



Minnesota Pollution  
Control Agency

520 Lafayette Road  
St. Paul, MN 55155-4194

# Biological Treatment Checklist Attached Growth-Trickling Filter

NPDES/SDS Permit Program  
National Pollutant Discharge Elimination System (NPDES)/  
State Disposal System (SDS)

Doc Type: Plan/Specification Review Summary

This checklist is intended for use by design engineers, to assist Minnesota Pollution Control Agency (MPCA) review engineers in the efficient review of planning and design documents. The information requested is the minimum technical data necessary for MPCA staff to review proposed designs; to determine whether there is reasonable assurance that the treatment system when constructed will comply with permit conditions, regulations, and criteria of the MPCA.

MPCA Use Only
Project Number
Date Received (MM/DD/YYYY)

The information in this checklist is based on the **Recommended Standards for Wastewater Facilities published by the Great Lakes Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (Ten State Standards) 2004 Edition**, other accepted engineering references, and MPCA recommendations. Specific references are listed where appropriate. The checklist is organized according to the numbering sequence found in Ten States Standards to allow for ease in locating the entire content and text of the recommendations.

Attachments and additional information is required for some questions and shall be included with the checklist for all questions when indicated, regardless of answering "yes" or "no". The checklist is designed so that a "yes" answer indicates compliance with 10 States Standards et al, while a "no" answer indicates a deviation from 10 States Standards et al. **Answering "no" to any question will require additional justification and supporting information, from wastewater treatment plant operational data, to demonstrate how the intent of the recommendation will be met.**

Additional information may be requested based on site specific conditions.

## Wastewater Treatment Facility Permittee Information

Facility name: \_\_\_\_\_ NPDES/SDS Permit No.:   MN    
Contact name: \_\_\_\_\_ Contact phone number: \_\_\_\_\_  
E-mail: \_\_\_\_\_

## Design Engineer Information

Title of project: \_\_\_\_\_  
Contact name: \_\_\_\_\_ Contact phone number: \_\_\_\_\_  
E-mail: \_\_\_\_\_

**Phase:** ☐ Planning phase ☐ Design phase  
**Filter:** ☐ New trickling ☐ Rehabilitation

## Trickling Filter (TF) Influent Characteristics

### A. Hydraulic load (mgd) and Recirculation rate (mgd and percent) [design] at:

	Hydraulic load (mgd) (without recirculation)	Recirculation rate (mgd)	Recirculation rate (percent)
ADW			
AWW			
DMD (design max day)			
PHWW			
PIWW			

**B. Organic load (mg/L and #BOD/day):**

Design Ave. BOD \_\_\_\_\_ & \_\_\_\_\_  
 Design Max BOD \_\_\_\_\_ & \_\_\_\_\_  
 Design peak hourly BOD \_\_\_\_\_ & \_\_\_\_\_

**(For strong industrial waste consideration should be given to using peak loading.)**

**C. TKN load (mg/L and #BOD/day):**

Design Ave. TKN \_\_\_\_\_ & \_\_\_\_\_  
 Design Max TKN \_\_\_\_\_ & \_\_\_\_\_  
 Design peak hourly TKN \_\_\_\_\_ & \_\_\_\_\_

**(For strong industrial waste consideration should be given to using peak loading.)**

**Upgrading an Existing Trickling Filter**

	Yes	No
Was the distribution system, underdrain system, and media inspected and evaluated (for an upgraded/expanded existing facility)?	<input type="checkbox"/>	<input type="checkbox"/>
Were rusted arms, missing and/or broken nozzles, splash plates, and plates and condition of bearings and bearing plate observed/evaluated?	<input type="checkbox"/>	<input type="checkbox"/>

**91.1 Trickling Filter General**

	Yes	No
Are the trickling filters preceded by effective clarifiers equipped with scum and grease removal devices and other suitable preliminary facilities?	<input type="checkbox"/>	<input type="checkbox"/>
What is the trickling filter(s) design influent dissolved oxygen concentration: _____ mg/L		
Will influent to the trickling filter be pre-aerated to improve effectiveness of aerobic treatment in the upper sections of the reactor (e.g. pre-aeration basins, aerated grit removal, etc.)?	<input type="checkbox"/>	<input type="checkbox"/>
Will multi-stage filters, or other subsequent biological treatment processes, be included to meet effluent standards?	<input type="checkbox"/>	<input type="checkbox"/>

