oregon association of CLEAN WATER agencies

Temperature Management Plan Guidance Manual July 2000

Acknowledgements

We would like to thank the Oregon Association of Clean Water Agencies for funding the development of this guidance document. We would also like to thank Janet Gillaspie, Garry Ott and John Jackson for overseeing this project. Finally we acknowledge the help and responsiveness of the municipalities and agencies that contributed data and information on treatment plant operations.

How to Use this Manual

This guidance manual was developed by the Oregon Association of Clean Water Agencies (ACWA) to assist municipal wastewater agencies in developing temperature monitoring programs and Publicly Owned Treatment Works (POTW) Temperature Management Plans as required by Oregon's 1996 temperature standard.

Chapter 1 reviews the current regulations and provides guidance on determining whether a POTW Temperature Management Plan is required. Overall, DEQ will be requiring temperature management plans as a permit condition:

- if the discharge is to a stream that is water quality-limited,
- if heat is contributed to the stream above a water quality-limited stream segment,
- if the discharge has a measurable impact outside of the assigned mixing zone,
- if there are endangered fish present,
- if you discharge to a lake,
- if the stream violates standards for dissolved oxygen, or
- if the mixing zone impairs a cold water refugia for fish.

To assess whether a discharge causes a measurable increase in stream temperature, DEQ may require that a temperature monitoring program be established. Chapter 2 offers guidance on temperature data collection in the receiving water, within the treatment plant, and in the collection system. Temperature data analysis and formatting procedures are presented in Chapter 3.

The impacts of a point source on receiving water temperature are measured at the edge of the mixing zone. Chapter 4 offers guidance on assessing the size and shape of a mixing zone. The size and shape of the mixing zone may be important in avoiding impacts on fish in the receiving water. The larger the mixing zone, the less likely there will be a measurable increase in stream temperature.

Chapters 5, 6, 7, and 8 offer guidance on developing a Temperature Management Plan once it has been determined that such a plan is required. These chapters present potential Best Management Practices (BMPs), discuss ways to evaluate the BMPs and provide a standardized template for writing a Temperature Management Plan.

System managers should carefully evaluate how temperature reduction efforts at the treatment plant will fit into the overall efforts within the basin to meet applicable water quality standards.

Incremental efforts to reduce temperature impacts at a treatment plant should be mindful of other environmental and water quality issues in the basin, including Endangered Species Act listings, and other water quality standards exceeded in the basin that might impact POTW discharges, such as elevated nutrient concentrations or lowered dissolved oxygen levels.

Table of Contents

TEMPERATURE MANAGEMENT PLAN GUIDANCE MANUAL

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Chapter 1.0 - Introduction

The Guidance Manual includes POTW temperature measurement methodologies, data analysis procedures, and best management practices (BMPs) and/or temperature control technologies that should be considered as part of a POTW's Temperature Management Plan. The Manual also includes BMP evaluation methodologies and criteria, Temperature Management Plan development guidance, and a standard template for the preparation of a Temperature Management Plan.

This chapter contains information on Oregon's temperature standard. It also includes guidance for POTWs on deciding if a Temperature Management Plan is required and what is to be included in a plan. Finally, details are given about temperature control on waters that currently meet the temperature criteria.

Temperature Is Critical to the Health of Oregon's Streams

Stream temperature is an important water quality parameter as it has a significant effect on the health of many of Oregon's native aquatic species, including those salmonids identified as endangered or threatened under the federal Endangered Species Act (ESA). Cold water is a fundamental characteristic of many of Oregon's natural aquatic ecosystems. The purpose of Oregon's temperature standard, like all water quality standards, is to protect the beneficial uses of the waters of the state and to preserve the health of aquatic ecosystems. The beneficial uses most sensitive to water temperature are fish and aquatic life and, therefore, the temperature standard is based on protecting these uses.

The goals of the temperature standard are to prevent or minimize surface water temperature warming caused by human activity and to maintain the "normal" temperature regime throughout the year. Oregon currently has approximately 480 streams, rivers, stream and river segments, lakes and estuaries identified as water quality-limited for temperature. "Water quality-limited" is a term that refers to a stream or river that fails to meet water quality standards, even after the best available technology is applied to discharges. Oregon's Department of Environmental Quality (DEQ) is required to establish Total Maximum Daily Loads (TMDLs) on water quality-limited streams. Once TMDLs are determined, sources will be assigned specific waste load allocations (WLA) to meet water quality standards.

It is possible that water quality standards may become more stringent as a result of the listing of salmonids, a cold water species, as "endangered" under the Endangered Species Act (ESA 7 U.S.C. 136; 16 U.S.C. 460 et seq. 1973). Greater stringency would result in many more stream segments being identified as water quality-limited for temperature.

The Purpose of ACWA's Guidance Manual

Many National Pollutant Discharge Elimination System (NPDES) permit holders will be required to develop Temperature Management Plans. The Oregon Association of Clean Water Agencies (ACWA) has recognized the number of stream segments within the state identified as water quality-limited for temperature and the number of its member agencies that may be required to develop surface water Temperature Management Plans for their wastewater treatment plants. Therefore, ACWA has developed this Temperature Management Plan Guidance Manual to help municipal wastewater agencies in the following ways:

- Simplify the development of the Temperature Management Plans, thus reducing their cost. Using this guidance manual, most publicly owned treatment works (POTWs) should be able to develop a Temperature Management Plan in a straightforward manner.
- Standardize temperature measurement methodologies to improve the usefulness of the temperature data collected across the State of Oregon. The guidance manual presents information on temperature measurement equipment, locating data collection points both in the receiving water and in the treatment plant, and data reduction.
- Reduce the time spent by the Department of Environmental Quality in the review and approval of Temperature Management Plans submitted by POTWs.
- Provide better, more standardized evaluation of possible temperature reducing best management practices (BMPs) and their feasibility at controlling or reducing temperature impacts at wastewater treatment plants. The guidance manual reviews potential BMPs and summarizes available information.
- Quantify the cost of compliance and the benefits gained from implementing Temperature Management Plans. This is essential to the long-term understanding of the water quality benefits and cost effectiveness of the regulatory approach in Oregon's 1996 temperature standard.

DEQ temperature implementation guidance had not been finalized at the time this manual was completed. This manual should be used in conjunction with the finalized DEQ guidance, which can be found on the DEQ water quality web site at *waterquality.deq.state.or.us/wq/*.

Oregon's Water Quality Standard for Temperature

Oregon's current temperature standard (OAR 340-41-026) was adopted in January of 1996. Since the standard was promulgated, there have been ongoing debates between state and federal regulatory agencies and interested parties on its appropriateness and the level of protection it provides. The U.S. Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), other federal, and state agencies are currently reviewing temperature criteria for the Northwest to make sure they are protective of salmonid fish species. This review may result in some modifications of Oregon's standard and how it is implemented.

The following section presents a brief overview of the past, present and potential future temperature standards and describes what is meant by a Temperature Management Plan, which is a requirement in the current temperature standard.

What was the previous temperature standard?

DEQ's temperature standard prior to January 1996 allowed very little flexibility to accommodate local conditions. It set the temperature standard between 58 to 72 degrees Fahrenheit (°F) depending on the beneficial uses of the river, stream, lake or estuary under consideration. If the temperature standard was violated, no further increase in stream temperature was allowed and the stream had to be brought into compliance with water quality standards.

How was the 1996 standard developed?

DEQ formed an advisory committee of scientific experts from universities, municipalities, industries, tribes, and state agency scientists from the Oregon Departments of Agriculture, Forestry, and Fish and Wildlife to develop the 1996 temperature standard for Oregon. This standard was to have more flexibility and be more effective in reducing temperatures. The advisory committee studied the temperature issue for more than a year before making its recommendations to DEQ.

DEQ incorporated the recommendations of the advisory committee into a proposed rule, held a public comment period with a series of public workshops and hearings, and submitted the proposed rule to the Environmental Quality Commission (EQC) for adoption. Under the federal Clean Water Act, all water quality standards are subject to review and approval by the EPA. Although adopted by the EQC in 1996 and conditionally approved by EPA, the current standard has yet to be fully approved by EPA.

The approval of Oregon's 1996 standard by EPA has been complicated by a number of factors; the most significant of which is the listing of a number of salmonid species as threatened and endangered.

How does the 1996 standard differ from the previous standard?

Table 1.1 Temperature Criteria

Applicable Area	Temperature Criteria
In a basin for which salmonid fish rearing is a designated beneficial use	64^{0}F
In waters and during periods of the year determined by DEQ to support native salmonid spawning, egg incubation, and fry emergence from the egg and from the gravels	55^{0}F
In waters determined by DEQ to support or be necessary to maintain the viability of native Oregon bull trout	50^{0}F
In the lower reaches of the mainstem of the Willamette and Columbia River[(1)]	68^{0}F

[(1)] **Not approved by EPA**

Oregon's 1996 temperature standard establishes revised temperature criteria for each basin and dictates procedures to be followed should the temperature criteria not be met. These requirements are presented in detail in the basin standards and in the Oregon Administrative Rules (OAR) 340-41-026. The criteria are summarized in Table 1.1.

It should be noted that for nearly all basins and sub-basins in Oregon, salmonid fish rearing has been designated as a beneficial use. This means that the 64°F criteria is the highest temperature allowed for nearly all waters in the state.

It is important for POTWs to identify whether the more stringent temperature criteria may apply to their receiving water. DEQ is currently working with the Oregon Department of Fish and Wildlife (ODF&W), NMFS, and the US Fish and Wildlife Service (USFWS) to identify the waters and time periods where salmonid spawning, egg incubation and fry emergence are occurring. The presence of these activities would result in more stringent criteria being applied when the activities are occurring. ACWA has developed a guidance document on how POTWs identify the seasonal presence and life stages of salmonids that potentially could be impacted by their discharge. For information on this manual see *www.oracwa.org*.

Under the standard promulgated by DEQ, if a stream or river exceeds temperature criteria, DEQ requires that responsible parties or management agencies develop Temperature Management

Plans to address the problem. Under the current standard, once an acceptable Temperature Management Plan has been implemented and DEQ determines that all feasible steps have been taken, if temperatures still do not meet water quality criteria, then the temperature actually attained will become the criteria for that waterbody. The Clean Water Act requires a Use and Attainability Assessment or equivalent. Based on EPA's review of Oregon's standard, DEQ believes that a formal modification to the standard will be required consistent with federal law. EPA will need to approve site specific criteria in consultation with NMFS. Oregon's current rule can be found in Appendix A.

What does the future Oregon temperature standard look like?

EPA has approved the 64°F criteria for protection of fish rearing and passage. However, they did not approve the 68°F criteria for the lower Willamette and Columbia Rivers or the portion of the rule indicating that the standard can be revised after all feasible efforts have been undertaken. The Federal agencies also have other issues with Oregon's temperature standard and its implementation.

A temperature standard development forum, including EPA, NMFS, USFWS and other agencies and experts in the field has been convened to provide guidance to the Northwest states on the temperature issue. Oregon's temperature standard may be modified so that both NMFS and EPA feel that the standard is protective of established beneficial uses. If Oregon and EPA can not reach agreement, EPA has the option to independently promulgate a new temperature standard for the state.

Issues being discussed by the forum include:

- The appropriate temperature criteria that are protective of salmonid species,
- The temporal and spatial distribution of egg-laying, incubation and fry emergence of salmonid species,
- The suitability and applicability of site-specific criteria,
- The suitability and applicability of mixing zones for temperature,
- Oregon's Temperature Management Plan approach and enforcement of the standard, and,
- Oregon's approach to Total Maximum Daily Load (TMDL) development.

Based on recent discussions with DEQ, EPA and NMFS, the following outcomes are possible:

- The 64°F and 55°F temperature criteria will likely remain unchanged. The 55°F criterion should be applied in all waters and all periods of time when spawning, incubation, emergence is occurring or has occurred.
- NMFS and EPA are uncomfortable with the best management approach to temperature and may set numeric limits within NPDES permits.
- NMFS and EPA may want end of the pipe limits instead of limits at the edge of the mixing zone. The discharger may be obligated to meet the in-stream criteria prior to discharge.

The forum will be issuing recommendations by 2002, and it may be longer before these issues are fully resolved. A likely outcome is the development of a more stringent temperature standard for the State of Oregon. In the interim, POTWs will be asked to develop Temperature Management Plans and to develop and implement temperature monitoring programs.

When is a Temperature Management Plan Required?

Oregon's temperature rule for basins that exceed the numeric temperature criteria states that no

measurable surface water temperature increase (0.25°F) from anthropogenic sources is allowed unless specifically permitted under a surface water Temperature Management Plan approved by DEQ. DEQ will be requiring temperature management plans as a permit condition in the following situations:

- If the discharge is to a stream that is water quality-limited,
- If heat is contributed to the stream above a water quality-limited stream segment,
- If the discharge has a measurable impact outside of the assigned mixing zone,
- If there are endangered species present,
- If the discharge is to a lake,
- If the stream violates standards for dissolved oxygen, or
- If the mixing zone impairs a cold-water refugia for fish.

A POTW may determine if the stream segment to which they discharge is water quality–limited at the DEQ web site. See waterquality.deq.state.or.us/org/3030lisst/202dpage.htm.

Once the TMDL is completed on the basin, the heat waste lead allocation requirements of the TMDL will be incorporated into the NPDES permit as appropriate.

What is in a Temperature Management Plan?

Temperature Management Plans are to describe the management practices, measures and/or control technologies that will be used to reverse the warming trend of the basin, watershed or stream segment. Temperature Management Plans shall be maintained or improved until the criterion is achieved or the TMDL is developed.

When developing the Temperature Management Plan, the POTW must evaluate the following alternatives:

- Recycling and eliminating the discharge. At a minimum the evaluation will consider this alternative during critical time periods,
- Recycling certain waste streams to reduce the thermal load discharged,
- Irrigating during critical time periods when stream temperature is high,
- Storing heated wastewater during periods when stream temperatures are high,
- Installing treatment technology to reduce the temperature of the discharge,
- Flow augmentation, and
- Reducing the thermal load by implementing one or more of the above alternatives.

The POTW may also consider riparian or instream work, such as planting trees to increase shade and therefore reduce stream temperature. Such mitigation is an option, but is not an alternative that a point source discharge must evaluate.

The above alternatives will be evaluated by DEQ permit writers according to the following criteria:

- The potential impact of the discharge on beneficial uses,
- The cost of adopting the alternative, (for water quality-limited water bodies, highest and best treatment technologies are expected), and
- Public benefit derived from the discharge.

Once the Temperature Management Plan is approved by DEQ, it will become a part of the POTW's NPDES permit.

