All NYC WPCPs currently chlorinate the wastewater using hypochlorite prior to discharging:

- Existing SPDES Limit for All NYC WPCPs is 2 mg/L
- Design Hydraulic Retention Time is 30 minutes for DDWF and 15 minutes during a wet weather event.
- NYSDEC has proposed more stringent TRC limits based on EPA marine chlorine toxicity criteria:
  - Acute TRC < 13 ug/l
  - Chronic TRC < 7.5 ug/l
- NYSDEC has included TRC requirements in the new SPDES permit
## SPDES TRC Compliance Schedule for Non-BNR WPCPs

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Current Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submit Scope of Work</td>
<td>10/1/03</td>
</tr>
<tr>
<td>Verify TRC Limits</td>
<td>8/1/04</td>
</tr>
<tr>
<td>Submit Alternatives Evaluation</td>
<td>10/1/05</td>
</tr>
<tr>
<td>Final Limit Verification</td>
<td>4/1/06</td>
</tr>
<tr>
<td>Submit Facility Plans</td>
<td>10/1/07</td>
</tr>
<tr>
<td>Submit Plans and Specs</td>
<td>10/1/08</td>
</tr>
<tr>
<td>Begin Construction</td>
<td>4/1/09</td>
</tr>
</tbody>
</table>

## Calculation of New TRC Limits

\[
\text{Where: } DF = \text{Dilution Factor} \\
\text{CD} = \text{Concentration in Drift Zone} \\
\text{CO} = \text{Concentration at Outfall} \\
\text{CE} = \text{Effluent Concentration} \\
\text{CP} = \text{Permit Limit Concentration} \\
\text{CU} = \text{Immediate Chlorine Uptake Concentration}
\]

\[
C_P = C_U + C_E \\
C_D = C_CE^{*r} \\
13 \times DF = C_D \\
C_D = C_CE^{*r}
\]

\[
C_D = C_CE^{*r}
\]

\[
CD = COe^{-kt}
\]

\[
13 \times DF = CD
\]

\[
CD = COe^{-kt}
\]

\[
CD = COe^{-kt}
\]
New TRC Limits for Jamaica Bay WPCPs

<table>
<thead>
<tr>
<th>WPCP</th>
<th>New TRC Limits (mg/l)</th>
<th>Average Eff TRC (2005-2006) (mg/l)</th>
<th>% Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>26th Ward</td>
<td>0.45</td>
<td>0.80</td>
<td>0.00</td>
</tr>
<tr>
<td>Coney Island</td>
<td>0.64</td>
<td>0.85</td>
<td>0.3</td>
</tr>
<tr>
<td>Jamaica</td>
<td>0.53</td>
<td>0.70</td>
<td>0.82</td>
</tr>
<tr>
<td>Rockaway</td>
<td>0.59</td>
<td>0.51</td>
<td>83</td>
</tr>
</tbody>
</table>

Treatment Technologies Evaluated

- Existing Chlorination Process Optimization
- Chlorination/Dechlorination
- UV Disinfection
- Chlorine Dioxide
- Brominated Compounds
- Peracetic Acid
- Ozone
**Chlorine Dioxide**

**Benefits**
- Very Effective Bactericide and Viricide
- Shorter Contact Time Required than for Sodium Hypochlorite

**Drawbacks**
- No Large Scale Wastewater Treatment Applications Identified
- On-site Generation Required
- Potential Chlorite Toxicity
- Corrosive
- Potential Odor Concerns

**Brominated Compounds**

**Benefits**
- Effective Bactericide and Viricide
- Capital and Operating Costs Similar to Chlorine

**Drawbacks**
- Same Discharge/Toxicity Constraints as Chlorine
- Not Widely Used in the U.S.
- Requires an Additional Chemical (Sodium Bromide and Sodium Hypochlorite)
- Potential DBP Formation
Peracetic Acid

Benefits
- Similar to Chlorination in Terms of Application and Equipment
- No DBPs
- Long Shelf Life

Drawbacks
- Not Yet Approved by USEPA as a Wastewater Disinfectant
- No Full-Scale U.S. Application
- Significantly Higher Costs ($7-8/gallon)