**91.2 Hydraulics****91.21 Distribution****91.211 Uniformity**

	Yes	No
Are rotary distributors provided? (See note #1)	<input type="checkbox"/>	<input type="checkbox"/>
What is the distribution of influent across the filter at design flow: _____ gal/feet <sup>2</sup>		
Is uniform distribution provided within a 10 percent deviation (per square feet) at any point along the surface area of the trickling filter? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Are reverse reaction nozzles, hydraulic brakes or motor-driven distributors provided for rotary distributors (to not exceed max speeds specified by the manufacturer)?	<input type="checkbox"/>	<input type="checkbox"/>
Are reverse reaction nozzles, hydraulic brakes or motor-driven distributors provided for rotary distributors to accommodate the media flushing rates below? (See note #2).	<input type="checkbox"/>	<input type="checkbox"/>

**Guidelines for TF dosing and flushing rates as a function of BOD loading (WEF 2000)**

BOD loading (kg/c.m. x d)	Operating dose (mm/pass)*	Flushing dose (mm/pass)*
0.25	10-30	> 200
0.5	15-45	> 200
1.0	30-90	> 300
2.0	40-120	> 400
3.0	60-180	> 600
4.0	80-240	> 800

\*mm/pass represents the amount of liquid applied for each pass of each distributor arm

<b>91.212 Head requirements</b>	<b>Yes</b>	<b>No</b>
Is a minimum head of 24 inches between low water level in the siphon chamber (or similar allowance for added pumping head) and center of arms provided for reaction type distributors. (See note #2).	<input type="checkbox"/>	<input type="checkbox"/>
<b>91.213 Clearance</b>	<b>Yes</b>	<b>No</b>
Is a minimum 12 inch clearance between media and distributor arms provided?	<input type="checkbox"/>	<input type="checkbox"/>
<b>91.22 Dosing</b>	<b>Yes</b>	<b>No</b>
Is the application of wastewater over the media continuous?	<input type="checkbox"/>	<input type="checkbox"/>
Is the piping system designed for recirculation?	<input type="checkbox"/>	<input type="checkbox"/>

## 91.3 Media

List type of media (rock, slag, plastic, etc.): \_\_\_\_\_

<b>91.31 Quality</b>	<b>Yes</b>	<b>No</b>
Is the media durable, resistant to spalling or flaking and insoluble in wastewater? (See note #3)	<input type="checkbox"/>	<input type="checkbox"/>
Is slag media free from iron or other leachable materials?	<input type="checkbox"/>	<input type="checkbox"/>
Is manufactured media resistant to high influent temperature degradation, ultraviolet degradation, disintegration, erosion, aging, all acids and alkalies, organic compounds, fungus, and biological attack?	<input type="checkbox"/>	<input type="checkbox"/>
What is the maximum temperature rating of the media: _____ deg. C.		
Is the media able to support a person's weight, or is an access walkway provided?	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.32 Depth</b>	<b>Yes</b>	<b>No</b>
Does the trickling filter media have a minimum depth of 6 feet or greater above the underdrains?	<input type="checkbox"/>	<input type="checkbox"/>
Is the rock/slag filter media depth less than 10 feet?	<input type="checkbox"/>	<input type="checkbox"/>
What is the media manufacturer's maximum recommended depth for their media: _____ feet		

## 91.33 Size, grading, and handling of media

<b>91.331 Rock, slag, and similar media</b>	<b>Yes</b>	<b>No</b>
Does rock, slag, and similar media contain less than five percent by weight of pieces whose longest dimension is three times the least dimension?	<input type="checkbox"/>	<input type="checkbox"/>
Is the media free from thin, elongated and flat pieces, dust, clay, sand or fine material?	<input type="checkbox"/>	<input type="checkbox"/>
Does the media conform to the gradation in 10 States Standards, when mechanically graded over a vibrating screen with square openings? (See note #4)	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.333 Media handling and placing</b>	<b>Yes</b>	<b>No</b>
Will the material delivered to the filter site be stored on wood-planked or other approved clean, hard surfaced areas?	<input type="checkbox"/>	<input type="checkbox"/>
Will the material be re-handled at the filter site and not dumped directly into the filter?	<input type="checkbox"/>	<input type="checkbox"/>
Will crushed rock, slag and similar media be washed and re-screened at the filter site to remove fines?	<input type="checkbox"/>	<input type="checkbox"/>
Will the material be placed by hand to a depth of 12 inches above the tile underdrains?	<input type="checkbox"/>	<input type="checkbox"/>
Will the remainder of the material be place by means of belt conveyors?	<input type="checkbox"/>	<input type="checkbox"/>
Do the plans and specifications specify that cutting or shaping of manufactured media is not allowed in the filter to avoid clogging?	<input type="checkbox"/>	<input type="checkbox"/>
Will trucks, tractors, and other heavy equipment be precluded from driving over the filter during or after construction?	<input type="checkbox"/>	<input type="checkbox"/>