The implementation of the Temperature Management Plan will be monitored to determine if the plan is resulting in the necessary water quality improvements or reversing the warming trend. If it is not, the Temperature Management Plan may need to be revised. When the temperature criteria are attained, the stream segment is no longer considered water quality-limited for temperature. Under current Oregon rules, if the criteria are not met, but DEQ determines that all feasible steps have been taken and the beneficial uses are not being adversely affected, the attainable temperature becomes the standard for the segment and the stream is no longer considered water quality-limited. These rules may change with the reevaluation of Oregon's 1996 temperature standard. Once the stream meets the standard, the management practices that led to the achievement must be maintained or the stream will again warm and the criteria will be exceeded, beginning the process all over again.

Temperature Control on Waters that Meet the Criteria

Even though a POTW's receiving water does not exceed the temperature criteria, the POTW may still be impacted by temperature control requirements. In basins where stream temperatures are below the numeric temperature criteria and are therefore not water quality-limited for temperature, Oregon's temperature standard requires that these temperatures be maintained by implementing technology-based permits and/or best management practices. This section of the temperature rule also states that any measurable increase in surface water temperature resulting from anthropogenic activities in these basins must be in accordance with Oregon's Antidegradation Policy (OAR 340-41-026). This means that any new or increased discharge must not cause water quality standards to be violated and should not threaten or impair any recognized beneficial uses.

Chapter 2.0 - Temperature Monitoring

Included in this chapter is information on in-stream, in-plant and collection system temperature monitoring procedures and equipment. Procedures for air temperature, solar irradiation, and stream flow monitoring are also outlined.

Thermal pollution is now recognized as having a significant impact on the health of many of Oregon's streams and rivers. Over time, POTWs will be under increasing pressure to reduce or offset the thermal pollution resulting from their discharges. Temperature monitoring provides data that will help in determining the most effective ways to reduce stream temperature. POTWs should develop and implement temperature monitoring plans for several important reasons:

- To proactively assist DEQ in identifying the causes and extent of elevated stream temperatures;
- To evaluate the effect of the POTW discharge on in-stream temperatures;
- To evaluate the temperature impacts of unit processes in the treatment plant;
- To locate heat loads in the collection system if wastewater influent is higher than typical values;
- To meet NPDES permit requirements; and,
- To assist in developing a realistic and effective regulatory approach.

In-stream Temperature Monitoring

The Oregon Department of Environmental Quality has developed guidance for stream temperature monitoring. The information contained in that document is summarized here; the entire document can be found in Appendix B.

Sampling Location

To both evaluate background stream temperatures and the effect of the POTW discharge on in-stream temperatures, POTWs should monitor stream temperature both upstream and downstream of their discharge. Sampling site selection should minimize the influence of confounding factors such as influence of tributaries, springs, wetlands, water withdrawals, or other effluent discharges.

The downstream site should be far enough downstream to be outside the mixing zone set by DEQ. The mixing zone determination and calculations will be discussed in Chapter 4.0. The upstream location can be immediately upstream of the discharge, but should avoid confounding factors mentioned above and should be a representative site of upstream water quality.

Monitoring equipment should be installed at sites with turbulence and mixing (such as riffles, runs, or cascades) towards the thalwag (area where the majority of flow is passing) of the channel. The monitoring probe should not be placed in a location that may be subject to thermal stratification that may lead to an inaccurate measurement of stream temperature. A hand-held thermometer should be used to survey the site and verify that there is sufficient mixing where the monitoring probe will be placed. The monitoring probe should be completely submerged, but not in contact with the bottom or with any large thermal mass like a bridge abutment or boulder. For non-wadable streams, the sensor should be placed approximately one meter below the surface.

Temperature monitoring probes need to be attached securely to prevent loss. DEQ has used aircraft cable to attach temperature monitors to fixed objects in the stream or on the banks. For

smaller streams, looped surgical tubing around native rocks may be used to secure the probe. Other securing devices such as driven rebar, hose clamps, and divers weights can also be used. Figure 2.1 is a schematic of a proper temperature probe installation.

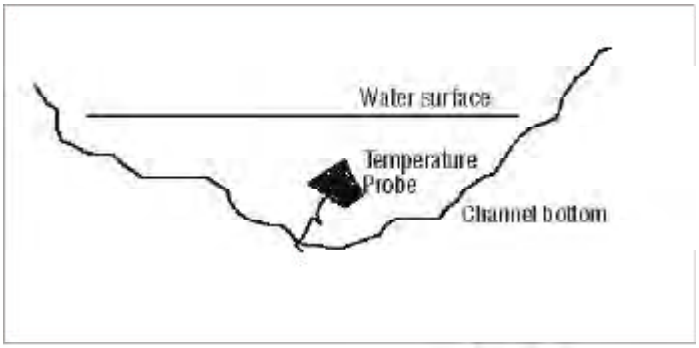


Figure 2.1
LOCATION OF TEMPERATURE PROBE
ASSOCIATION OF CLEAN WATER AGENCIES

The stream bed will move, even in non-flood conditions. It is important to protect the temperature monitoring probes from damage by moving rocks. It is often necessary to attach the monitoring probes to the downstream side of the anchor to reduce the potential for damage.

A large problem when monitoring in public areas is vandalism, theft, or accidental disturbance of monitoring equipment. In areas frequented by the public it is recommended that equipment be secured and camouflaged. Visible tethers are not recommended as this will draw attention to the equipment. If the equipment can not be adequately protected, an alternative site may be necessary.

It is important to identify the latitude and longitude of the sampling site. This can be obtained from a topographic map, or from a global positioning system (GPS) device. It is important to document general information about the site such as flow conditions, depths, and references to landmarks such as tributary names, river mile, roads, and bridges. It is also helpful to photograph the monitoring site for help in locating the equipment when retrieving the unit or performing field audits.

Temperature Monitoring Equipment

There are many temperature monitors available on the market today. The following guidelines to selecting the appropriate monitor should be followed to ensure accurate, defensible temperature data.

Monitoring equipment must have a temperature range applicable to the data being collected. Instruments with a range of 23° to 95°F (-5° to 35°C) are available and ensure that all numeric criteria can be assessed. If an instrument with a different range is selected, the range must bracket the appropriate numeric criteria by + 9°F (5°C). DEQ requires that all monitoring equipment have a resolution of 0.4°F (0.2°C) or better, and an accuracy of +0.6°F (0.3°C) or better. The preferred type of monitoring equipment is a thermograph or data logger set to record either at regular intervals or the hourly or daily maximum temperatures.

Vemco, Ryan, and Onset manufacture in-stream monitors, which are currently in use by Oregon POTWs. Of the three, the Onset Hobo is usually the least expensive. The following table contains the names and phone numbers of the suppliers, the appropriate models, and estimated costs.

Table 2.1 Temperature Monitoring Equipment Options

Manufacturer	Model	Phone Number	Price	
			Data Logger	Software
Vemco	Minilog 12-T	(902) 852-3047	$135	$135
Ryan	RL 100	(800) 999-7926	$155	__
Onset	Hobo 8k Temp Logger	(800) 564-4377	$79	$14 or $95 [2]
	Stowaway		$129	$14 or $95 [2]

[1] Software package included with purchase of data logger.
[2] There are two options of software packages. Either will work with both data loggers. The more expensive option has more advanced data analysis tools.

Appendix C includes information from the manufacturers of the listed monitoring equipment.

Field Protocols

The period of stream temperature concern should be identified before beginning temperature monitoring efforts. For assessing maximum stream temperature, continuous temperature monitoring is generally conducted from June through September when solar angles are high and streamflow is low. If this is not possible, a three-month period including July and August and either June or September may be more practical depending on local conditions. Sources that discharge to stream reaches that support salmonid spawning or rearing in other months may need to monitor during times when these occur to verify that these activities are not being negatively impacted.

Monitoring frequency should be adequate to provide a realistic estimate of the maximum temperature. Samples should be collected anywhere from once every 15 minutes to once an hour. There is no benefit derived from a sampling frequency of less than 15 minutes. If samples are collected infrequently, or less then once per hour, the maximum temperature may be missed. Sampling once an hour will provide the daily maximum temperature, but with more frequent sampling, the duration of this maximum temperature can be more accurately determined.

It is recommended that in-stream temperature data initially be collected every half-hour. If there is little variation between subsequent temperature measurements, then sampling frequency could be reduced. If there is variation, then sampling frequency could be increased to every 15 minutes. More frequent monitoring is usually of more importance in smaller streams. It is important to note that thermistors set for a sampling interval of 15 minutes will have one half the deployment period of a unit set for a 30 minute sampling interval.

Data Quality

DEQ has developed procedures to ensure the quality and usefulness of temperature data. These procedures include verifying instrument accuracy, field auditing to test for proper functioning during the sampling period, and setting criteria for data acceptance.

The accuracy of the monitoring equipment must be tested with a National Institute of Standards and Technology (NIST) traceable thermometer. This thermometer must have a resolution and an accuracy of 0.4°F (0.2°C) or better. The monitoring equipment should be checked pre-and post-

deployment at one or more temperatures between 50 and 68°F (10 and 20°C). The temperature data recorded with the monitoring equipment should be directly compared to that of the NIST thermometer. Accuracy must be within + 1.0°F (0.5°C).

Monitoring equipment must also be field audited during the sampling period. A minimum of two field temperature audits should be taken - one after deployment when the instrument has reached thermal equilibrium, and one prior to recovery. A third, mid-deployment audit is also recommended.

The thermometer used for the field audit must have an accuracy of + 1.0°F (0.5°C), and a resolution of 0.4°F (0.2°C). The audit value is recorded when a stable reading is obtained. "Real-time" temperature data can be viewed with most general purpose data loggers by connecting a computer to the data logger in the field. This will not interfere with the data logger's sampling schedule. Real-time audit accuracy must be within + 2.7°F (1.5°C).

Most miniature data loggers interrupt data collection when the unit is connected to a computer. If this is the type of unit being used, field audit data can be applied by "post-processing". This means that the stored data are off-loaded and later compared to audit values. Auditing times should be reasonably close to the data logger's logging time. Post-processing audit accuracy must also be within + 2.7°F (1.5°C).

In order to be compared to the numeric temperature criteria, temperature data must meet quality control requirements. The data is considered valid if the instrument's pre- and post-deployment calibration checks are within + 1.0°F (0.5°C) of the NIST thermometer and the data are bracketed by field audits which meet the + 2.7°F (1.5°C) criteria.

In-Plant Temperature Measurement

One goal of temperature monitoring is to determine the temperature increase of the wastewater due to treatment processes. At a minimum, POTWs should be monitoring influent and effluent temperature to determine the overall temperature change through the plant. On average, most treatment plants increase the temperature minimally (2 to 3°F).

In-plant temperature measurements should be taken anywhere from every 15 minutes to once an hour. The goal is to capture the daily maximum temperature. It is recommended that sampling be started at half-hour intervals. Frequency can be reduced if there is little variation between subsequent temperature measurements. If a large variation is seen between samples, then the frequency can be increased.

If there is a temperature increase of more than a few degrees Fahrenheit across the treatment plant, then a POTW should evaluate the source of the heat load by monitoring temperature at different locations throughout the treatment train. Potential areas to bracket with temperature probes include:

- aeration basins;
- large uncovered basins such as secondary clarifiers and chlorine contact chambers; and,
- ultraviolet (UV) irradiation channels.

These treatment processes add energy to the wastewater stream and could potentially increase the effluent temperature.

The temperature probes can be attached to wire, weighted and then placed in the designated location. Probes should be placed where flow is moving and is turbulent so as to achieve a representative reading. As an example, probes should not be placed in the middle of the secondary

clarifier due to temperature stratification, but instead should be in the clarifier influent channel and effluent launders.

Equipment used to monitor temperature throughout the treatment plant is similar to that used to monitor stream temperatures. The same procedures should be used for calibration and data verification.

Another source of heat load to the wastewater stream is cooling water. Cooling water may be used in many areas of the plant including chillers for plant HVAC systems, motors on large pumps, air compressors, cogeneration facilities, and aeration blowers. This cooling water is typically discharged back to the treatment stream. In summary, anything that is water-cooled is a heat source for the wastewater stream. The easiest method to determine the temperature effect is to contact the equipment manufacturer who can supply cooling information in BTU/hour.

The following equation can then be used to determine the change in temperature due to this heat load:

$Q = C_p\ m\ \Delta T$ or solving for ΔT, $\Delta T = Q/(C_p\ m)$; where,

Q = Heat waste load, BTU/hr

m = Mass flow rate of wastewater, lbs/hr

C_p = Specific heat of water, BTU/lb/°F

ΔT = Change in temperature, °F

The equipment manufacturers supply Q. C_p for water is typically in the range of 1 to 1.15 BTU/lb/°F. At 25°F, C_p is equal to approximately 1 BTU/lb/°F. The mass flow rate of water, m, is equal to the plant flow rate multiplied by the density of water. Multiply the plant flow rate in million gallons per day by 41,667 to convert to gallons per hour. The result is multiplied by 0.1337 cubic feet per gallon and by the density of water in pounds per cubic feet. ΔT is the change in temperature of the effluent due to the heat load of the waste cooling water. This calculation is a worst case scenario assuming that the equipment is operating at full capacity and generates the maximum heat load. It should be done for all of the potential heat loads to the effluent to determine the overall effect of cooling water on the effluent temperature. Those loads that have a significant effect should be prioritized for replacement with air cooling or improvement of energy efficiency.

If cooling equipment performance data are not available from the equipment manufacturers, thermodynamic principals should be used to calculate the required cooling. It is beyond the scope of this guidance manual to present a detailed discussion on thermodynamics. A basic thermodynamics reference book should be consulted for these calculations.

Collection System Temperature Monitoring

If the influent temperature to the POTW is typically above 71°F, then a POTW could consider implementing collection system temperature monitoring to identify heat sources. This can be done through a phased program beginning with manual temperature readings throughout the collection system, identification of potential sources of high temperature water and finally, if shown to be necessary, permanently installed flow and temperature monitoring stations within the collection system.

Collection System Manual Temperature Survey

The first step of this phased program would be a manual temperature survey moving away from the treatment plant. The purpose of this survey is to identify the location of large heat loads to the collection system. A hand-held temperature probe with extension cable and hold function could

be lowered into manholes, allowed to stabilize, withdrawn, and temperature recorded. In this manner, the area where the temperature of the sewage rapidly changes could be identified.

The recommended method of monitoring temperature is to begin near the treatment plant and work out into the collection system. Manholes along the major interceptor could be done first to identify which trunk lines to examine more closely. Then the temperature in the suspect trunk lines could be measured to identify from which laterals the heat load is flowing. The source of the heat loads could then be narrowed.

Identification of Potential Sources of High Temperature Water

POTWs may also want to conduct a survey of industrial facilities in the area. The survey could determine whether the industries in the area discharge a significant volume of heated wastewater to the collection system. As part of the survey, actual grab temperatures can be taken at the industrial user connection points to determine the temperature of the discharge and identify potential heat sources. This type of survey is particularly recommended if a large percentage of the wastewater flow, more than 10%, is industrial flow.

Industrial facilities which may contribute large heat loads to the collection system include food processing facilities, manufacturing plants, large chillers and commercial laundries.