Ozone

Benefits
- Highly Effective Bactericide and Viricide

Drawbacks
- Not Widely Used in U.S. for Wastewater Disinfection
- Significantly Higher Capital Cost
- Significantly Higher Operational Costs
- More Complicated to Operate than Other Technologies
- Most Effective on Filtered and/or Nitrified Wastewaters
Optimized Chlorination

**Benefits**
- Familiar Application, Requires Only Minor Modifications to Existing Disinfection Facilities
- Very Low Capital Cost

**Drawbacks**
- Chlorine Level May Be Difficult to Control with Low Ammonia Effluents
- Potential for DBP Formation with Low Ammonia Effluents
- Increase I&C requirements

Chlorination/Dechlorination

**Benefits**
- Familiar Application, Similar to Chlorination in Terms of Equipment
- Relatively Minor Modifications to Existing Disinfection Facilities
- Lower Capital Cost

**Drawbacks**
- Chlorine Level May Be Difficult to Control with Low Ammonia Effluents
- Potential for DBP Formation with Low Ammonia Effluents
- Re-aeration May be Required
- Higher Operational Costs
UV Disinfection

Benefits

- Simple Operation
- No DBP Generation
- Not Affected by Ammonia Level
- Smaller Space Requirements
- Lower Operating Costs
- Proven Technology

Drawbacks

- Greater Power Requirements
- Higher Capital Costs

UV Disinfection – Proven Technology

* Over 20% of North American Wastewater Treatment Plants now disinfect with UV light
Bench Scale Testing/Wastewater Characterization

- UVT
  - 26th Ward
  - Coney Island
  - North River
  - Port Richmond
  - Rockaway
  - Tallman Island
  - PO-55 Pilot

UV Basics - How Does UV Work?

- Irradiation of Wastewater with UV Light
- Inactivation vs Kill
  - UV Inactivates
    - Causes damage to DNA preventing replication
    - Organism no longer infective
### UV Dose Requirements for Secondary Effluent

<table>
<thead>
<tr>
<th>WPCP</th>
<th>Disinfection Influent (cfu/100 ml)</th>
<th>Required Log Reduction</th>
<th>Required UV Dose (mJ/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fecal Coliform</td>
<td>Enterococcus</td>
<td>Fecal Coliform</td>
</tr>
</tbody>
</table>

#### SECONDARY EFFLUENT - Based on Monthly Limits of (cfu/100 ml)

<table>
<thead>
<tr>
<th></th>
<th>200 cfu/100 ml</th>
<th>35 MPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>26th Ward</td>
<td>8.0E+05</td>
<td>3.5</td>
</tr>
<tr>
<td>Coney Island</td>
<td>2.4E+05</td>
<td>3.1</td>
</tr>
<tr>
<td>North River</td>
<td>8.6E+05</td>
<td>3.6</td>
</tr>
<tr>
<td>Port Richmond</td>
<td>1.0E+06</td>
<td>3.7</td>
</tr>
<tr>
<td>PO-55</td>
<td>1.5E+05</td>
<td>2.9</td>
</tr>
<tr>
<td>Tallman Island</td>
<td>7.7E+05</td>
<td>3.6</td>
</tr>
</tbody>
</table>

### Bench Scale Testing/Wastewater Characterization

- **Chlorination/Dechlorination Dose Response Tests**
  - Coney Island (non-nitrifying)
  - 26th Ward (BNR)
  - Wards Island (BNR)
  - Port Richmond (Low Ammonia Effluent)
  - Rockaway (Low Ammonia Effluent)
  - PO-55 (Low nitrogen)
**Chlorination/Dechlorination Basics - How Does It Work?**

- Chlorination Kills
  - Attacks cell wall, enzymes, & DNA
  - Sodium Bisulfite is then added at the end of the process to remove excess residual chlorine
  - No toxicity issues associated with Sodium Bisulfite
  - An excess could result in lower effluent DO concentrations.