## 91.4 Underdrainage System

<b>91.41 Arrangement</b>	<b>Yes</b>	<b>No</b>
Are underdrains with semicircular inverts or equivalent provided?	<input type="checkbox"/>	<input type="checkbox"/>
Does the underdrainage system cover entire filter floor?	<input type="checkbox"/>	<input type="checkbox"/>
Do the inlet openings into the underdrains have an unsubmerged gross combined area of at least 15 percent of the filter surface area? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.42 Hydraulic Capacity</b>	<b>Yes</b>	<b>No</b>
Do the underdrains have a minimum slope of one percent?	<input type="checkbox"/>	<input type="checkbox"/>
Do the effluent channels have a minimum velocity of 2 fps at design average flow rates? (See note #2).	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.43 Ventilation</b>	<b>Yes</b>	<b>No</b>
Are the size of the drains, channels, and pipes such that not more than 50 percent or less of their cross-sectional area will be submerged under design peak instantaneous wet weather flow, including proposed or possible future recirculation flows? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Are ventilating manholes with open-grating types of covers installed for both ends of the central collection channel (M and E 2003)?	<input type="checkbox"/>	<input type="checkbox"/>
Are branch collecting channels with ventilating manholes or vent stacks installed at the filter periphery (M and E 2003)?	<input type="checkbox"/>	<input type="checkbox"/>
Is 1 s. f. of ventilation area for each 10 to 15 feet of trickling filter tower periphery provided (MOP #8 1977)?	<input type="checkbox"/>	<input type="checkbox"/>
Is 10 s. f. of gross area of open grating in ventilating manholes and vent stacks provided for each 250 s. f. of filter area? (M and E 2003). (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Is a minimum airflow of 1 c. f./min.- s. f. of filter area in either direction provided (M and E 2003)? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Will forced ventilation be provided?	<input type="checkbox"/>	<input type="checkbox"/>
Are windows or simple louvered mechanisms arranged to ensure air distribution throughout the enclosure?	<input type="checkbox"/>	<input type="checkbox"/>
Does the design of ventilation facilities provide for operator control of air flow?	<input type="checkbox"/>	<input type="checkbox"/>
Are the design computations showing adequacy of air flow to satisfy process oxygen requirements attached? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Does the design include provision to restrict air flow through the filter to keep it from freezing during periods of extremely low air temperature?	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.44 Flushing</b>	<b>Yes</b>	<b>No</b>
Are provision in the plans and specifications included for flushing the underdrains?	<input type="checkbox"/>	<input type="checkbox"/>
Are inspection facilities provided?	<input type="checkbox"/>	<input type="checkbox"/>

## 91.5 Special Features

<b>91.51 Flooding</b>	<b>Yes</b>	<b>No</b>
Are appropriate valves, sluice gates, or other structures provided to enable flooding of filters?	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.52 Freeboard</b>	<b>Yes</b>	<b>No</b>
Is a freeboard of four feet or more provided between the media surface to the top of the tank wall?	<input type="checkbox"/>	<input type="checkbox"/>
Is a headroom of at least six feet provided between the distributor and the tank cover for maintenance of the distributor?	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.53 Maintenance</b>	<b>Yes</b>	<b>No</b>
Are distribution devices, underdrains, channels and pipes designed so that they may be properly maintained, flushed and/or drained?	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.54 Winter protection</b>	<b>Yes</b>	<b>No</b>
Are covers provided for all trickling filters?	<input type="checkbox"/>	<input type="checkbox"/>

<b>91.55 Recirculation</b>	<b>Yes</b>	<b>No</b>
Is the recirculation rate variable and subject to plant operator control at the range of 0.5:1 up to 4:1 pursuant to section 91.211?	<input type="checkbox"/>	<input type="checkbox"/>
Are a minimum of two recirculation pumps provided?	<input type="checkbox"/>	<input type="checkbox"/>
What is the design flow for each pump:		mgd
What is the TDH for each pump:		feet
What is the design flow for the pumping system:		mgd
What is the TDH for the pumping system:		feet
Is the media flushing rate variable and subject to plant operator control at the range of 0.5:1 up to 4:1 pursuant to section 91.211?	<input type="checkbox"/>	<input type="checkbox"/>

91.56 Recirculation measurement			Yes	No
Is a device provided to measure the recirculation rate?			<input type="checkbox"/>	<input type="checkbox"/>
What is the maximum recirculation rate:		mgd		
What is the minimum recirculation rate:		mgd		

