Temperature

Thermal pollution occurs when humans change the temperature of a body of water. The most common point source of thermal pollution is cooling water, which is used to cool machinery. Thermal pollution may also be caused by stormwater runoff from warm surfaces such as streets and parking lots. Soil erosion is another cause, since it can cause cloudy conditions in a water body. Cloudy water absorbs the sun's rays, resulting in a rise in water temperature. Thermal pollution may even be caused by the removal of trees and vegetation which normally shade the water body.

Thermal pollution can result in significant changes to the aquatic environment. Most aquatic organisms are adapted to survive within a specific temperature range. As temperatures increase, cold water species, such as trout and stonefly nymphs, may be replaced by warmwater species, like carp and dragonfly nymphs. Thermal pollution may also increase the extent to which fish are vulnerable to toxic compounds, parasites, and disease. If temperatures reach extremes of heat or cold, few organisms will survive.

In addition to thermal pollutions' direct effects on aquatic life, there are numerous indirect effects. Thermal pollution results in lowered levels of dissolved oxygen, since cooler water can hold more oxygen than warmer water. Low dissolved oxygen levels will cause oxygen-sensitive species to die.

Photosynthesis and plant growth increase with higher water temperatures, resulting in more plants. When these plants die, they are decomposed by bacteria that consume oxygen. This can result in a further drop in dissolved oxygen levels.

The metabolic rate of fish and aquatic organisms also increases with increasing water temperatures, and additional oxygen is required for respiration. Life cycles of aquatic insects may speed up in response to higher water temperatures. Animals that feed on these insects may be harmed, especially birds that depend on aquatic insects emerging at specific times during their migratory flights.

Water Quality Standards for Temperature

Rules 69 through 75 of the Michigan Water Quality Standards (Part 4 of Act 451) specify temperature standards which must be met in the Great Lakes and connecting waters, inland lakes, and rivers, streams and impoundments. The rules state that the Great Lakes and connecting waters and inland lakes shall not receive a heat load which increases the temperature of the receiving water more than 3 degrees Fahrenheit above the existing natural water temperature (after mixing with the receiving water). Rivers, streams and impoundments shall not receive a heat load which increases the temperature of the receiving water more than 2 degrees Fahrenheit for coldwater fisheries, and 5 degrees Fahrenheit for warmwater fisheries.

These waters shall not receive a heat load which increases the temperature of the receiving water above monthly maximum temperatures (after mixing). Monthly maximum temperatures for each water body or grouping of water bodies are listed in the rules.

The rules state that inland lakes shall not receive a heat load which would increase the temperature of the hypolimnion (the dense, cooler layer of water at the bottom of a lake) or decrease its volume. Further provisions protect migrating salmon populations, stating that warmwater rivers and inland lakes serving as principal migratory routes shall not receive a heat load which may adversely affect salmonid migration.

Effluent Limitations for Temperature in NPDES Permits

Temperature limits are necessary if a facility's effluent has the potential to raise the temperature of the receiving water above acceptable levels. Limits are often needed for facilities discharging noncontact cooling water. Effluent monitoring may be required to gain more information about a facility's effluent.