**Predicted Chlorine Requirements**

<table>
<thead>
<tr>
<th>WPCP</th>
<th>Flow (MGD)</th>
<th>Contact Time (Minutes)</th>
<th>Required Chlorine Residual Based On 200 FC/100 ml (mg/l)</th>
<th>Required Chlorine Residual Based On 35 Entero/100 ml (mg/l)</th>
<th>Limit (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26th Ward</td>
<td>60.3</td>
<td>46.3</td>
<td>0.8</td>
<td>0.8</td>
<td>0.45</td>
</tr>
<tr>
<td>Coney Island</td>
<td>90.8</td>
<td>23.5</td>
<td>1.4</td>
<td>2.8</td>
<td>0.64</td>
</tr>
<tr>
<td>Rockaway</td>
<td>19.2</td>
<td>68.4</td>
<td>0.25</td>
<td>0.9</td>
<td>0.59</td>
</tr>
</tbody>
</table>
Disinfection By Products Associated with Chlorination

Average THMs Formation in Disinfected Secondary Effluent

<table>
<thead>
<tr>
<th>THM Species</th>
<th>WPCPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDCM</td>
<td>PO-55</td>
</tr>
<tr>
<td>BRFM</td>
<td>Port Richmond</td>
</tr>
<tr>
<td>CDBM</td>
<td>Rockaway</td>
</tr>
<tr>
<td>CLFM</td>
<td>Coney Island</td>
</tr>
<tr>
<td></td>
<td>26th Ward</td>
</tr>
<tr>
<td></td>
<td>Wards Island</td>
</tr>
</tbody>
</table>

THM Concentration, ug/L

Chlorine Breakpoint Chemistry

CL2 Conc (mg/l)

5 7.6

CL2 to NH3-N Ratio

Breakpoint

Non-germical complexes

Monochloramine

Mono, Di-, & NCl3

Free

Cl2 Residual

Total Applied Dose
## Revised SPDES TRC Compliance Schedule for BNR WPCPs

<table>
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<tr>
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</tr>
<tr>
<td>Final Limit Verification</td>
<td>4/1/06</td>
</tr>
<tr>
<td>Submit Testing Plan</td>
<td>10/1/06</td>
</tr>
<tr>
<td>Begin Operating Demonstration Facilities</td>
<td>4/01/09</td>
</tr>
<tr>
<td>Submit Demonstration Report</td>
<td>10/01/10</td>
</tr>
<tr>
<td>Submit Facility Plans</td>
<td>4/1/11</td>
</tr>
<tr>
<td>Begin Construction</td>
<td>According to Schedule in Facility Plan</td>
</tr>
</tbody>
</table>

### 26th Ward Disinfection Demonstration Facilities

- Side-by-side comparison of UV disinfection and chlorination/dechlorination to assess effectiveness and operation & maintenance requirements
- Full-scale operation and testing for one year
**Coney Island WPCP**
- Recommended Alternative: Chlorination/Dechlorination
- New Permit Limit: 0.64 mg/l
- Percent Compliance: 0.3%
- Facility Plan Scheduled for Submission 11/30/06
- Recommended Work:
  - CFD Modeling (completed)
  - Sodium Bisulfite Storage and Feed System
  - Instrumentation and Controls
- Estimated Cost: $9.2M, 2006

---

**Rockaway WPCP**
- Recommended Alternative: Chlorination System Optimization
  - New Permit Limit: 0.59 mg/l
  - Percent Compliance: 83%
- Facility Plan Submitted 9/5/06
- Optimization Work:
  - CFD Modeling (Completed)
  - High Rate Mixers
  - Elimination of Carrier Water
  - Replacement of Metering Pumps
- Construction Cost - $1.24M, Escalated to 2008
Jamaica WPCP

- Recommended Alternative: Optimization of Existing Chlorination System
- New Permit Limit: 0.53 mg/l
- Percent Compliance: 0.8% (One CCT Operational, Manually Operated)
- Instrumentation & Controls Currently Being Added
- Facility Plan Scheduled for 12/1/06
- Additional Optimization Work
- High Rate Mixers
- Potential Future Contingency: Dechlorination

Questions