

Thermal Rules Implementation What You Should Know



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2011 Government Affairs Seminar

Overview

- Basics of NR 102 and NR 106
- Intro to Limit Calculations
- Monitoring Requirements
- DC Evaluation
- Questions?



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Types of Standards (NR 102)

- Public health & welfare
 - 120° F
- Fish and aquatic life
 - Acute (lethality)
 - Sub-lethal
 - Spawning
 - Juvenile growth
 - Gametogenesis



Ambient Temperature (NR 102)

- Specific large rivers
- Northern and southern inland lakes
- Great Lakes waters
- Non-specific waters (default)



Who Needs to be Evaluated? (NR 106)

Does the point source have a WPDES permit?

Includes all WPDES permits even Municipal POTWs

Does the point source discharge heat or is there a heat gradient?

Does the point source discharge to a surface water to the state?

Is the point source a stormwater discharge?

If yes to each box, permit **must** be evaluated for thermal limits

No to any box above

Yes

No evaluation required

Rule Flexibility

- NR 102
 - Site-specific ambient temperature values
 - Site-specific water quality criteria
- NR 106
 - Annual, seasonal, or monthly limits
 - Alternative mixing zones
 - Limits derived from water quality models
 - Dissipative cooling (*for POTWs only*)
 - Compliance schedules
 - Variances- 283.15, Stats. (3-yr duration)
 - Alternative Effluent Limits- equivalent of federal 316(a) demonstration (10-yr duration)

Orange= Federal approval required

Flexibilities in Order of Cost/Likely Benefits/Ease

- Monthly low flows
- Site-specific ambient temperatures
- Mixing zone studies/modeling
- Real-time limits
- Site-specific criteria
- Variances as a last resort

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Does My Discharge Need Thermal Limits?

- Use $Q_s:Q_e$ ratio for preliminary evaluation
 - $Q_s:Q_e$ can be found in Appendix D of the Guidance Document

Flow Ratio and Limitations		
Warm Water	Cold Water	Effluent Temperature Limitation
$Q_s:Q_e \geq 20:1$	$Q_s:Q_e \geq 30:1$	120°F
$20:1 > Q_s:Q_e > 2:1$	$30:1 > Q_s:Q_e > 2.5:1$	120°F or sub-lethal WQBEL, whichever is lower
$Q_s:Q_e \leq 2:1$	$Q_s:Q_e \leq 2.5:1$	Sub-lethal and acute WQBELs

Stream Types for Criteria and Ambient Temperatures

- Cold water community
- Large warm water sport or forage fish community
- Small warm water sport or forage fish community
- Limited forage fish community
- Mississippi River
- Rock River
- Upper Wisconsin River
- Lower Wisconsin River
- Lower Fox River

What You Need to Calculate Limits

Stream Conditions

- **Stream flow (Qs) from USGS**
 - $Q_s = \frac{1}{4}$ of the 7-Q10
 - Annual, Monthly or Seasonal 7-Q10
- **Ambient Temperature**
 - NR 102
 - Site-Specific

Discharge Conditions

- **Effluent flow (Qe)**
 - **Municipal**
 - Annual design flow
 - **Industrial**
 - Annual average flow
 - Seasonal or other (case by case)
- **Effluent Temperature Data***

*If insufficient data, *limits subject to drop* may be included in permit

Calculating the Limits

- Equations found in NR 106

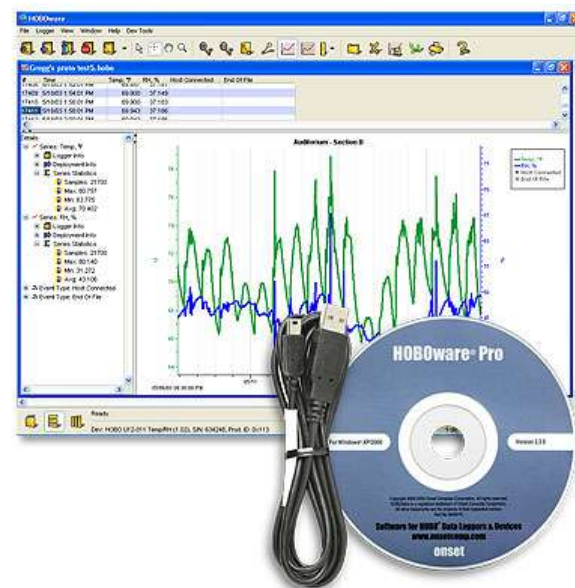
<http://dnr.wi.gov/org/water/wm/wqs/thermalrulesrevisions.htm>