91.57 Ventilation ports			Yes	No
Are the underdrainage ventilation ports designed to ensure that the interior flow will be retained inside the trickling filter?			<input type="checkbox"/>	<input type="checkbox"/>

## 91.6 Rotary Distributor Seals

	Yes	No
Are existing seals mercury free (for existing facilities)?	<input type="checkbox"/>	<input type="checkbox"/>
Are mercury seals being replaced (for existing facilities)?	<input type="checkbox"/>	<input type="checkbox"/>
Do the plans and specifications provide for ease of seal replacement to ensure continuity of operation?	<input type="checkbox"/>	<input type="checkbox"/>

## 91.7 Unit Sizing

	Yes	No
Were the MPCA Reliability Guidelines used to determine required number of units?	<input type="checkbox"/>	<input type="checkbox"/>
Is the required volume(s) of filter media based on pilot testing with the particular wastewater? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Is the required volume(s) of filter media based on use of empirical design equations that have been verified through full scale experience with the particular wastewater? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Is the trickling filter design based on the peak organic load conditions including the oxygen demands due to recycle flows? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>
Is the volume of media determined based upon design maximum day BOD organic loading rate? (See note #2)	<input type="checkbox"/>	<input type="checkbox"/>

What design formulations are being utilized (NRC, Velz, Howland, Schulze, Germain, Eckenfelder, Barnhart, Galler & Gotaas, Bruce & Mertens, etc.):

What are the media constants/packing coefficients:

What is the design minimum temperature: \_\_\_\_\_ deg. C

What are the treatability factors/treatability constants/rate constants/hydraulic constants:

What is the trickling filters design removal rate(s)

(e. g., settled filter effluent BOD/filter influent BOD {[mg/L]/[mg/L]}) (See note #2):

What is the design equations contact time (t): \_\_\_\_\_ min.

Are the design loadings calculations attached in the design summary? ☐ Yes ☐ No

(The design loading calculation list below are considered the minimum.)

Parameter	Unit	Value
Number of filters	Number	
Diameter	Feet	
Depth	Feet	
Total packing volume	c. f.	
Media surface area	s.f./c.f.	
Hydraulic load	gpd/s.f.*	
Organic load	#BOD/1000 c.f. – day	
TKN load	#TKN/1000 c.f. – day	
Maximum temperature	Degrees C.	
Minimum temperature	Degrees C.	
Total pumping rate	gpd, gpm, and cfs	
Recirculation ratio	Unitless	
Distributor arms	Number	
Normal distributor speed	Min/Rev	
Flushing distributor speed	Min/Rev	
Clarifiers	Number	
Clarifier depth	Feet	
Clarifier diameter	Feet	

\*Without recirculation

## Notes

1. If no, attach alternative design summary.
2. Attach design summary, reports, analysis, pilot testing, calculations, etc.
3. Attach sodium soundness testing pursuant to 10 States Standards section 91.31.
4. Attach screen/sieve analysis as specified in 10 States Standards section 91.331.

## References

GLUMRB (2004) *Recommended Standards for Wastewater Facilities* (Ten States Standards), Great Lakes-Upper Mississippi River Board of State Sanitary Engineering Health Education Services Inc., Albany NY.

Metcalf & Eddy, Inc. (2003) *Wastewater Engineering, Treatment and Reuse*, 4th ed., McGraw-Hill, New York.

WEF (1998) *Design of Municipal Wastewater Treatment Plants, Manual of Practice No. 8*, Water Environment Federation, Alexandria, VA.

WEF (2000) *Aerobic Fixed-Growth Reactors; A Special Publication*, Water Environment Federation, Alexandria, VA.

WPCF (1977) *Wastewater Treatment Plant Design, Manual of Practice No. 8*, Water Pollution Control Federation, Alexandria, VA.

## Acronym definitions

ADW	Average Dry Weather Flow
AWW	Average Wet Weather flow
BOD	Biochemical Oxygen Demand
C	Celcius
c.f.	cubic feet
cfs	cubic feet per second
c.m.	cubic meter
d	day
DMD	Design max day
fps	feet per second
ft	feet
ft <sup>2</sup>	feet squared
gal	gallon
gpd	gallons per day
kg	kilogram
mg/L	milligram per liter
mgd	million gallons per day
mm	millimeter
PHWW	Peak Hourly Wet Weather flow
PIWW	Peak Instantaneous Wet Wether flow
s.f.	square feet
TF	Trickling Filter
TKN	Total Kjeldahl Nitrogen
TDH	Total Dynamic Head

## Comments: