

The insert title of person overseeing the facility (e.g., plant superintendent) will inform the plant staff of issues affecting product quality that are suspected of impacting recycled water quality. This will include use of the excursion system.

## External

General communication with recycled water customers is handled by the insert title of person responsible for notifying recycled water customers (e.g., public relations manager). Customers are provided with product information and a contact number for enquiries. Complaints will be handled by the insert title of department that handles complaints (e.g., customer service department). Communications with the insert environmental regulating agency are handled by the insert title of person who communicates with the regulating agency.

# Nonconforming product

The insert facility name complies with the insert title of permit as established by the insert name of regulatory agency Order No. Insert permit number, NPDES No. Insert permit #, if NPDES permit. In accordance with the permit, insert agency name is responsible for reporting any condition related to the treatment facility or distribution system that may endanger human health or the environment. Any incident must be reported to the insert name of reporting agency as soon as insert agency name becomes aware of the circumstances. A written report will be submitted within 5 days and contain a description of the condition and its cause; the duration of the condition, including exact dates and times and, if the condition has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent recurrence of the condition, with a schedule for their implementation. If at any time a CCP reaches a critical limit, the problem will be discussed internally, and corrective action will be taken.

# Incident Management

Insert agency name has an incident management plan under document control. According to the plan, any employee can declare an incident. The severity of an incident is categorized according to criteria, and there are procedures related to these categories.

All plant staff should be aware of how to access the incident management plan. The reporting system covers deviations from optimal operating conditions, but if the deviation from optimal is extreme, or the deviation cannot be brought under control within a working day, the insert name of person responsible (e.g., lead operator) must consider declaring an incident.

If an incident is declared, the insert name of person responsible (e.g., plant superintendent) will be included in immediate contacts. The Incident Management Team will consider the need for customer or regulator notification and the need to recall or isolate faulty product. The insert name of person responsible (e.g., plant superintendent) may make unilateral decisions in this regard if a decision is required before an incident management team can be convened.

# Validation

The validity of the process controls adopted through this HACCP plan has been endorsed by the insert name of person responsible (e.g., design consultant experienced in validation of treatment process trains) and insert name of oversight authority (e.g., regulatory office responsible). The report can be found at the insert reference for scheme validation report. Validation needs to be based on reference to specific validation standards, such as United States Environmental Protection Agency validation guidance documents or a similar credible standard.

# Continuous Improvement

Continuous improvement is driven through the reporting system outlined in the HACCP procedures. The system involves the reporting of any event that exceeds HACCP critical limits for the required amount of time. Reports are emailed to the insert name of person responsible (e.g., general manager) and other selected senior staff. This means that operational stall is motivated to optimize the facility to avoid reporting failures caused by poor practice.

Management also has a responsibility to ensure that any necessary improvements are made to prevent water quality issues. The use of internal audits and online instruments helps ensure the reports are generated in the first place.

Reports also help better allocate capital and maintenance expenditure. Finally, because HACCP limits are set close to optimal performance limits, there is early recognition of emerging hazards and risks. This means that risk identification is automatically ongoing, and existing risks are frequently being reassessed.

## Excursion Reports

Excursion reports must be completed when critical limits are outside the accepted range. The excursion report is a controlled 1-page template document available online from the quality system. Excursion reports should be emailed to management within 24 hr of the completion of the event.

Management can examine excursions to assess if the event is indicative of systemic failure (e.g., equipment, resources, training). As a minimum, the following people will be on the excursion report email list. (Insert names of staff that will be on the excursion report email list. Below is an example.)

* Director of wastewater operations and director of water operations
* Operations and maintenance manager and customer services manager
* Water quality manager, public information officer, and source control manager

Other parties with reasonable interest in performance may be added on request.

It is the responsibility of the insert name of person responsible for completion of excursion reports (e.g., lead operator) to complete internal excursion reports as required. The insert name of person responsible for completion of external notifications (e.g., treatment plant manager) must complete the external notifications.

## Work Improvement Notices

Workplace improvement notices are used for any staff to submit their suggestions for opportunities for improvement. The work improvement notices can be submitted through a template in the quality system.

Once a work improvement notice is logged, it will be followed through to completion by a insert name of person responsible for completion of work improvement notices (e.g., quality officer). The initiator will receive a formal response from the respondent, and this will be signed off by the relevant manager.

# Training Awareness and Competence

Insert facility name operators have many years of experience with operation of wastewater treatment facilities including MF and RO membrane treatment processes and AOP. The insert facility name operations staff includes insert number of staff members members with the highest level (Grade Level 5) of certification, who are supported by many other highly qualified operators.

Newly hired operation and maintenance technicians are thoroughly trained on the insert facility name and the HACCP plan.

# Internal Audit and Management Review

In accordance with the requirements of HACCP, this plan will be audited from time to time. The auditor will:

* be familiar with the insert facility name treatment process
* check water quality trend reports
* check accuracy of online monitoring equipment
* check plant alarms to ensure they are working properly

The auditor may:

* select random equipment and check that maintenance is up to date
* check staff records for training, certifications, and competency
* carry out safety and environmental training audits as requested by the (insert regulatory agency

**Appendix 1: HACCP Workshop Attendees**

Enter date, time, and location of workshop.

|  |  |
| --- | --- |
| **Attendee** | **Position/Department** |
| Enter attendee’s name | Enter position or department. |
|  |  |
|  |  |
|  |  |

Appendix 2: HACCP Decision Tree