Special Cases:

- LAL limit = 86 ° F daily max
- Effluent channel = 120 ° F daily max
- Wetland = case by case with 120 ° F cap

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How to Monitor?

- Only monitor when you are actively discharging during a 24-hour period
- Continuous method
 - Record data every 15 minutes or less
- Multiple grab sample method
 - Record data at 6 evenly spaced time intervals
 - Sampling interval can be modified via supporting data
- Collect data at discharge point or closest point to it within a facility

What to Record?

- **Effluent temperature**

- **Daily maximum**

- Highest record value during a 24-hour period

- **Minimum effluent temperature requirements**

- **Low variability**

- At least 1 operating day per week for 1 years

- **Highly variable discharges**

- At least 1 operating day per week for 2 years

- If insufficient data present, *limits subject to drop* will be included in permit

Temperature Logger System

- Set-up
- Deploy
 - Re-bar and zip ties??
- Download/Re-deploy



Data Logger Options



HOBO

- Operation range: -20 °C to 70 °C
- Battery life: ≈ 1 yr.
- User replaceable battery
- Cost: \$59 each



Water Temp Pro V2

- Operation range: -20 °C to 70 °C
- Battery life: ≈ 6 yrs.
- Factory replaceable battery
- Cost: \$123 each



TidbiT V2

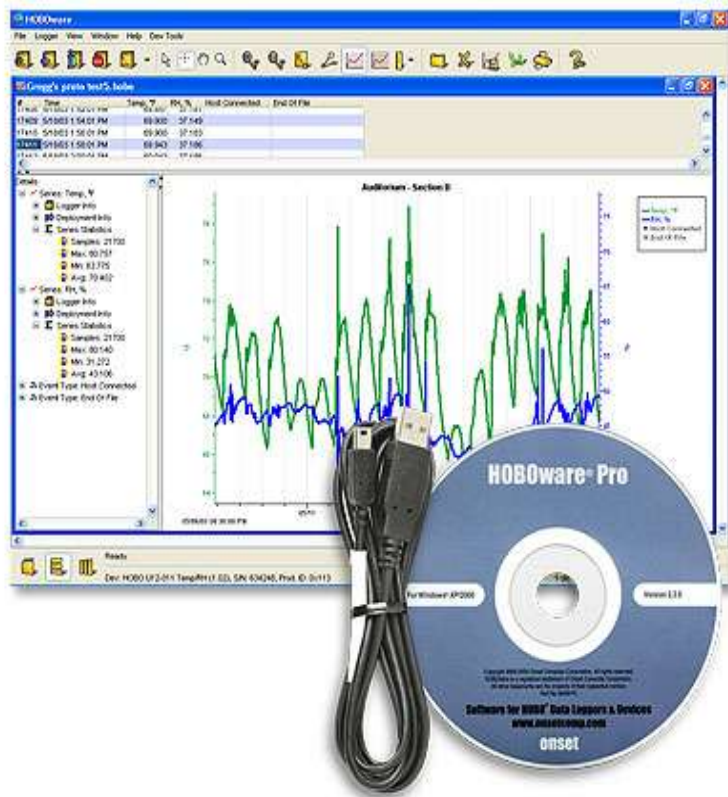
- Operation range: -20 °C to 70 °C
- Battery life: ≈ 5 yrs.
- Non-replaceable battery
- Cost: \$133 each

Waterproof Shuttle



- Communicate between pc and temp. logger via USB
- Download and reset logger in the field
- Can be used with multiple tidbits
- AA batteries
- Cost: \$230 each

HOBOWare Pro Software



- Required for temp. logger set-up and download.
- Used for graphing and data analysis.
- Easy export to excel.
- Cost: \$89

TOTAL COST FOR DATA LOGGER= \$378-\$452

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What is Dissipative Cooling?

- **Cooling effects associated with heat loss to the ambient water, the atmosphere and the surrounding environment (NR 106.59)**
 - Dispersion
 - Diffusion
 - Dilution
 - Heat Dissipation



Why Request Dissipative Cooling?

By successfully supporting DC, **weekly limits** are no longer included in permit

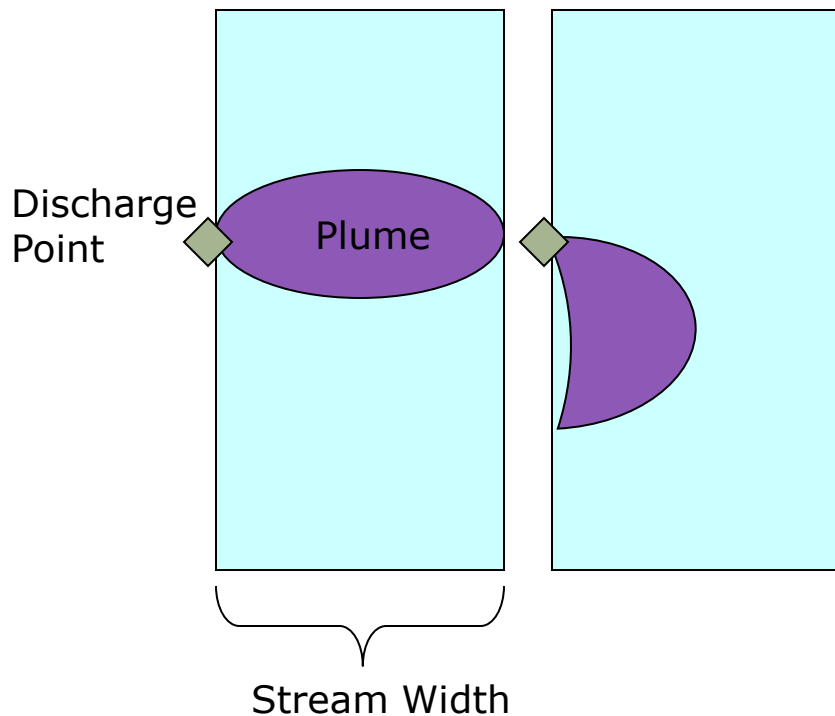
Facts to consider:

- Permittees are responsible to provide the Department with all relevant information
- Data collection may be required
- For POTWs only

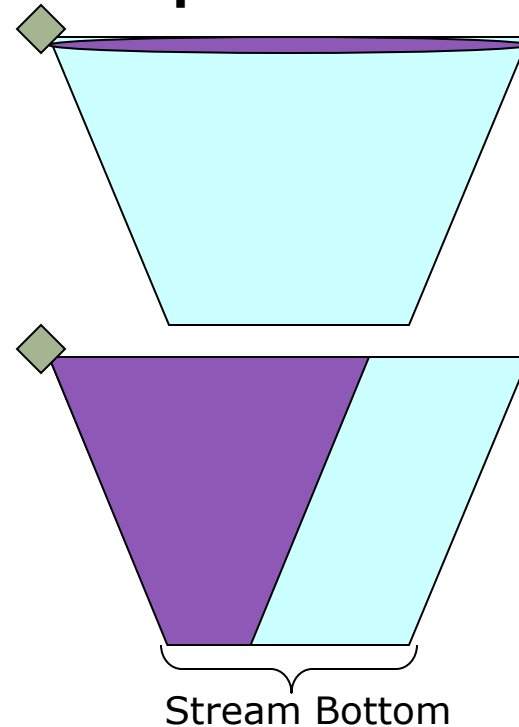
Things to Look For → Plume Behavior

- Zone(s) of free passage
- Zone does not extend more than 25% of the cross-sectional area or more than 50% of the width of the receiving stream

Surface View



Depth View



Things to Look For → Rapid Heat Loss

- High exit velocity



- Ambient flow conditions



- Structures



- Loss to atmosphere?