Permanent Monitoring Stations

The field survey work or the presence of large industries may indicate a need to install fixed-in-place temperature monitoring stations. These stations can be very costly and are typically not necessary. This type of monitoring may be important for enforcing industrial facility temperature control requirements, assessing the effectiveness of collection system BMPs or for demonstrating a reduction in discharge temperatures to the sewer system.

Although temperature monitoring without flow monitoring is much less expensive, it is recommended that both be monitored. By monitoring both, the heat load can be calculated. A small volume of flow with a high temperature may actually have an insignificant heat load compared with a much larger volume of flow with a lower temperature.

The following table contains the name, telephone number, and price range for two manufacturers of collection system monitoring equipment.

Table 2.2 Collection System Temperature Monitoring Equipment

Manufacturer	Telephone Number	Estimated Cost
ADS	(206) 780-9935	$6600
American Sigma	(970) 669-3050	$5000

Appendix D contains more detailed information on the monitoring equipment.

Both manholes and sewer lines are considered confined spaces. Therefore, workers need to follow Occupational Safety and Health Administration (OSHA) confined space entry requirements. Information on permits required for confined space entry can be found at www.osha.gov under regulations, (See 29 CFR Part 1910.146). For specific information on the standards for Oregon visit *www.cbs.state.or.us/osha/index.html*.

Other Data Collection

It is recommended that the POTW collect other data to help in making good decisions regarding temperature management. Air temperature, solar irradiation and stream flow measurement are useful in establishing correlations or temperature increase causality.

Air Temperature

Air temperature is an important parameter to record for several reasons. First, air temperature determines the effectiveness of direct effluent treatment options. It also is the parameter that some experts believe has the largest affect on the in-stream temperature.

Reliable air temperature data can be collected from existing weather stations in the area of the discharge. The Oregon State Climatology Center, the US Forest Service, the National Weather Service and local radio stations can be contacted for this data.

The following internet addresses can be accessed to provide historical and current air temperatures around the state of Oregon:

- *www.wrh.noaa.gov/wrhq/nwspage.html*
- *www.wrh.noaa.gov/Portland/current.html*
- *www.wrh.noaa.gov/Medford/obs/srfc-obs.html*
- *www.ncdc.noaa.gov/ol/climate/stationlocator.html*
- *http://ocs.oce.orst.edu* (look under observations or climate data)

Wet Bulb Temperature

Wet bulb temperature is a measure of the relative humidity and can be used to assess the potential effectiveness of evaporative cooling as a temperature management practice.

Solar Irradiation

Solar irradiation has also been found to have a large affect on the temperature of streams and rivers. This can be measured both with mechanical models and with real time instruments.

The method currently used by Oregon DEQ is the Solar Pathfinder, a type of mechanical model. This method utilizes a reflective dome and paper charts specific to the latitude and longitude. Objects that shade the river are then reflected in the dome and can be traced with a wax crayon. Given the total average solar radiation that hits that spot daily, the actual percentage can be calculated by subtracting the percentage of the width that is shaded. Using relationships given, the total BTUs can be calculated. The solar pathfinder can be used twice a year to provide a reasonable estimate of solar input.

As an alternative, real time instruments can also be used. These vary in both sophistication and price. These monitors calculate solar radiation based on the temperature differential between metals that are heated from the sun and those that are not. This creates a voltage that can be read and translated to solar radiation. The readout from this type of monitor is watts per square meter. This can easily be converted to BTUs per square meter per hour by multiplying by 3.4129. Real time instruments need to be connected to data loggers to capture radiation over time.

The following table contains equipment manufacturers, contact phone numbers, estimated prices, and approximate accuracy.

Table 2.3 Solar Irradiation Monitoring Equipment

Manufacturer	Telephone Number	Estimated Cost	Accuracy
Eppley Laboratory, Inc.	(401) 847-1020	$2000	1%
Li-Cor, Inc.	(402) 467-3576	$250	10%

Additional information on the types of solar irradiation monitors can be found in Appendix E.

Depending on the desired accuracy in solar irradiation monitoring, a monitoring program could include one primary Eppley monitor with Li-Cor units spread throughout the study area. Prior to beginning a solar radiation monitoring program, POTWs should contact equipment manufactures for site specific recommendations.

Stream Flow

It is necessary to know the stream flow of the receiving water in order to determine the effect of the discharge on stream temperature. Stream flow can typically be found on either the Oregon Department of Water Resources or the US Geological Survey web pages. These addresses are *www.wrd.state.or.us* and *wwworegon.wr.usgs.gov* (no period after www), respectively. If the stream is not listed on either of these web sites, or the flow gaging station is not located near the point of discharge, DEQ or Oregon Department of Water Resources can be contacted to assist with installing a staff gage and establishing a rating curve for determining flow based on water surface elevation.

Empirical relationships can also used to estimate the stream flow. These relationships can be found in two USGS documents. One for eastern Oregon is a Water Resources Investigations Report (WRIR) 82-4078 entitled “Magnitude and Frequency of Floods in Eastern Oregon”, by D.D. Harris and L.E. Hubbard, 1983. The other for western Oregon is an Open File Report (OFR) 79-553 “Magnitude and Frequency of Floods in Western Oregon” by D.D. Harris, L.L. Hubbard and L.E. Hubbard, 1979. These reports can be obtained from the USGS office in Portland at (503) 251-3201.

Chapter 3.0 - Data Handling and Analysis

This chapter presents options for data downloading, data management and storage, and data analysis. Information is presented on DEQ macros for converting data files to a useable form, on submitting data to DEQ, and on using the EPAs STORET system for data storage. Analysis of in-stream, in-plant, and collection system temperature data is described and includes the calculation of the seven-day moving mean of daily maximum temperatures. Information on DEQ's TempTure program for data analysis is included. Also presented is an equation for calculating the effect of in-plant cooling water on wastewater temperature.

Data Downloading and Conversion

Temperature data from data loggers are typically downloaded once every few months. Therefore, data files from the data loggers are quite large. To help deal with this data, DEQ has developed data conversion macros for converting data files into a useable format for manipulating the data and also the standard format as required by the DEQ TempTure data analysis program. The TempTure program was developed by DEQ and can be used to calculate daily minimum and maximum temperatures and daily temperature fluctuations. The program will also calculate the seven-day moving average for these values. This program will be discussed in a subsequent section.

Since the data files from data loggers vary from manufacturer to manufacturer, DEQ has four different data conversion macros for use with the different types of data loggers. These macros can also be used to remove the first and last day of data collected if these days contain invalid temperature data. The data can be graphed to see if additional days need to be deleted. The macro will store the data sets into an Excel 5.0 workbook, and multiple data sets can be combined in the same data workbook, each on its own sheet. See Appendix F for the complete instructions for the data conversion macros. A copy of the macros can be obtained from DEQ. Contact the Water Quality Monitoring Specialist in the DEQ Laboratory, (503) 229-5983.

Data Management & Storage

Submitting Data to DEQ

DEQ is currently in the process of developing a data management system for the temperature data being collected throughout Oregon. Data submitted to DEQ must be submitted on standardized data reporting forms. These forms can be generated on any common spreadsheet program including Excel, Quattro Pro, or Lotus. Information required on the data forms includes: name of the organization collecting the data, specific location of the samples collected, the date and time, the temperature reading and units, the field audit measurements, and any comments on the sample. This information is referred to as metadata. All fields must be filled out in the data reporting form. The DEQ Laboratory, (503) 229-5983 can assist organizations having trouble supplying the necessary metadata. A complete listing and description of the necessary information can be found in Appendix G in the Data Submittal Procedure Guidance.

The data reporting form asks for documentation of the quality assurance level that is attained in the sampling. Table 3.1 contains information on the three possible levels.

Table 3.1 DEQ Data Quality Levels

Data Quality Level	Quality Assurance Plan	Water Temperature Methods	Potential Data Uses
A	QAPP approved by DEQ QA criteria met	Thermometer or data logger. Accuracy checked with NIST standard. A = ± 1.0°F (0.5°C) P = ± 1.8°F (1.0°C)	Regulatory Permitting Compliance with water quality standards.
B	Meets DEQ Data Acceptance Criteria	Thermometer or data logger Non NIST accuracy check. A = ± 3.6°F (2.0°C) P = ± 1.8°F (1.0°C)	Screening level information Early warning sign
C	Meets DEQ Data Acceptance Criteria	Un-calibrated thermometer	Education
A: Accurancy; P: Precision; QAPP: Quality Assurance Procedure Plan			

It is always recommended that quality assurance/quality control (QA/QC) procedures be followed when implementing monitoring plans. In some cases it is necessary to develop and submit a Quality Assurance Project Plan (QAPP). A sample plan is attached in Appendix H. It is beyond the scope of this guidance to discuss this in detail. It is important for POTWs to know that a QAPP may be necessary and DEQ should be consulted on this issue prior to implementing in-stream temperature monitoring. Sample data reporting forms and information on the Quality Assurance Project Plan can be found on the internet at http:\\waterquality.deq.state.or.us/wq/303dlist/303dpage.htm.

STORET

Temperature data collected by POTWs can also be stored on STORET, a computerized data base utility maintained by the U.S. Environmental Protection Agency (EPA) for the storage and retrieval of chemical, physical, and biological data pertaining to the quality of the waterways within the United States. The EPA regional office, (206) 553-1640, can create accounts for local municipalities. Personal computers with an EPA distributed software package can be used to access STORET.

All previous temperature data have been stored on STORET by DEQ. This is done at the end of each year. Currently STORET is in the process of being upgraded. As of now, DEQ is unsure whether 1999 and 2000 data will be able to be downloaded onto the new version of STORET. While this version is being finalized, DEQ will be storing data in-house on CDs. Once the new version of STORET is functioning, data can either be entered directly by the POTWs or by DEQ.

Data entered into STORET are organized into 5 data-type categories: organizations, projects, sites,

samples and results. The following describes the information needed for each of these topics:

- Organizations: The group or entity responsible for the data set, either for collecting and otherwise generating the data, or sponsoring the activity for which the data set was created.
- Projects: The activity during and for which the data set was created.
- Sites: Also referred to as station, identification and description of the physical location at which monitoring occurs.
- Samples: Water quality sampling, observation, and measurement activities that occur at these sites; comprehensive descriptors of the event during which samples were collected.
- Results: The findings of the sampling event, measurements, and field activities.

For more information on EPA's STORET system contact the STORET Users Assistance Hotline at (800) 424-9067 or go to www.epa.gov for the latest information via the internet. EPA offers training classes for organizations interested in beginning to use this system.

Data Analysis

In-stream Temperature Data

The seven-day moving mean of daily maximum temperatures is used in the state's current water quality standard. In general, the seven-day moving mean of maximum temperature is a number calculated by taking the daily maximum stream temperature of seven consecutive days and averaging them together. A seven-day average smooths out the daily fluctuations in the temperature profile and is intended to provide a better picture of conditions impacting fish populations.

To calculate the seven-day mean of maximum temperatures, select one day. Then select the daily maximum temperatures for the three days prior and the three after. Average these seven day maximum temperatures to calculate the seven-day moving mean of maximum temperatures for the selected day. For any data collection period, the first three and last three days of data do not have a value for the seven-day mean of maximum temperature.

TempTure, a program developed by DEQ for data analysis, can be used to calculate daily minimum and maximum temperatures and daily temperature fluctuations. The program will also calculate the seven-day moving average for these three values. Section 2.4 discusses macros for converting data files to a form that can be used by the program. See Appendix I for more details on required data format and instructions for using this program. This program can be obtained from the Water Quality Monitoring Specialist in the DEQ Laboratory, (503) 229-5983.

Once the seven-day moving mean of daily maximum temperatures is calculated for the stream reach, it should be compared to the appropriate numeric criteria for that reach. See Table 1.1. If any of the seven-day moving means of maximum temperatures exceed the criteria, then the stream is considered out of compliance or water quality-limited with respect to temperature for that period of time.

Figure 3.1 is a graph of typical hourly stream temperatures versus time of day. The maximum daily temperature is indicated on the graph. This is the value that would be used in the 7-day mean of maximum temperatures calculation. Figure 3.2 is a graph of typical 7-day mean maximum stream temperatures from July to October. The typical variation from July to October can be seen on Figure 3.2.

In-Plant Temperature Data

The important temperature data needed from temperature monitoring of the effluent is the maxi-

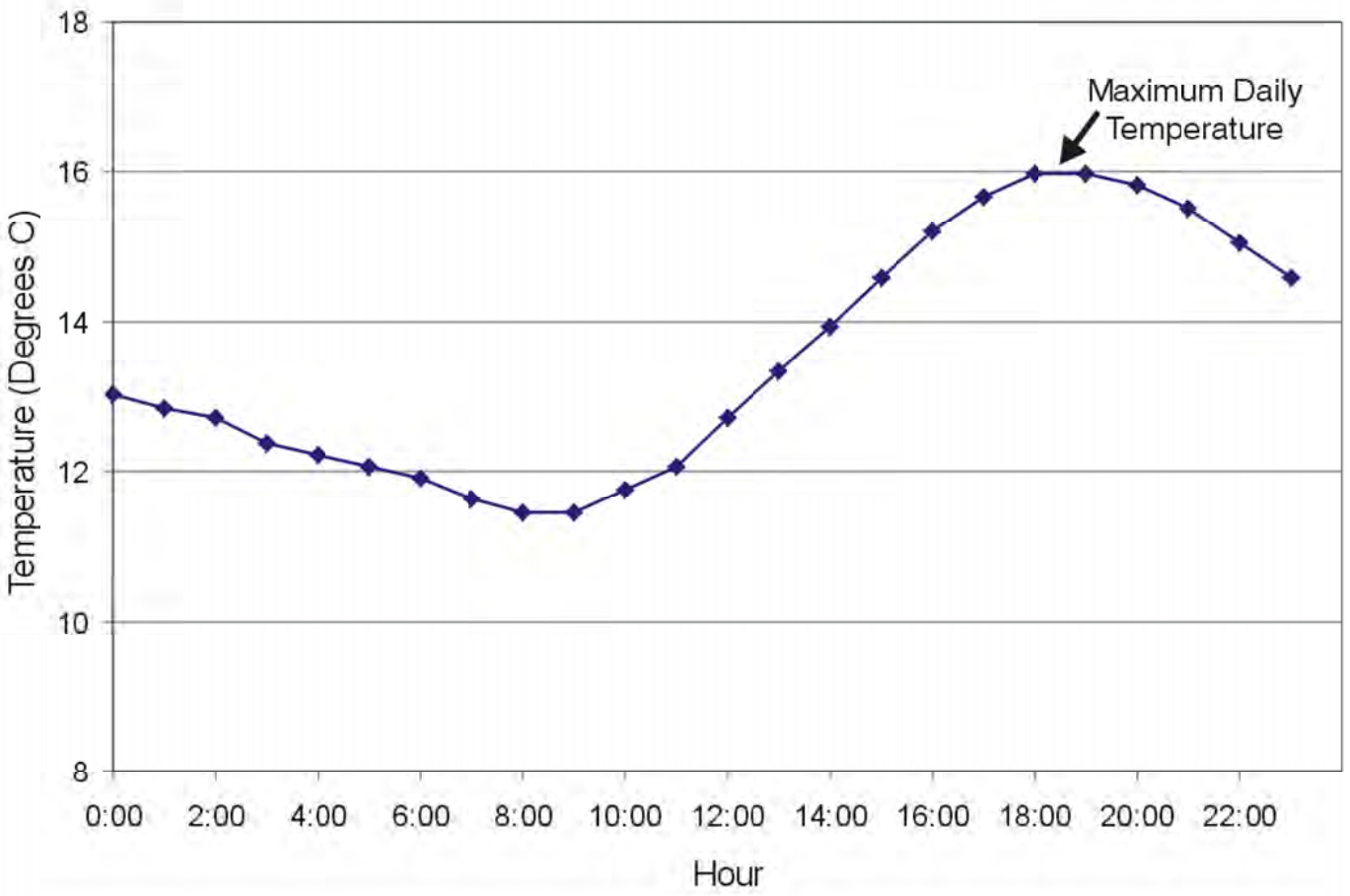


Figure 3.1
TYPICAL HOURLY TEMPERATURE DATA
ASSOCIATION OF CLEAN WATER AGENCIES

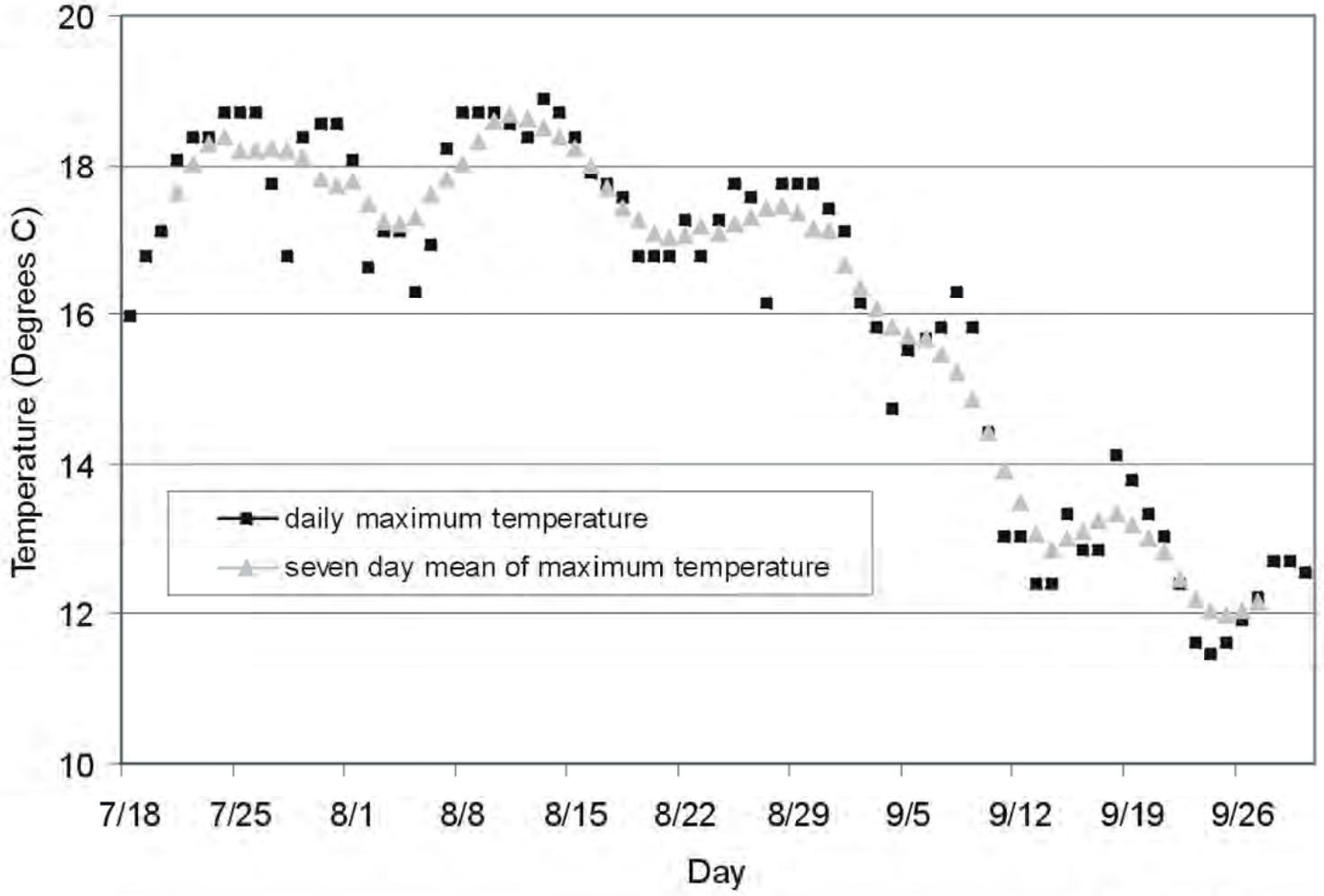


Figure 3.2
DAILY MAXIMUM TEMPERATURES
& 7-DAY MEAN OF TEMPERATURES
ASSOCIATION OF CLEAN WATER AGENCIES

mum daily temperature. DEQ currently requires using the maximum discharge temperature to evaluate the effect of the discharge on the receiving water.

Effluent temperature and flow can also be used to calculate the heat load to the river or stream from the POTW. Heat load is a more useful parameter than temperature alone for assessing the temperature impacts from a POTW and for assessing the effectiveness of best management practices. This heat load will vary throughout the day. A graph of flow multiplied by temperature versus hour of the day is useful in evaluating alternatives for temperature management.

A comparison of temperature data from the influent to data collected within the treatment plant can be used to evaluate the potential for temperature control within the plant. The first step is to determine the net temperature change across the treatment plant by comparing influent versus effluent temperature. In general, most treatment plants raise the temperature a maximum of 2 to 3°F. If there is a net increase in temperature, then POTWs can begin monitoring to determine the temperature changes across individual unit processes. This can be done by comparing the temperatures from monitors located at the influent and effluent of each unit process. The difference between the two, is the net temperature change due to the process. Processes which show a net increase of more than a 1.8°F may be potential sources for temperature control measures.

When sampling across the treatment plant or a single unit process, it is important to know the hydraulic residence time across the processes being monitored. By knowing the time lag, the influent and effluent data across the processes can be properly compared and the temperature impacts of the treatment processes can be more accurately assessed.

Collection System Temperature Data

The maximum daily temperature data within a collection system should be compared to the average temperature range of residential discharge, 69° to 72°F. If the data from a certain area of the collection system is significantly higher than this average, and the flow is a significant percentage of the total flow to the treatment plant (larger than 10%), then this area should be investigated for potential temperature control measures including establishing pretreatment requirements for industrial dischargers.

Chapter 4.0 - Mixing Zones and Impact Assessment

This chapter has information on mixing zones and whether there is enough dilution in the receiving stream to prevent the discharge from raising the temperature by more than 0.25°F. Information on dye testing and computer modeling to assist with determining an appropriate mixing zone is included. Use the mass balance equation found at the end of this chapter to calculate the effect of the discharge on the receiving water temperature.

Mixing Zone Determination

Most point sources have mixing zone allowances set by DEQ in their NPDES permit. If a mixing zone is not set in the current NPDES permit, it will most likely be set in the next permit renewal. DEQ is currently developing standard policy and guidance on mixing zone determinations and these guidelines are anticipated by January 2001.

The size and shape of the mixing zone will influence whether the discharge raises the temperature of the receiving water by more than 0.25°F. POTWs can make some simple calculations to determine if they can avoid having a measurable impact on the temperature of the stream by the establishment of an appropriately sized mixing zone.

Within the mixing zone, DEQ will not allow temperatures to exceed 77°F so as to prevent acute lethal toxicity to salmonids within the mixing zone.

Is The Existing Mixing Zone Big Enough?

Mixing zones in existing NPDES permits were established to prevent chronic toxicity outside of the mixing zone and were typically determined with little consideration for temperature. It may be possible for POTWs to negotiate a mixing zone for temperature that differs in dimensions from the mixing zone established to prevent toxicity, as long as the temperature mixing zone is protective of established beneficial uses in the receiving water.

If a POTW has a mixing zone in their existing permit, the first step is to determine whether that mixing zone is also adequate for temperature mixing. DEQ has determined that there is no measurable impact from a single discharge if the increase in temperature at the edge of the mixing zone is equal or less than 0.25°F. The required mixing to achieve “no measurable impact” can be determined using a mass balance calculation as shown in this chapter. Figure 4.1 shows the required mixing for a range of effluent temperatures.

It is still uncertain as to what stream temperature should be used for the mass balance calculation. The current indication from DEQ is that the applicable temperature criterion should be used for the upstream temperature even if the upstream temperature is above the criterion. The other approach is to use the actual upstream temperature, even if it is above the applicable temperature criterion. Using the criteria instead of the actual upstream temperature can have a significant impact on the mixing zone determination and will result in larger mixing volumes being needed to result in “no measurable impact”.

Is There Enough Water to Establish a Mixing Zone?

Before spending much effort in evaluating the benefits and proper dimensions of a temperature mixing zone, it is important to assess whether there is enough mixing water available in the receiving water. If the POTW discharge cannot meet the 0.25°F "no measurable impact" criteria when the entire stream flow is used for mixing, no further mixing zone analysis may be required. Figure 4.1 can be used to provide a quick assessment of whether adequate mixing volumes are available.

If more than the available stream flow is needed to result in "no measurable impact", it is then apparent that regardless of the mixing zone size, the POTW will be exceeding the 0.25°F increase criteria and will therefore need to develop a Temperature Management Plan and begin initiating temperature control strategies.

If the POTW finds that less than the full volume of stream flow is required to provide the necessary mixing, it is important to identify the volume that is required to meet the 0.25°F increase and the extent and dimensions of the mixing zone. The Oregon Administrative Rules require that the mixing zone be established to minimize any adverse impacts on beneficial uses. Therefore, it is necessary for the POTWs to be aware of fish activities in the area of their discharge to determine if the mixing zone will have any adverse affects on fish passage, fish spawning, egg incubation, or fry rearing.

Finding the Size and Shape of the Mixing Zone

It may be necessary to determine the dimensions of the mixing zone. This information can be used to:

- confirm that beneficial uses in the receiving water are being protected,
- identify a need to modify the outfall or the diffusers to improve mixing, and,
- establish the level of temperature reduction that may be needed.

Many POTWs have already completed mixing zone studies to determine the effect of other constituents of concern. The same value determined previously can be used in this case, but there may be merit and justification for using a different mixing zone for temperature. If a mixing zone analysis has not been previously performed or if a different mixing zone is being utilized for temperature, then field studies or a model evaluation can be undertaken.

Currently DEQ does not typically allow a mixing zone of more than half of the stream flow. This is a rule of thumb that most permit writers follow.

The physical conditions which determine the actual mixing achieved within the receiving water include the type and location of the outfall, the river conditions at the point of discharge including turbulence and velocity, and the velocity of the discharge.

Dye testing, conductivity testing, and computer modeling can be used to determine the size and dimensions of the mixing zone.

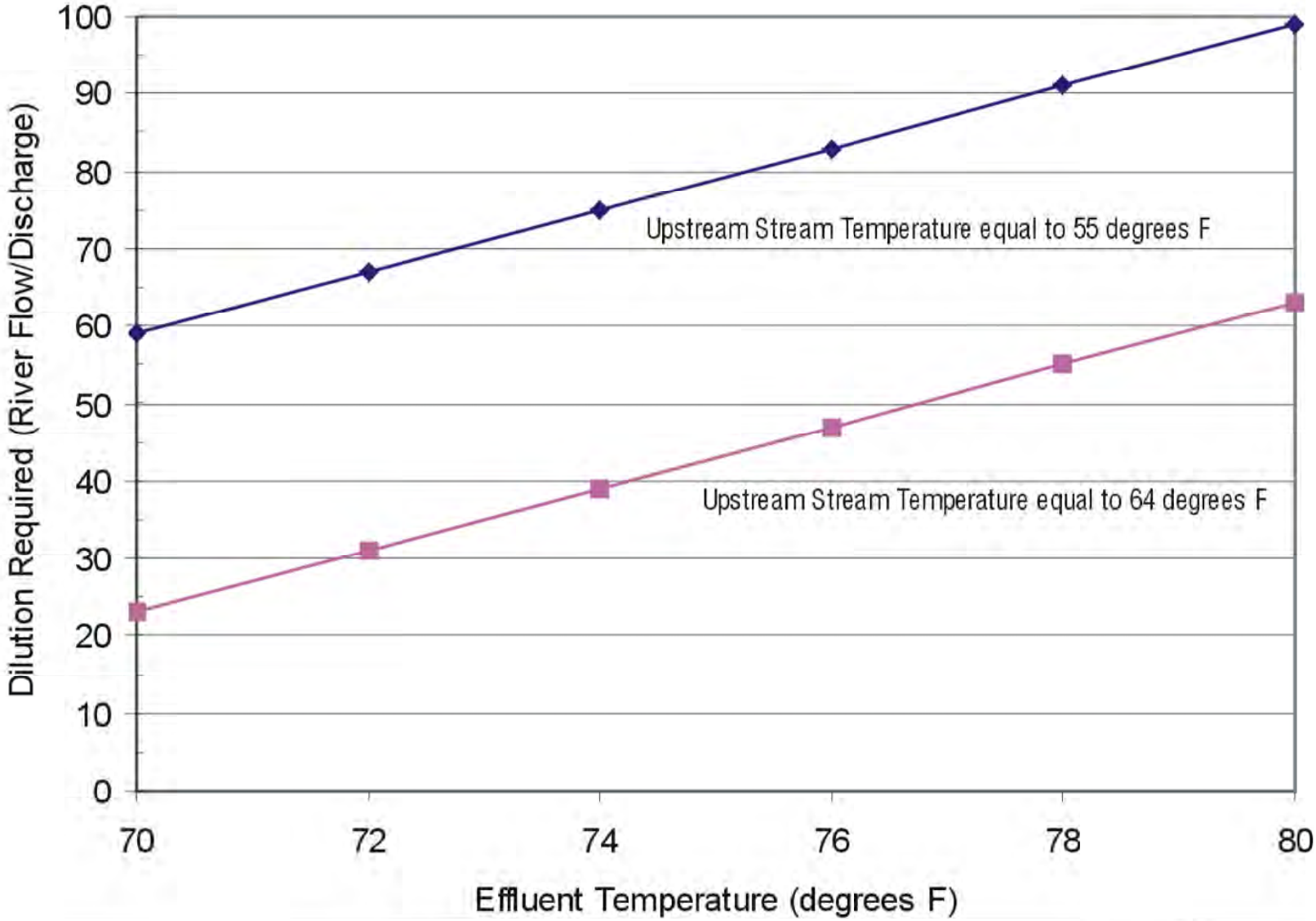


Figure 4.1
DILUTION REQUIREMENT
ASSOCIATION OF CLEAN WATER AGENCIES

Dye Testing

Field studies can be performed by discharging a predetermined concentration of dye into the treatment plant effluent and then collecting several samples at the edge of the mixing zone. Samples should then be analyzed to determine the concentration of dye. By doing a simple mass balance calculation the mixing zone dilution can be found:

$Q_s = Q_e*(C_i - C_f)/C_f$ where,

Q_s = Stream flow that actually mixes with effluent in mixing zone, mgd

Q_e = Effluent Flow, mgd

C_i = Initial concentration of dye, mg/l

C_f = Concentration of dye after mixing, mg/l

Conductivity Testing

POTW effluents typically have a higher conductivity than the receiving water. A conductivity meter can therefore be used to assess mixing and to determine the dimensions of the mixing zone.

Conductivity measurements must first be taken on the effluent prior to discharge and the stream prior to mixing. Measurements should then be taken along several transects across the mixing zone. It is important to take measurements of various depths to ascertain the extent of vertical mixing as well.

Computer Modeling

Although in some cases a field study may still be done to determine the mixing zone dilution, a more typical method is to utilize computer models for this analysis. A field study may still be done to verify the computer modeling results.

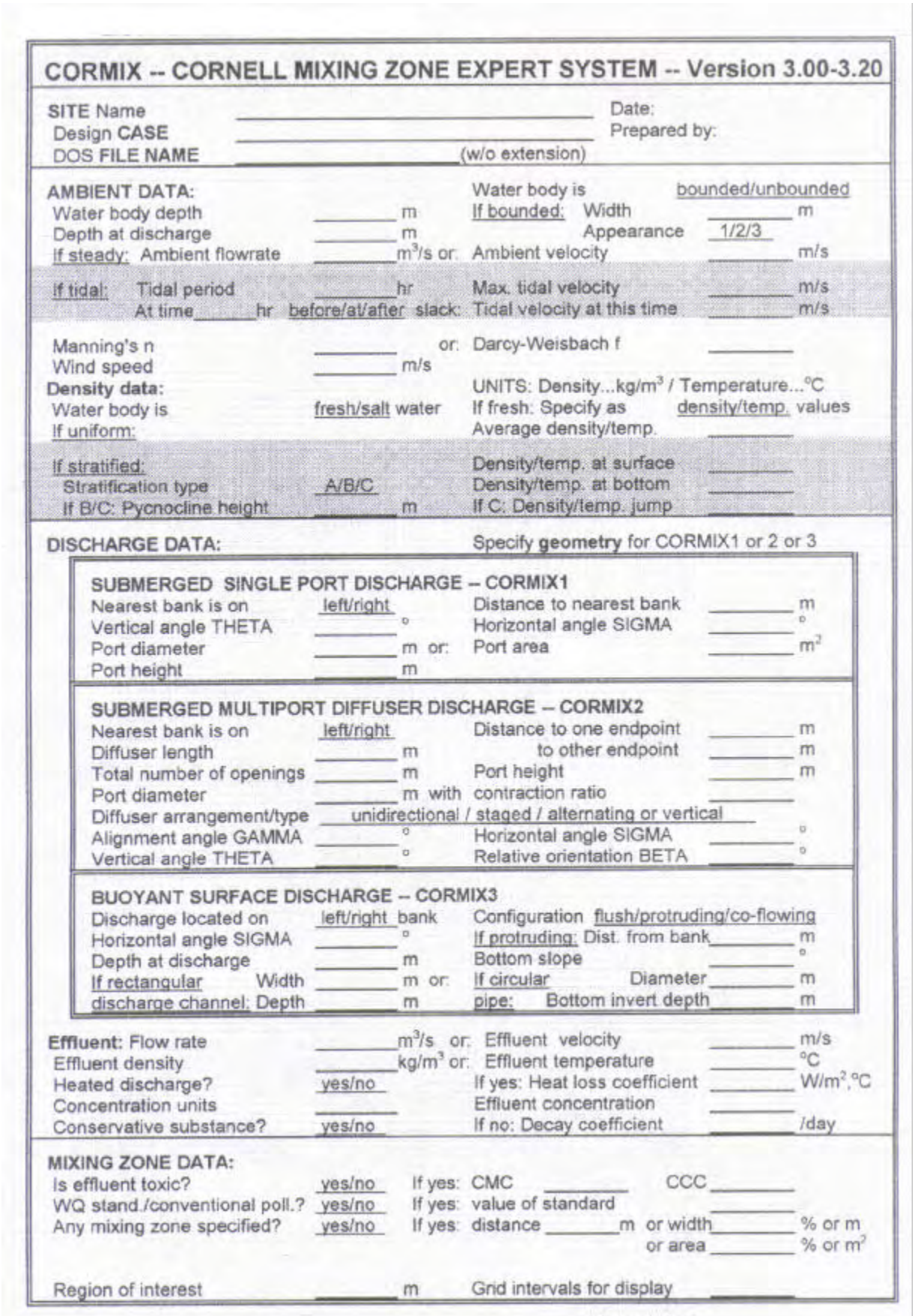
A common computer model used for the mixing zone analysis is the Cornell Mixing Zone Expert System (CORMIX). This software system can be used for the analysis, prediction, and design of aqueous toxic or conventional pollutant discharges into diverse water bodies. The major emphasis is on the geometry and dilution characteristics of the initial mixing zone but the system also predicts the behavior of the discharge plume at greater distances. One advantage of this model is that the methodology provides a way for personnel with little or no training in hydrodynamics to investigate improved design solutions for aquatic discharge structures.

All data are entered interactively in response to the system prompts. The user is queried for a complete specification of the physical environment of the discharge as well as the applicable regulatory considerations for the situation undergoing analysis. Four topics of questions are asked:

- site/case descriptions,
- ambient conditions,
- discharge characteristics; and,
- regulatory mixing zone definitions.

Throughout the data input, menu options within the program are available to provide help on how to prepare and enter data values when clarification of the system prompts is needed. Figure 4.2 is a complete checklist for data to be entered into the model. CORMIX output is both a qualitative description and detailed quantitative numerical prediction. The output can be viewed as both text and graphs in several different formats.

When regulatory mixing zone criteria have been specified during data entry, the geometric, dilution and concentration conditions at the edge of the specified or proposed mixing zone are compared to these criteria. The CORMIX Guidance Document describes this output in detail.



CORMIX -- CORNELL MIXING ZONE EXPERT SYSTEM -- Version 3.00-3.20

SITE Name _____ Date:
Design CASE _____ Prepared by:
DOS FILE NAME _____ (w/o extension)

AMBIENT DATA:
Water body depth _____ m
Depth at discharge _____ m
If steady: Ambient flowrate _____ m^3/s or:
If tidal: Tidal period _____ hr
At time _____ hr before/at/after slack:
Manning's n _____ or:
Wind speed _____ m/s

Density data:
Water body is fresh/salt water
If uniform:
If stratified:
Stratification type A/B/C
If B/C: Pycnocline height _____ m

Water body is bounded/unbounded
If bounded: Width _____ m
Appearance 1/2/3
Ambient velocity _____ m/s
Max. tidal velocity _____ m/s
Tidal velocity at this time _____ m/s
Darcy-Weisbach f _____
UNITS: Density...kg/m^3 / Temperature...°C
If fresh: Specify as density/temp. values
Average density/temp. _____
Density/temp. at surface _____
Density/temp. at bottom _____
If C: Density/temp. jump _____

DISCHARGE DATA: Specify **geometry** for CORMIX1 or 2 or 3

SUBMERGED SINGLE PORT DISCHARGE -- CORMIX1
Nearest bank is on left/right
Vertical angle THETA _____ °
Port diameter _____ m or:
Port height _____ m
Distance to nearest bank _____ m
Horizontal angle SIGMA _____ °
Port area _____ m^2

SUBMERGED MULTIPORT DIFFUSER DISCHARGE -- CORMIX2
Nearest bank is on left/right
Diffuser length _____ m
Total number of openings _____ m
Port diameter _____ m with
Diffuser arrangement/type unidirectional / staged / alternating or vertical
Alignment angle GAMMA _____ °
Vertical angle THETA _____ °
Distance to one endpoint _____ m
to other endpoint _____ m
Port height _____ m
contraction ratio _____
Horizontal angle SIGMA _____ °
Relative orientation BETA _____ °

BUOYANT SURFACE DISCHARGE -- CORMIX3
Discharge located on left/right bank
Horizontal angle SIGMA _____ °
Depth at discharge _____ m
If rectangular discharge channel: Width _____ m or: Depth _____ m
Configuration flush/protruding/co-flowing
If protruding: Dist. from bank _____ m
Bottom slope _____ °
If circular pipe: Diameter _____ m
Bottom invert depth _____ m

Effluent: Flow rate _____ m^3/s or:
Effluent density _____ kg/m^3 or:
Heated discharge? yes/no
Concentration units _____
Conservative substance? yes/no
Effluent velocity _____ m/s
Effluent temperature _____ °C
If yes: Heat loss coefficient _____ $W/m^2,°C$
Effluent concentration _____
If no: Decay coefficient _____ /day

MIXING ZONE DATA:
Is effluent toxic? yes/no If yes: CMC _____ CCC _____
WQ stand./conventional poll.? yes/no If yes: value of standard _____
Any mixing zone specified? yes/no If yes: distance _____ m or width _____ % or m
or area _____ % or m^2

Region of interest _____ m
Grid intervals for display _____

Figure 4.2
DATA CHECKLIST FOR COMPUTER MODELING

CORMIX can also be used in evaluating temperature management alternatives such as moving the discharge location and changing the configuration of the discharge outfall. This will be discussed in the next section.

CORMIX may be obtained free of charge from the EPA Center for Exposure Assessment Modeling, 960 College Station Road, Athens, GA 30605-2700, and telephone (706) 355-8400. The model and all supporting materials can also be downloaded directly off the internet at *http://www.epa.gov/ceampubl/cormix.htm.*

Dr. Robert Doneker, the developer of CORMIX, is available locally for assistance and guidance in using CORMIX. He can be located at the Department of Environmental Science and Engineering, Oregon Graduate Institute, P.O. Box 91000, Portland, OR 97291-1000, by phone at (503) 690-4053, and by e-mail at *doneker@ese.ogi.edu*.

Mass Balance Calculation to Determine Effect of Discharge

Once temperature data have been collected and the mixing zone determined, POTWs need to evaluate the effect of the treatment plant effluent on the temperature of the receiving water. The DEQ temperature implementation guidance requires the POTW to conduct a mass balance analysis to determine the estimated change in stream temperature as a result of a discharge. The following information is needed to conduct a mass balance analysis:

- Receiving stream name, coordinates (latitude and longitude), and river mile,
- Receiving stream low flow data (7Q10 flow) and temperature,
- Maximum effluent flow and temperature, and
- Mixing zone dilution.

In-stream flows can be obtained from Oregon Department of Water Resources or the United States Geological Survey with the above information on the stream and location. The maximum effluent flow and temperature can be determined from the monitoring activities described in previous chapters. The mixing zone dilution information can be obtained from field studies or a modeling evaluation described in the previous section.

Once stream and effluent temperatures, flow data and the mixing zone dilution are known, the following calculation can be performed to determine the overall affect of the discharge on the stream temperature.

$$T_{mz} = \frac{T_E + DT_S}{1 + D}$$; where,

D = dilution of effluent discharge in mixing zone

T_e = effluent temperature, °F

T_{mz} = temperature of the stream at the edge of the regulatory mixing zone, °F

T_s = stream temperature criteria, °F

This equation is derived from a mass balance of the effluent and the stream within the mixing zone. The mass balance is:

$(Q_s + Q_e)Tmz = (Q_s * T_s) + (Q_e * T_e)$; where,

Q_s = stream flow within the mixing zone, MGD (7Q10 flow)

Q_e = effluent flow, MGD

One thing that it is important to note, is that Q_s is not the total stream flow, but is the percentage of flow that mixes with the effluent in the mixing zone. This is the value that is determined through the mixing zone analysis described in the previous section.

This calculation should be performed for several different conditions. The first condition to evaluate is when stream flow is at 7Q10 and temperature is at the criteria. For this case, assume the effluent flow and temperature are at 90th percentile values for the time period when the receiving water temperature is elevated, usually June through September. This is considered the worst case scenario. If this does not show a measurable increase in stream temperature (more than 0.25°F), than the POTW is meeting the temperature standard and should follow the recommendations for this case in Chapter 1.0.

If there is a measurable increase in stream temperature, then the POTW can look more closely at the assumed values in the mass balance. It may be that the 90th percentile effluent flow never occurs with the 90th percentile effluent temperature or that the assumed stream temperature never occurs with the 90th percentile effluent flow. It is then necessary for the POTW to perform the mass balance at several different conditions, i.e., one with the stream temperature set at the criteria and a realistic effluent temperature and flow. The POTW should also evaluate when the stream flow is not at a minimum, but the treatment plant flow and temperature are elevated. In this manner, a more reasonable assessment of the impact on the receiving water can be determined.

Based on the calculated temperature increase due to the discharge, the POTW may need to prepare a Temperature Management Plan as discussed in Chapter 1.0. As part of this, the POTW must evaluate temperature management strategies as discussed in the next chapter.

Chapter 5.0 - POTW BMPs

Information on potential BMPs for reducing the effect of the discharge on the receiving water is included in this chapter. BMPs are described and benefits and implementation constraints are given for each BMP. Approximate cost ranges are given for most BMPs. In cases where the cost is very site specific, there is a brief narrative describing the factors influencing the cost.

If a Temperature Management Plan is required, a POTW is required by Oregon's 1996 temperature standard to develop and evaluate BMPs to reduce the impact to the receiving water.

If the POTW is currently not in violation of the standard, it may be advantageous to begin evaluating potential management practices for future conditions of increased effluent flow or a more stringent temperature standard. Alternatives for temperature control could be incorporated into the next planned treatment plant upgrade.

This section discusses various alternatives for the reduction of temperature impacts to the receiving water. Not all alternatives presented are applicable to all POTWs. The benefits of the alternatives will also vary widely from treatment plant to treatment plant. POTWs should evaluate the options and present rationale why certain best management practices would not be applicable.

These alternatives, and others, may be evaluated by the POTW to determine the Best Management Practices to be incorporated in the Temperature Management Plan.

Table 5.1 includes the categories of potential management practices, a description, and lists the BMPs associated with each category.