Things to Look For → Other

■ Biota

- Endangered/threatened species absent
- *Difference in biotic communities in and outside of discharge*
- *No impediment of migration*

■ Multiple discharges present

■ Others?



No Data Available

- Some facilities may not have data available
- Recommendations
 - Perform temperature profile study
 - If needed, perform dye study
 - Provide visual evidence



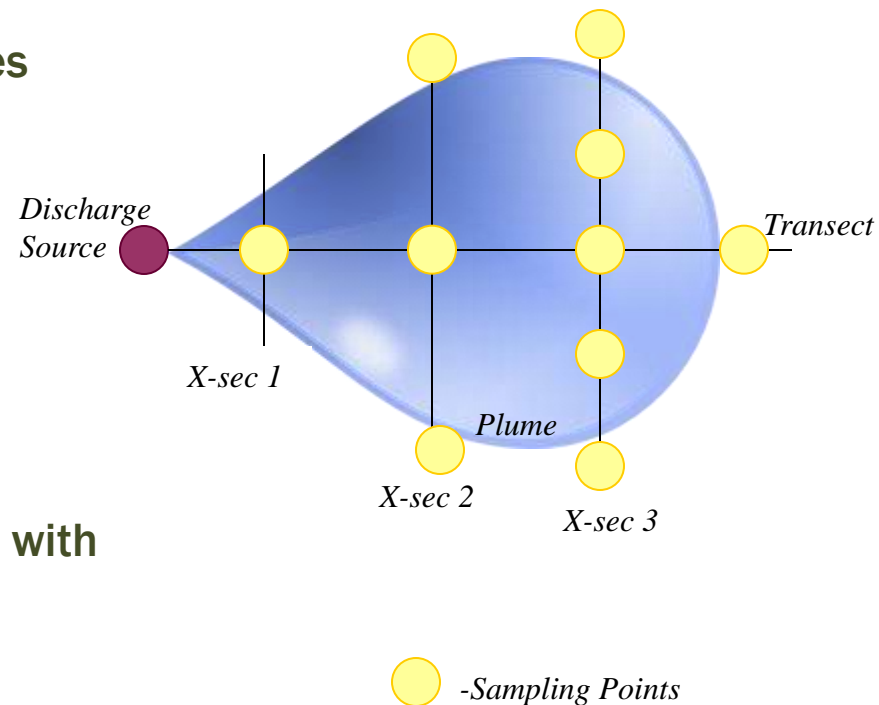
Thermal profile

■ Goal:

- Represent vertical and horizontal distribution of mixing zone
- Represent significant morphological changes
 - Depth
 - Stream flow/direction
 - Substrate
 - Emergent features
 - Others

■ Needed Elements:

- Ambient temperature reading upstream
- Surface temperature readings and readings with depth
- Depth at each sampling
- Distance between sample and discharge source
- Conductivity measurements