Table 5.1 Best Management Practices

Catagory	Description	BMP
Collection System	Reduce the overall heat load entering the treatment plant by either reducing the temperature or reducing the flow.	♦ Pretreatment of identified heat loads ♦ Public awareness/education ♦ Limiting discharge to the collection system
Treatment Process Modifications	May be necessary if it is found from in-plant monitoring that certain treatment processes increase the waste stream temperature significantly.	♦ Covering basins ♦ Disinfection alternatives evaluation ♦ Recycling and/or eliminating cooling water discharge ♦ Energy conservation
Discharge Alternatives	These management practices would not make changes to the actual temperature of the wastewater, but would eliminate or modify the discharge to reduce impact on the receiving water.	♦ Move discharge location ♦ Alter Diffuser ♦ Storing heated effluent ♦ Land application during critical time periods ♦ Rapid infiltration
Direct Effluent Treatment	Reduce the temperature of the wastewater effluent prior to discharge. These tend to be very expensive and may be cost prohibitive.	♦ Cooling ponds ♦ Spray ponds ♦ Cooling towers ♦ Chillers

Where possible, approximate costs are included for the BMPs. In most cases, costs will be site specific and therefore, costs are presented as a range with a brief narrative describing the factors influencing the cost.

Other options such as diluting heated effluent with groundwater or a subsurface riparian discharge are not discussed as they are very site specific and would require either a pilot or demonstration study to verify their effectiveness. DEQ should also be consulted when considering these options.

Pretreatment of Identified Heat Loads

BMP	Pretreatment of Identified Heat Loads
DESCRIPTION	If a large heat load(s) is identified during collection system monitoring, temperature control can be required at the source. Industrial users can install a cooling tower or chiller or store heated effluent, and release when other temperature inflows are lower or stream flow may be cooler. This is determined by looking at the graph of flow multiplied by temperature versus time of day. If there are times when the heat load is significantly less than others, this might be an appropriate time for the industry to release the water. Storing the water may also provide opportunity for cooling prior to release into the collection system.
POTENTIAL BENEFIT	• Volume of water being treated in cooling system would be greatly reduced from treating entire flow at the plant. • Cost of the treatment system would be reduced because volume treated is reduced. • Municipality would not be responsible for cost of treatment system.
IMPLEMENTATION CONSTRAINTS	• This would only be applicable to areas that have large industries including: food processing facilities, canneries, large chillers, commercial laundries and other similar facilities that discharge significant volumes of high temperature water.
COST	The cost for installing pretreatment at individual facilities is typically incurred by the industry that is discharging the heated water. The POTW would be responsible for monitoring costs. The manpower required for this would depend on the size of the municipality and would range from 0.25 to 0.5 of a full time employee (FTE) or between $10,000 and $25,000 per year.

Public Awareness/ Education

BMP	Public Awareness/ Education
DESCRIPTION	Public awareness/education could be used to increase water conservation measures of hot water sources. This would reduce the heat load to the treatment plant and therefore reduce the effect of the discharge on the receiving water. Water conservation is not a large issue in Oregon, but has been the focus of many studies and regulations in states such as California where water is a more limited resource. There is a range of possible effort for public awareness/education programs. POTWs can begin by reaching out to industries and large commercial sources. The other end of the spectrum is a full residential program that could involve school programs, mailers, or bill inserts. The breadth of the program will determine the cost. Toilet flushing is the largest residential indoor use of water. Although it can be conserved with low flush toilets, this is a cool water source and such water conservation will have no impact on POTW effluent temperatures. A reduction in all water sources may actually increase the temperature of the residential discharge since a larger percentage of the water may be heated.
POTENTIAL BENEFIT	• A reduction in residential hot water sources entering the collection system could potentially reduce the influent temperature. • Program would increase public awareness of how temperature issues are impacting the cost of operating a POTW.
IMPLEMENTATION CONSTRAINTS	• It is unlikely that hot water sources alone will be conserved in any type of large-scale indoor water conservation program. • It has been previously shown that residential users are typically not the largest contributors of hot water sources.
COST	Varies with size of municipality. • $5,000 to $10,000 for small cities • $10,000 to $30,000 for medium cities • $30,000 and up for larger cities Manpower required would be approximately 0.25 to 0.5 of a FTE.

Limiting Discharge to the Collection System

BMP	Limiting Discharge to the Collection System
DESCRIPTION	Some hot water discharges to the collection system could be eliminated by requiring open loop industrial cooling systems to be converted to closed loop systems. Industries that have large cooling systems include canneries, wood-fiber industries, and metal processing industries.
POTENTIAL BENEFIT	• Reduction of heat load to the collection system. • Water conservation
IMPLEMENTATION CONSTRAINTS	• This may have limited application in areas with few or only small open loop cooling systems.
COST	The cost of installing a closed loop cooling system would be incurred by the industries. The POTW would be responsible for costs associated with identifying the industries discharging the heated wastewater and monitoring the system to verify that the discharge has been eliminated. Approximately 0.25 to 0.5 of a FTE, or $10,000 to $25,000 per year, would be required for this effort depending on the number of cooling systems to be converted.

Covering Basins

BMP	Covering Basins
DESCRIPTION	Covers can be installed on large basins such as clarifiers and chlorine contact tanks to reduce the increase in temperature due to solar irradiation. The covers can be insulated and ventilated to prevent the air temperature above the basin from heating. There are three practical options for covering rectangular and circular basins with insulating covers: Aluminum flat or dome covers, fiberglass reinforced plastic (FRP) flat covers, or cloth flat covers. There are advantages and disadvantages to each material. Aluminum is the most common cover material and is relatively strong and lightweight. FRP covers are also strong and lightweight but have a smaller span length without additional support than aluminum covers. Cloth covers are relatively new in the marketplace and are less widely used, but have the advantage of being very lightweight and easy to remove. See Appendix J for additional information on cover suppliers.
POTENTIAL BENEFIT	• The effect of solar irradiation on the wastewater temperature may be reduced by covering the basins. • Covers also provide opportunity for odor control.
IMPLEMENTATION CONSTRAINTS	• Covers restrict access to basins and equipment located within basins. • There may not be a significant increase in temperature within the treatment plant, and therefore covers would not greatly affect the effluent temperature.
COST	For a typical circular clarifier with a diameter of 60 feet, an insulated aluminum cover with blower and associated piping would be approximately $85,000. For every additional 10 feet in clarifier diameter, the price of the cover would increase $25,000 to $30,000.

Disinfection Alternatives Evaluation

BMP	Disinfection Alternatives Evaluation
DESCRIPTION	There are currently three methods of disinfection that are practiced in wastewater treatment plants within Oregon: chlorine gas, hypochlorite solution, and UV irradiation. Of the three, UV irradiation has the potential to raise the wastewater temperature. Many treatment plants are currently evaluating their disinfection method. Recently issued NPDES permits limit chlorine concentration in the discharge. In August 1996, EPA initiated a Risk Management Program that requires municipalities storing over threshold amounts of chlorine gas to develop Risk Management Plans (40 CFR Part 68, Chemical Accident Prevention Provisions). If more than 150 pounds of chlorine are stored on site, the municipality must meet the storage requirements in the Uniform Fire Code Article 80. More municipalities are also concerned about the training costs and risks associated with handling chlorine gas. As a result, many POTWs are looking to modify their disinfection process by the conversion to UV irradiation. UV irradiation adds significant energy to the water and has the potential to increase effluent temperature. A POTW should factor this consideration into the evaluation of disinfection processes.
POTENTIAL BENEFIT	• Prevent installation of UV irradiation for disinfection if this treatment modification will increase effluent temperature. • Can evaluate relative temperature impacts of low pressure and medium pressure UV systems.
IMPLEMENTATION CONSTRAINTS	• If a treatment plant has already installed UV disinfection equipment, they have already made a significant investment and changing the disinfection process for thermal load reduction would be costly.
COST	There are no direct costs for this alternative. In future evaluations of disinfection methods, temperature needs to be considered.

Recycling and/or Eliminating Cooling Water Discharges

BMP	Recycling and/or Eliminating Cooling Water Discharges
DESCRIPTION	In-plant cooling water is one source of heat to the wastewater stream. This discharge can be cooled prior to release or recycled. Such cooling water can also be eliminated by installing only air-cooled equipment or by installing a closed loop cooling system.
POTENTIAL BENEFIT	• A chiller installed for the cooling water would be significantly smaller and therefore less expensive than a cooling tower for the entire wastewater flow. • Future plant upgrades could incorporate this into design.
IMPLEMENTATION CONSTRAINTS	• The effectiveness of this measure would depend on the amount of the cooling water compared to the entire flow. • In most cases, cooling water has a minimal affect on the temperature of the effluent.
COST	Possible cost of a separate cooling tower ($15,000 to $40,000 for construction depending on the amount of cooling water) is not warranted because cooling water has a minimal affect on effluent temperature. Modifications to in-plant cooling systems should be considered as part of plant upgrades and expansions. As part of the temperature management plan, POTW should list hot water sources and amounts within the plant and verify that they are not affecting the temperature of the flow. There is minimal cost associated with this evaluation.

Energy Conservation

BMP	Energy Conservation
DESCRIPTION	Although it is not likely that energy conservation will reduce wastewater temperatures dramatically, if an entire treatment plant is made more energy efficient there will be some reduction in effluent temperature. There may also be cost savings resulting from a reduction in electricity consumption. There are several areas within a treatment plant that can be made more energy efficient including pumping, lighting, heating, diffusers, automation, and solids handling. Both pumping efficiency and maintenance affect energy consumption. An improperly maintained pump may still work, but is likely to use significantly more power than necessary. If one pump is made more efficient this may not have an effect, but if the efficiencies of all pumps are improved, there may be a measurable reduction in heat load. The HVAC system may be another area that could be effected by energy conservation. Some HVAC systems are water cooled. If they are run more efficiently, then there would be smaller chillers and therefore, a smaller waste stream discharged to the treatment plant. Energy efficiency can also be improved in the aeration basin. A dissolved oxygen based blower control system can be installed to automatically increase or decrease blower output to maintain a DO set point in the aeration basin. This type of system can reduce over aeration and increase system efficiencies. The cooling water requirements for the blowers will be reduced. Additional information on energy conservation can be found in the "Operations and Training Manual on Energy Efficiency in Water and Wastewater Treatment Plants" prepared by the University of Florida TREEO Center (available from the ACWA office).
POTENTIAL BENEFIT	• Reduce volume of cooling water discharged to waste stream. • Reduce electricity costs at the treatment plant.

COST	There are minimal costs associated with an evaluation of the possible areas to improve energy efficiency. Some areas such as the HVAC system could be improved by simple changes in operation, while others such as the aeration system might require additional instrumentation such as dissolved oxygen probes. Energy audits and energy efficiency improvements should be considered as part of every treatment plant improvement.

Move Discharge Location

BMP	Move Discharge Location
DESCRIPTION	A POTW can move the discharge location to a less sensitive area (i.e. one where spawning does not take place). ACWA's ESA manual should be consulted to determine what fish activities are present in the current stream segment and in other potential discharge locations. *(See www.oracwa.org)* The discharge location could also be relocated to where stream characteristics are different. If a reach of river is deeper or there is more turbulent mixing, it may be advantageous to move the discharge so as to have a larger dilution of the effluent within the mixing zone.
POTENTIAL BENEFIT	• Reduction of in-stream temperature increase due to the discharge. • Discharge to stream reach with a higher temperature criterion. • Discharge could be moved to a stream reach that would have less of an impact on endangered species.
IMPLEMENTATION CONSTRAINTS	• May be difficult to move the discharge location to a stream reach with different characteristics. • May increase the length of the outfall pipe.
COST	Costs are dependent upon the length and diameter of the outfall. For preliminary planning purposes, installed costs will range from $100/foot for 8-inch pipe up to $1,000/foot for 48-inch pipe.

Alter Diffuser

BMP	Alter Diffuser
DESCRIPTION	POTWs can change the effluent outfall. There are many different types of diffusers. If the type currently used does not provide adequate mixing to protect instream uses, then a modified diffuser or different type of diffuser may increase mixing with the river so as to increase the dilution of the effluent. ACWA's ESA manual should be consulted to determine fish activities present that need to be protected. *(See www.oracwa.org)*
POTENTIAL BENEFIT	• Increase in mixing, which could reduce the temperature increase due to the discharge. • Minimize impacts on fish populations by keeping mixing zone away from sensitive uses.
IMPLEMENTATION CONSTRAINTS	• In terms of temperature, it may not be advantageous to the POTW to try to achieve mixing across the entire cross section of the stream. If the temperature of the stream is negatively effected, it may be better to limit the area of impact so as to be protective of fish passage.
COST	The cost of a new diffuser is dependent upon its length, diameter, material, and design and on the physical characteristics of the receiving stream. For preliminary planning purposes, installed diffuser costs will range from $200/foot for 18-inch diameter diffusers up to $1,500/foot for 48-inch diameter diffusers.

Storing Heated Effluent

BMP	Storing Heated Effluent
DESCRIPTION	Treated effluent can be stored and released during a less sensitive time of day. Stream temperatures are usually cooler during the night. Flows from the treatment plant are typically low during this time. Therefore, if flow from earlier in the day was stored, it could be released at a time when stream temperatures are lower. Also, the effluent temperature may be decreased at the time the stored wastewater is released, leading to a reduction in overall discharge temperature. A mass balance, similar to the one performed in Chapter 4 should be completed to evaluate the benefits of storage. Another potential benefit of storage and delayed discharge would be cooling gained through evaporation while the water was being stored. Effluent could be stored in lined reservoirs. Reservoir depth can range from 3 or 4 feet to 20 feet depending on available land.
POTENTIAL BENEFIT	• Heated wastewater can be allowed to cool before discharge into the river. • If river temperatures are less during the night, discharge may have less of an effect.
IMPLEMENTATION CONSTRAINTS	• May require a large volume for storage.
COST	Site conditions influence the cost of this BMP. Dependent upon liner requirements and site conditions, a storage reservoir could be constructed for $10,000 to $50,000/million gallons stored.

Land Application During Critical Time Periods

BMP	Land Application During Critical Time Periods
DESCRIPTION	Treated effluent may be land applied during critical periods. Effluent can be applied either on-site or pumped to off site locations for spray or drip irrigation. Depending on the use of the reclaimed water additional levels of treatment may need to be added at the treatment plant. This will affect the cost of this BMP. The regulations pertaining to land application of reclaimed water are found in the Oregon Administrative Rules (OAR) 340-55. The regulations specify the treatment and monitoring requirements for use of reclaimed water and must be consulted before developing a program to land apply treated effluent. Some important aspects of the regulations are summarized below: • Reclaimed water used at the treatment plant site where it is generated is exempt from the regulations in some cases, provided certain criteria are met. • A NPDES permit issued by DEQ is required. A reclaimed water use plan must be submitted and approved before DEQ will issue a permit. • Groundwater protection that complies with OAR Chapter 340 Division 40 is also required unless the treatment system owner can demonstrate that reclaimed water will not be used in a manner or applied at rates that cause groundwater contamination. Appendix K contains the Oregon Administrative Rules pertaining to land application of reclaimed water. Application rates depend on local precipitation and evaporation, soil conditions and crop selection. Gross irrigation requirements for most crops can be obtained from the *Oregon Crop Water Use and Irrigation Requirements* manual. This manual can be ordered from Oregon State University Extension Service at (541) 737-2513.
POTENTIAL BENEFIT	• The POTW discharge to the receiving water would be decreased or removed.