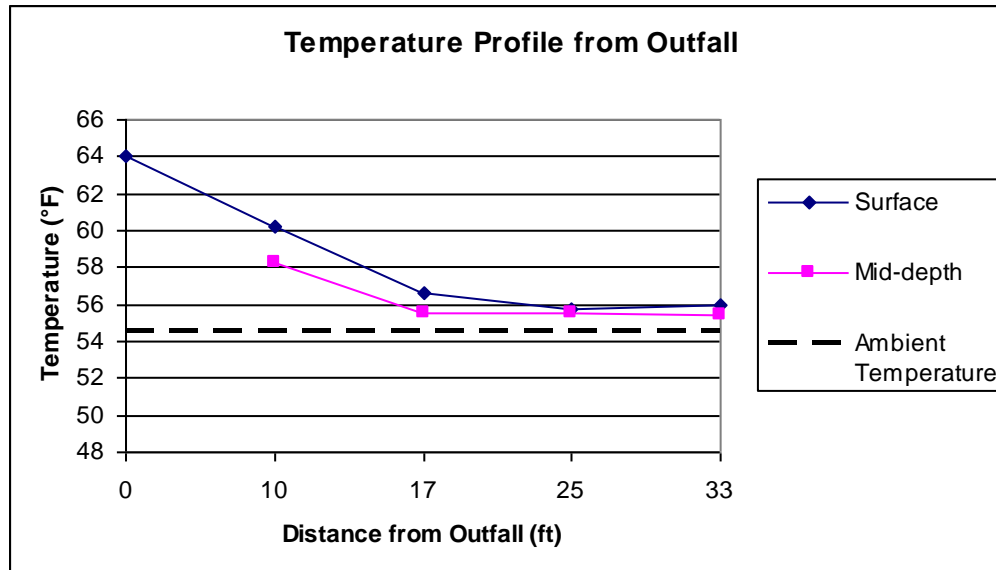
Stoughton DC example

- Unidirectional waters
- Rough bottom substrate present resulting in turbulent flow
- Zone(s) of free passage exist for fish and aquatic life

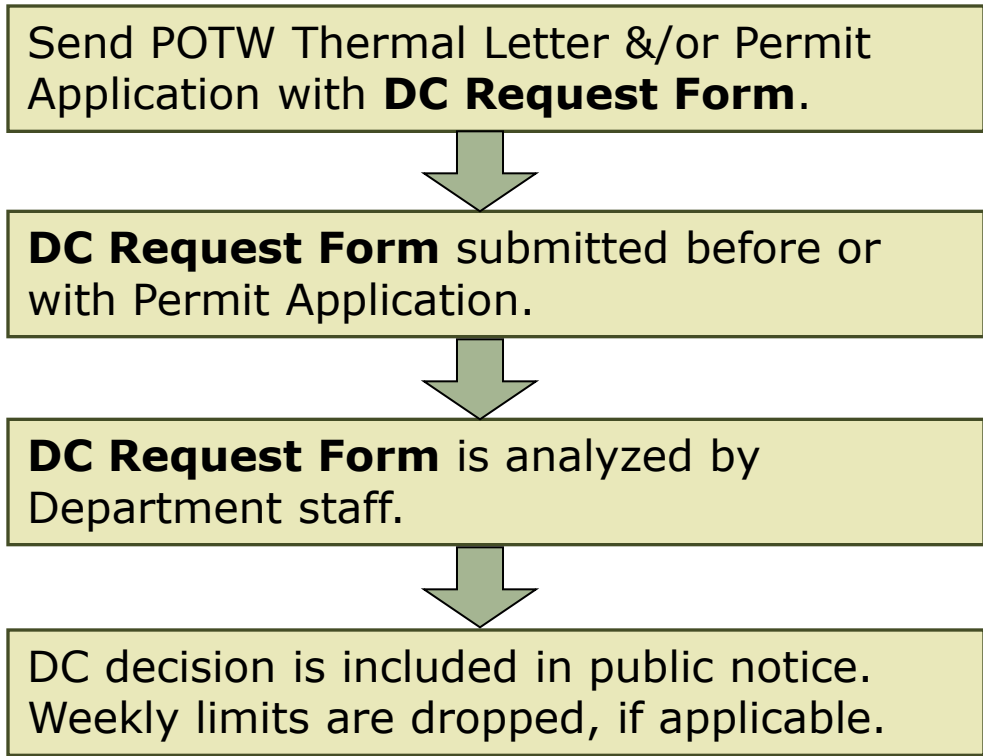


Stoughton Profile Results

- Discharge 10 °F warmer than the ambient
- 85% of heat lost at 33 ft from the outfall source
- Thermal mixing zone does not extend more than 50% of the width of the receiving stream



DC Evaluation Process



DISSIPATIVE COOLING EVALUATION CHECKLIST

This checklist is meant to be a tool to help WQBEL calculators analyze dissipative cooling (DC) requests made by POTWs under NR 106.59(4) or (6).

Permit Information:

Permittee name: _____ WPDES Permit No.: _____

This operation is (check one): New POTW, or Existing POTW

This DC evaluation is (check one): Original DC proposal, or Updated DC proposal

Submitted Information:

Physical Characteristics:

Type of Receiving Water	<input type="checkbox"/> Non-unidirectional water <input type="checkbox"/> Unidirectional water	Comments:
Waterbody type	<input type="checkbox"/> Cold water fishery <input type="checkbox"/> Warm water sport fishery <input type="checkbox"/> Warm water forage fishery	Comments:
Substrate	<input type="checkbox"/> Rocky <input type="checkbox"/> Gravel <input type="checkbox"/> Sand <input type="checkbox"/> Silt <input type="checkbox"/> Other <input type="checkbox"/> Unknown	Comments:
Emergent features	<input type="checkbox"/> Rocks <input type="checkbox"/> Other <input type="checkbox"/> Structure <input type="checkbox"/> None <input type="checkbox"/> Rip-rap	Comments:
Ambient temperature data	<input type="checkbox"/> Available <input type="checkbox"/> Not available	Comments:

Operation Characteristics:

Multiple Discharges	<input type="checkbox"/> There are multiple discharges that may contribute thermal loads <input type="checkbox"/> There are NOT multiple discharges	Comments:
Availability of effluent temperature data	<input type="checkbox"/> Available <input type="checkbox"/> Month(s) only (explain) <input type="checkbox"/> 12 months of representative data (as defined in NR 106.59(4) or 6(3)) <input type="checkbox"/> Not available	Comments:
Temperature profile of thermal plume	<input type="checkbox"/> Data available <input type="checkbox"/> Zones of free passage identified <input type="checkbox"/> Zones of free passage present <input type="checkbox"/> Zones of free passage absent <input type="checkbox"/> No data available	Comments:
Mixing zone characteristics	<input type="checkbox"/> Visual/photographic information <input type="checkbox"/> Dye study <input type="checkbox"/> No data available	Comments:
Heat loss to the atmosphere	<input type="checkbox"/> Significant <input type="checkbox"/> Not significant <input type="checkbox"/> Unknown	Comments:

Biological Characteristics:

Discharge impacts on migration of organisms	<input type="checkbox"/> Impeded <input type="checkbox"/> Not impeded <input type="checkbox"/> Unknown	Comments:
Difference between communities in and outside of discharge	<input type="checkbox"/> Observed <input type="checkbox"/> Not observed <input type="checkbox"/> Unknown	Comments:
Threatened or endangered organisms	<input type="checkbox"/> Present; source? <input type="checkbox"/> Not present; source? <input type="checkbox"/> Unknown	Comments:

What is required to be submitted?

- **NR 106.59(4) or NR 106.59(6)**
- **Required**
 - Written description of physical characteristics
 - Written description of other thermal loads
- **Required if available**
 - Effluent temperature data
 - Biological quality data
 - Presence of threatened/endangered species
 - Receiving water temperature
 - Other
- **All pertinent data should be included in submittal whether affirmative or negative**

Conclusion

- Municipalities may be subject to thermal limits, particularly daily maximum and weekly limits
- Effluent temperature monitoring will likely be required
 - If unspecified, can use continuous or multiple grab methods
- Dissipative cooling can provide relief from weekly limits
 - Marginal amounts of data collection will likely be required

Additional Resources

- **Thermal Website:**

- <http://dnr.wi.gov/org/water/wm/wqs/thermalrulesrevisions.htm>

- Thermal Guidance Document

- Frequently Asked Questions

- **Thermal Email: DNRthermal@wisconsin.gov**

Questions?

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