IMPLEMENTATION CONSTRAINTS	• Some small streams in Oregon may be effluent dominated. In other words, the majority of flow in some small streams is the wastewater treatment plant effluent. Removing the effluent may cause a significant reduction in stream flow during the warmer months and result in increased in-stream temperatures. • The State's reuse regulations must be followed. DEQ should be consulted prior to any decisions being made. • An effective public involvement process is usually needed to both educate the public and to gain approval.
COST	Average cost for irrigation is $3800/acre of land irrigated. Assuming an average application rate of 20 inches per irrigation season (6 months), the cost for land application of 1mgd ranges from $750,000 to $1,200,000. This doesn't include the cost for the land. Pipeline costs for transporting the reclaimed water are $5/inch diameter/foot length. The cost to increase the level of treatment at the treatment plant to include filtration is approximately $400,000/mgd. For off-site reuse a pump station will be necessary. Cost depends on quantity of reclaimed water and the distance being pumped.

Rapid Infiltration

BMP	Rapid Infiltration
DESCRIPTION	Rapid infiltration removes the discharge from the receiving water. Percolation ponds allow the effluent to infiltrate groundwater. Another option is to discharge the effluent over an area and allow it to flow through the ground to the receiving water. Heat would be exchanged between the heated effluent and the ground. The effluent would be discharged over a stretch of the receiving water rather than as a point source. The flow of the effluent could be controlled with synthetic liners under the leach field.
POTENTIAL BENEFIT	• Reduces heat load to the receiving water.
IMPLEMENTATION CONSTRAINTS	• Infiltration to groundwater is difficult to do in Oregon because the Oregon Administrative Rules require that there be no adverse affects on groundwater. This is evaluated on a constituent by constituent basis. Therefore, if any constituent is higher than that found in the groundwater originally, this type of discharge is not allowed. This is especially difficult because most discharges are most likely near streams and rivers where groundwater is very near the surface. This type of alternative may be more likely in places where groundwater is at greater depths. • May require a large area of land. • Pilot testing is recommended for any heat exchange with the ground.
COST	The cost of this BMP depends on the cost for land acquisition. There would also be a cost associated with the process of acquiring DEQ approval for this type of disposal.

Cooling Ponds

BMP	Cooling Ponds
DESCRIPTION	Cooling ponds provide evaporative cooling of the heated effluent prior to discharge. To prevent groundwater infiltration, the soil must be relatively impervious or a liner must be used. Because detention times are usually longer than 24 hours, cooling ponds require large surface areas. The advantage to the long detention time is that the design is based on average temperatures rather than maximum daily temperatures. Design of cooling ponds is outlined in Perry's Chemical Engineers Handbook (Perry, 1984).
POTENTIAL BENEFIT	• Typically requires minimal pumping. • Cooling ponds could be used as a wildlife habitat with limited access to the public.
IMPLEMENTATION CONSTRAINTS	• Requires a large surface area. • During the months when air temperature is elevated, the ability to cool the effluent will be reduced. • Advanced treatment may be required if pond is used for recreational purposes.
COST	Construction costs range from $30,000 to $50,000/mgd. This does not include costs for land acquisition, obtaining necessary permits or increasing the level of treatment to permit public access.

Spray Ponds

BMP	Spray Ponds
DESCRIPTION	Spray ponds are an evaporative cooling method similar to cooling towers (see below). With spray ponds, water is sprayed into the air and then collected in a basin or pond below the nozzles. Typical spray nozzles such as those used in secondary clarifiers can be used. The basins typically have synthetic liners. Installation of spray ponds may require the installation of a new effluent pump station. Spray ponds are not as efficient as cooling towers because the air flow (wind for a spray pond, fan for cooling tower) is not as controlled. When the wet bulb air temperature is very near the effluent temperature neither process can effectively reduce the effluent temperature. When the wet bulb temperature is above the effluent temperature, the cooling tower will lower the temperature of the effluent closer to the wet bulb temperature than will the spray pond.
POTENTIAL BENEFIT	• Reduction of effluent temperature prior to discharge.
IMPLEMENTATION CONSTRAINTS	• The effectiveness of temperature reduction by evaporation cooling is dependent upon the ambient air temperature and the relative humidity. The temperature of the effluent cannot be cooled below the wet bulb temperature.
COST	Approximate cost for installation is $50,000/mgd/5°F. This cost does not include the cost of a new pump station which is typically needed. There would be operation and maintenance costs associated with the pump station which are not included.

Cooling Towers

BMP	Cooling Towers
DESCRIPTION	Cooling towers are a widely used technology in the chemical manufacturing industry. Heat from the effluent is absorbed by evaporating water. Cooling towers operate by creating a thin layer of water and putting it in contact with air. Generally, water is introduced at the top of the tower and air is fed in to the bottom. As the water falls, some evaporates and leaves the tower as water vapor in the air stream. The remaining water is cooled from the loss of heat required for evaporation. Cooling towers for the wastewater treatment industry would require a closed-loop water filled heat exchanger. Plant effluent is not clean enough to pass directly through the cooling tower. Thus, separate clean water would have to be passed through the cooling tower and recirculated through a heat exchanger that was in contact with the plant effluent. The wet bulb temperature is the theoretical lower limit to which water can be cooled using this method. The wet bulb temperature is lower than the ambient temperature (dry bulb) except under conditions of 100% humidity. The wet bulb temperature can be measured directly or determined from the air temperature and the relative humidity. In Oregon, a typical summer day has a temperature of 70°F. Given a humidity of 50%, the wet bulb temperature is approximately 58°F. Due to the inefficiencies of heat exchangers, the temperature to which plant effluent can realistically be cooled is at least 5 to 7 degrees higher than the wet bulb temperature. Under these conditions, wastewater effluent could be cooled to approximately 63° to 65°F. Climate Conditioning is a manufacturer or cooling towers and can be contacted at (503) 620-3911 for information on site specific design information and costs.
POTENTIAL BENEFIT	• May be effective cooling method in certain climatic areas that have low relative humidity.

IMPLEMENTATION CONSTRAINTS	• As a general guideline, cooling towers are capable of cooling plant effluent to approximately the ambient air temperature. This may not be a sufficient reduction in effluent temperature to reduce the effect of the discharge on the receiving water.
COST	The cost for installation is approximately $75,000/mgd/5°F. This cost assumes the cooling tower is designed to lower the temperature from 72 to 67°F and that the wet bulb temperature is lower than this. The cost will vary depending on controls and site specific conditions. Operation and Maintenance costs are approximately $10,000/mgd/yr.

Chillers

BMP	Chillers
DESCRIPTION	Mechanical refrigeration can be used to cool the effluent below ambient temperatures. Chillers use mechanical energy from a motor to remove heat. These systems are expensive and require large quantities of power. There are a number of chiller manufacturers using different technologies. The efficiencies of different technologies vary significantly and should be considered. Similar to air conditioners, the capacity of water chillers are specified by their tonnage. A ton of cooling is equal to 12,000 BTUs per hour. In addition to the capital costs, a ton of cooling will require approximately 1 horsepower. For example, lowering one mgd of effluent by 5°F would require 145 tons of cooling and approximately 135 horsepower. PermaCold is a manufacturer or chillers and can be contacted at (503) 249-8190 for site specific design information and cost.
POTENTIAL BENEFIT	• Can achieve cooling of effluent below ambient air temperatures • Is only technology that will allow POTWs to consistently meet end-of-pipe limits if discharging to a stream.
IMPLEMENTATION CONSTRAINTS	• Expensive and energy consumptive. As mentioned above, lowering one mgd of effluent by 5°F would require approximately 135 horsepower or 101 kilowatts. This translates to high operation and maintenance costs. • Chillers must exchange heat removed from the effluent with air. Some chillers transfer the heat to an open loop water stream. This would defeat the intent.
COST	Approximate cost for installation is $60,000/mgd/1°F reduced. Operation and maintenance costs are approximately $100,000/mgd/year.

Chapter 6.0 - Watershed Management

This chapter provides a brief description of actions that can be taken within a watershed to reduce the temperature of the receiving water. Information on riparian shading and flow augmentation is included. It is recommended that the POTW contact their DEQ permit writer before undertaking any work in the watershed as there are currently no protocols within DEQ to give POTWs credit for this type of work.

As discussed in the previous sections, there are many alternatives that POTWs can investigate for reducing the impact of the discharge on the receiving water. In most cases the treatment plant only increases the temperature of the wastewater by 2° or 3°F. Therefore, it is usually difficult to reduce the temperature in the plant by a significant amount.

To have any significant impact on in-stream temperatures, the problem must be addressed on a watershed basis. Riparian shading, channel modifications, flow management, and other non-point activities all impact stream temperatures. POTWs should take an active role in watershed councils formed for their basin and work with them to identify, support, and implement activities within the watershed that will result in reduced stream temperatures.

An alternative or supplement to improvements or implementation of Best Management Practices at the POTW is to implement other improvements in the watershed to reduce stream temperatures. However, there are currently no protocols within DEQ to allow POTWs to get credit for improvements made within the watershed that might offset temperature impacts from a POTW. Each POTW should discuss this in detail with their DEQ permit writer prior to considering any watershed activities as part of their surface water Temperature Management Plan.

DEQ has hired a consultant to develop metrics that can be used for pollutant trading and to prepare a resource guide. This resource guide will include guidance on determining credit received for the action, which agency enforces or oversees this, and how long the credit lasts. Currently, DEQ is looking at four activities: planting riparian buffer vegetation, fencing, filtering stormwater, and erosion and sedimentation control measures. Of these four non-point source actions, planting riparian buffer vegetation could be effective in reducing in-stream temperatures.

The POTW will be able to use the resource guide to evaluate an upgrade at the plant versus a non-point source control measure. A workshop will be scheduled once the guide is completed to present general information on the guide and demonstrate the method for the POTW to develop a trade. Contact the Water Quality Division of DEQ at (503)229-5073 and ask to speak with the person responsible for overseeing the pollutant trading resource guide.

Riparian shading typically has the greatest impact on stream temperatures. While riparian shading may have minimal impact on the mainstem of a river, where the stream is wide, it can be very effective on smaller, higher order tributaries.

Another option to decrease the effect of the discharge on the receiving water is flow augmentation. As flows increase, the time of travel decreases and there is more water available for mixing. In general, more flow will result in lower temperatures.

Cities or POTWs may have secured water rights on the receiving stream which are currently used for irrigation or other out-of-stream uses. The City may have the opportunity to stop diverting this water and lease the water to an "in-stream" use. Some POTWs have also evaluated and are moving forward with purchasing property with water rights. These water rights can be transferred to in-stream uses.

HeatSource is a computer model used by both Oregon DEQ and EPA Region 10 to simulate stream thermodynamics and hydrology. Heat Source can be used as a tool in evaluating potential riparian restoration efforts. It can be used to select the river reach where the maximum benefit would be derived from the planting of riparian buffer vegetation. Point source discharges can be directly input into the model. The model can then be used to examine the far field effects of the discharge. This model requires extensive data and may be too laborious in some cases to pursue.

DEQ currently maintains the HeatSource methodology and computer programming. Contact the Water Quality Modeler/Hydrologist in the Water Quality Division of DEQ, (503) 229-5374 for questions and information on this model.

Prior to developing any watershed approaches to addressing temperature problems, the POTW should discuss with DEQ all of the planning and implementation details and confirm that the POTW will get credit in their permit for implementation.

Chapter 7.0 - Developing Your BMPs

Potential evaluation criteria for temperature management BMPs are presented in this chapter. Each POTW should arrive at their own evaluation criteria that reflect their community's values. A preliminary comparison of BMPs in terms of effectiveness and cost is included.

Each POTW must evaluate the temperature control alternatives available for their facility and develop the Best Management Practices that they will implement as part of their surface water Temperature Management Plan.

It is important that during the development of the Temperature Management Plan, each POTW develop alternative evaluation criteria prior to selecting potential BMPs. These evaluation criteria can then be applied in an unbiased fashion to fairly assess the relative merits of any proposed BMPs. Each POTW should arrive at their own evaluation criteria that reflect their community's values. Understanding these community values may require a public participation process as part of the Temperature Management Plan's development.

The following evaluation criteria are often used in planning processes to evaluate alternatives and arrive at the BMPs to be implemented at the POTW:

- Capital cost,
- Present worth cost,
- Implementation feasibility,
- Temperature reduction effectiveness,
- Cost effectiveness,
- Public acceptance,
- Environmental benefits.

Once the list of evaluation criteria has been developed, it is often helpful to weight the criteria in a fashion that reflects their relative importance to the community and/or the evaluators.

The relative cost-effectiveness of the various management practices that are considered as part of the temperature management planning is often of most importance. A simple cost/benefit ratio for assessing temperature control management practices can be expressed in terms of cost to accomplish heat load reduction ($/BTU/hr) using present worth costs or annual costs.

Once evaluation criteria are selected, BMPs should be rated for each criteria. One method is to assign each BMP a value of 1 through 3 for each criteria, with 3 being the best and 1 the worse. Multiple BMPs can have the same rating. In many cases, multiple BMPs will need to be initiated to reduce the temperature impacts of the discharge.

Table 7.1 provides a preliminary general comparison of the proposed best management practices included in this guidance manual. Cost and effectiveness will vary depending on site specific conditions. The table can be used as a starting point for the individual POTW Best Management Practices evaluations.

Table 7.1 Comparison of BMPs

BMP	Cost Ranking	Effectiveness Ranking
Collection System		
Pretreatment of identified head loads	$	★ ★
Public awareness/education	$-$$	★
Limiting discharge to the collection system	$	★ ★
Treatment Process Modifications		
Covering basins	$$	★ ★
Disinfection alternatives evaluation	N/A	★
Recycling and/or eliminating cooling water discharges	$	★
Energy conservation	$	★
Dishcarge Alternatives		
Move discharge location	$$	★ ★
Alter diffuser	$$	★ ★
Storing heated effluent	$$	★ ★
Land application during critical time periods	$$$	★ ★ ★ ★
Rapid infiltration	$$$	★ ★ ★
Direct Effluent Treatment		
Cooling ponds	$$$	★ ★ ★
Spray ponds	$$$	★ ★ ★ ★
Cooling towers	$$$$	★ ★ ★ ★
Chillers	$$$$$	★ ★ ★ ★ ★

SCALE
Cost:
$: Inexpensive, < $25,000
$$$$$: Expensive, > $300,000

Effectiveness:
★: Very Limited effectiveness
★ ★ ★ ★ ★: Reliably reduces temperature over a range of conditions

Chapter 8.0 - Temperature Management Plan Development

This chapter of the guidance manual describes the actual preparation of the Temperature Management Plan, including the necessary elements. A standard template has been prepared and should be used by POTWs in developing their plans.

Once it has been identified that a POTW is affecting the in-steam temperature and an evaluation of temperature control strategies has been completed, POTWs under Oregon's 1996 temperature standard are required to develop a surface water Temperature Management Plan to be approved by DEQ. This plan will become part of the POTWs NPDES permit once it is approved. The plan must include the following sections:

- Background,
- Plant details,
- Site specific data including information on the treatment plant and the receiving stream,
- Physical setting,
- BMPs considered,
- Evaluation of BMPs, and
- Implementation including budget and schedule.

These elements have been discussed and described in previous Chapters. Appendix L includes a template for preparing the temperature management plan. This template has been approved by DEQ. The template has instructions to assist with the temperature management plan preparation.

Chapter 9.0 - References

Carollo Engineers, 1991. Sacramento Regional Wastewater Treatment Plant: Thermal Compliance Study.

Davis, L.R., 1999. Fundamentals of Environmental Discharge Modeling. CRC Press, New York.

Guyer, E.C. and D.L. Brownell, 1989. Handbook of Applied Thermal Design. McGraw-Hill Book Company, New York.

Harper, Craig, 1999. Willamette Basin Water Temperature Standard Update, Prepared for the Willamette Restoration Initiative.

Jirka G., R. Doneker, and S. Hinton, 1996. User's Manual for CORMIX: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters. Office of Science and Technology, U.S. Environmental Protection Agency, Washington DC.

Oregon Department of Environmental Quality, 1997. Instructions for Excel Data Conversion Macros Pre-Release Versions.

Oregon Department of Environmental Quality, 1997. Instructions for Excel Temperature Macro Version 1.00.

Oregon Department of Environmental Quality, 1996. The Scientific Basis for Oregon's Stream Temperature Standard: Common Questions and Straight Answers.

Oregon Department of Environmental Quality, 1997. Stream Temperature Protocol: Oregon Coastal Salmon Restoration Initiative.

Oregon Department of Environmental Quality, 1996. Temperature Implementation Guidance for Point Source Discharges.

Oregon Department of Environmental Quality, September 18,1996. Procedural Guidance for Water Temperature Monitoring.

Perry, R. H. and D.W. Green, 1984. Perry's Chemical Engineers' Handbook, Sixth Edition. McGraw-Hill Book Company, New York.

University of Florida, TREEO Center, Operations and Training Manual on Energy Efficiency in Water and Wastewater Treatment Plants: Volume 1 Energy Conservation Measures, Gainesville, Florida.

Appendices

Appendix A: 1996 Oregon Temperature Standard (OAR 340-41-026)

The Oregon Administrative Rules contain OARs filed through May 15, 2000

DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER POLLUTION

DIVISION 41

STATE-WIDE WATER QUALITY MANAGEMENT PLAN;

BENEFICIAL USES, POLICIES, STANDARDS, AND TREATMENT CRITERIA FOR OREGON

340-041-0001

Preface

(1) The rules which follow, together with the applicable laws of the State of Oregon and the applicable regulations of the Environmental Quality Commission, set forth Oregon's plans for management of the quality of public waters within the State of Oregon.

(2) Under this plan, the Department of Environmental Quality will continue to manage water quality by evaluating each discharge and activity, whether existing or a new proposal, on a case-by-case basis, based on best information currently available and within the limiting framework of minimum standards, treatment criteria, and policies which are set forth in the plan.

(3) The EQC recognizes that the deadlines for adoption of this plan prevented thorough involvement by local government in the development and review of the plan. Accordingly, the Department will review the contents of this plan with affected local governments and will use their comments and suggestions in preparing amendments for consideration by the EQC not later than December, 1977. At a minimum, the processes of coordination with local governments will consist of the following elements:

(a) Work with county coordinators to set up meetings to explain the plan to groups of local governments and solicit their comments;

(b) Provide copies of the plan and supporting documents to any affected local governments who have not already received them;

(c) Seek input from councils of governments;

(d) Upon request, visit local level governments to discuss the plan;

(e) Work with statewide associations of local governments and others to inform local governments of the plan.

Stat. Auth.: ORS 468

Stats. Implemented: ORS 468.015, ORS 468.035 & ORS 468B.015

Hist.: DEQ 128, f. & ef. 1-21-77

340-041-0006

Definitions

Definitions applicable to all basins unless context requires otherwise:

(1) "BOD" means 5-day 20°C. Biochemical Oxygen Demand.

(2) "DEQ" or "Department" means the Oregon State Department of Environmental Quality.

(3) "DO" means dissolved oxygen.

(4) "EQC" or "Commission" means the Oregon State Environmental Quality Commission.

(5) "Estuarine Waters" means all mixed fresh and oceanic waters in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties.

(6) "Industrial Waste" means any liquid, gaseous, radioactive, or solid waste substance or a combination thereof resulting from any process of industry, manufacturing, trade, or business, or from the development or recovery of any natural resources.

(7) "Marine Waters" means all oceanic, offshore waters outside of estuaries or bays and within the territorial limits of the State of Oregon.

(8) "mg/l" means milligrams per liter.

(9) "Pollution" means such contamination or other alteration of the physical, chemical, or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt, or odor of the waters, or such radioactive or other substance into any waters of the state which either by itself or in connection with any other substance present, will or can reasonably be expected to create a public nuisance or render such waters harmful, detrimental, or injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life, or the habitat thereof.

(10) "Public Water" means the same as "waters of the state".

(11) "Sewage" means the water-carried human or animal waste from residences, buildings, industrial establishments, or other places together with such groundwater infiltration and surface water as may be present. The admixture with sewage as herein defined of industrial wastes or wastes, as defined in sections (6) and (13) of this rule, shall also be considered "sewage" within the meaning of this division.

(12) "SS" means suspended solids.

(13) "Wastes" means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive, or other substances which will or may cause pollution or tend to cause pollution of any water of the state.

(14) "Waters of the State" include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

(15) "Low Flow Period" means the flows in a stream resulting from primarily groundwater discharge or baseflows augmented from lakes and storage projects during the driest period of the year. The dry weather period varies across the state according to climate and topography. Wherever the low flow period is indicated in the Water Quality Management Plans, this period has been approximated by the inclusive months. Where applicable in a waste discharge permit, the low flow period may be further defined.

(16) "Secondary Treatment" as the following context may require for:

(a) "Sewage Wastes" means the minimum level of treatment mandated by EPA regulations pursuant to Public Law 92-500;

(b) "Industrial and other waste sources" imply control equivalent to best practicable treatment (BPT).

(17) "Nonpoint Sources" refers to diffuse or unconfined sources of pollution where wastes can either enter into -- or be conveyed by the movement of water to -- public waters.

(18) "Loading Capacity (LC)" -- The greatest amount of loading that a water can receive without violating water quality standards.

(19) "Load Allocation (LA)" -- The portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Whenever possible, natural and nonpoint source loads should be distinguished.

(20) "Wasteload Allocation (WLA)" -- The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation.

(21) "Total Maximum Daily Load (TMDL)" -- The sum of the individual WLAs for point sources and LAs for nonpoint sources and background. If a receiving water has only one point source discharger, the TMDL is the sum of that point source WLA plus the LAs for any nonpoint sources of pollution and

natural background sources, tributaries, or adjacent segments. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs.

(22) "Land Development" refers to any human induced change to improved or unimproved real estate, including but not limited to construction, installation or expansion of a building or other structure, land division, drilling, and site alteration such as that due to land surface mining, dredging, grading, construction of earthen berms, paving, improvements for use as parking or storage, excavation or clearing.

(23) "Jurisdiction" refers to any city or county agency in the Tualatin River and Oswego Lake subbasins that regulates land development activities within its boundaries by approving plats, site plans or issuing permits for land development.

(24) "Erosion Control Plan" shall be a plan containing a list of best management practices to be applied during construction to control and limit soil erosion.

(25) "Public Works Project" means any land development conducted or financed by a local, state, or federal governmental body.

(26) "Stormwater Quality Control Facility" refers to any structure or drainage way that is designed, constructed, and maintained to collect and filter, retain, or detain surface water runoff during and after a storm event for the purpose of water quality improvement. It may also include, but not be limited to, existing features such as wetlands, water quality swales, and ponds which are maintained as stormwater quality control facilities.

(27) "Water Quality Swale" is a natural depression or wide shallow ditch used to temporarily store, route, or filter runoff for the purpose of improving water quality.

(28) "In Lieu Fee" means a fee collected by a jurisdiction in lieu of requiring construction of on-site stormwater quality control facilities.

(29) "Effluent Limited" can mean one of the following categories:

(a) A receiving stream which is meeting and/or is expected to meet water quality standards with the implementation of standard treatment technology which is secondary treatment for sewage wastes and best practicable treatment (BPT) for industrial and other waste sources;

(b) A receiving stream for which there is insufficient information to determine if water quality standards are being met with standard treatment technology.

(30) "Water Quality Limited" can mean one of the following categories:

(a) A receiving stream which does not meet instream water quality standards during the entire year or defined season even after the implementation of standard technology;

(b) A receiving stream which achieves and is expected to continue to achieve instream water quality standard but utilizes higher than standard technology to protect beneficial uses;

(c) A receiving stream for which there is insufficient information to determine if water quality standards are being met with higher than standard treatment technology or where through professional judgment the receiving stream would not be expected to meet water quality standards during the entire year or defined season without higher than standard technology.

(31) "Reserve Capacity" means that portion of a receiving stream's loading capacity which has not been allocated to point sources or nonpoint sources and natural background as waste load allocations or load allocations, respectively. The reserve capacity includes that loading capacity which has been set aside for a safety margin and is otherwise unallocated.

(32) "Aquatic Species" means any plants or animals which live at least part of their life cycle in waters of the State.

(33) "Biological Criteria" means numerical values or narrative expressions that describe the biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.

(34) "Designated Beneficial Use" means the purpose or benefit to be derived from a water body, as designated by the Water Resources Department or the Commission.

(35) "Indigenous" means supported in a reach of water or known to have been supported according to historical records compiled by State and Federal agencies or published scientific literature.

(36) "Resident Biological Community" means aquatic life expected to exist in a particular habitat when water quality standards for a specific ecoregion, basin, or water body are met. This shall be established by accepted biomonitoring techniques.

(37) "Without Detrimental Changes in the Resident Biological Community" means no loss of ecological integrity when compared to natural conditions at an appropriate reference site or region.

(38) "Ecological Integrity" means the summation of chemical, physical and biological integrity capable of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region.

(39) "Appropriate Reference Site or Region" means a site on the same water body, or within the same basin or ecoregion that has similar habitat conditions, and represents the water quality and biological community attainable within the areas of concern.

(40) "Critical Habitat" means those areas which support rare, threatened or endangered species, or serve as sensitive spawning and rearing areas for aquatic life.

(41) "High Quality Waters" means those waters which meet or exceed those levels that are necessary to support the propagation of fish, shellfish, and wildlife and recreation in and on the water, and other designated beneficial uses.

(42) "Outstanding Resource Waters" means those waters designated by the Environmental Quality Commission where existing high quality waters constitute an outstanding state or national resource based on their extraordinary water quality or ecological values, or where special water quality protection is needed to maintain critical habitat areas.

(43) "Short-Term Disturbance" means a temporary disturbance where water quality standards may be violated briefly, but not of sufficient duration to cause acute or chronic effects on beneficial uses.

(44) "Intergravel Dissolved Oxygen" (IGDO) -- The concentration of oxygen measured in the stream gravel pore water. For the purposes of compliance with criteria, the dissolved oxygen concentration should be measured within a redd or artificial redd, down-gradient of the egg pocket. Measurements should be taken within a limited time period; for example, prior to emergence of fry during the month of March.

(45) "Spatial Median" -- The value which falls in the middle of a data set of multiple IGDO measurements taken within a spawning area. Half the samples should be greater than, and half the samples should be less than the spatial median.

(46) "Daily Mean" (dissolved oxygen) -- The numeric average of an adequate number of data to describe the variation in dissolved oxygen concentration throughout a day, including daily maximums and minimums. For the purpose of calculating the mean, concentrations in excess of 100 percent of saturation are valued at the saturation concentration.

(47) "Monthly (30-day) Mean Minimum" (dissolved oxygen) -- The minimum of the 30 consecutive day floating averages of the calculated daily mean dissolved oxygen concentration.

(48) "Weekly (seven-day) Mean Minimum" (dissolved oxygen) -- The minimum of the seven consecutive day floating average of the calculated daily ***mean*** dissolved oxygen concentration.

(49) "Weekly (seven-day) Minimum Mean" (dissolved oxygen) -- The minimum of the seven consecutive day floating average of the daily ***minimum*** concentration. For purposes of application of the criteria, this value will be used as the reference for diurnal minimums.

(50) "Minimum" (dissolved oxygen) -- The minimum recorded concentration including seasonal and diurnal minimums.

(51) "Cold-Water Aquatic Life" -- The aquatic communities that are physiologically restricted to cold water, composed of one or more species sensitive to reduced oxygen levels. Including but not limited to *Salmonidae* and cold-water invertebrates.

(52) "Cool-Water Aquatic Life" -- The aquatic communities that are physiologically restricted to cool waters, composed of one or more species having dissolved oxygen requirements believed similar to the cold-water communities. Including but not limited to *Cottidae*, *Osmeridae*, *Acipenseridae*, and sensitive *Centrarchidae* such as the small-mouth bass.

(53) "Warm-Water Aquatic Life" -- The aquatic communities that are adapted to warm-water conditions and do not contain either cold- or cool-water species.

(54) "Numeric Temperature Criteria" are measured as the seven-day moving average of the daily maximum temperatures. If there is insufficient data to establish a seven-day average of maximum temperatures, the numeric criteria shall be applied as an instantaneous maximum. The measurements shall be made using a sampling protocol appropriate to indicate impact to the beneficial uses;

(55) "Measurable Temperature Increase" means an increase in stream temperature of more than 0.25°F;

(56) "Anthropogenic", when used to describe "sources" or "warming", means that which results from human activity;

(57) "Ecologically Significant Cold-Water Refuge" exists when all or a portion of a waterbody supports stenotypic cold-water species (flora or fauna) not otherwise widely supported within the subbasin, and either:

(a) Maintains cold-water temperatures throughout the year relative to other segments in the subbasin, providing summertime cold-water holding or rearing habitat that is limited in supply, or;

(b) Supplies cold water to a receiving stream or downstream reach that supports cold-water biota.

Stat. Auth: ORS 183.500, ORS 468.020, ORS 468B.048, ORS 468.705, ORS 468.710 & ORS 468.735

Stats. Implemented: ORS 468B.048

Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 24-1981, f. & ef. 9-8-81; DEQ 16-1988, f. & cert. ef. 7-13-88; DEQ 16-1989, f. & cert. ef. 7-31-89 (and corrected 8-3-89); DEQ 30-1989, f. & cert. ef. 12-14-89; DEQ 22-1990, f. & cert. ef. 7-6-90; DEQ 14-1991, f. & cert. ef. 8-13-91; DEQ 17-1991, f. & cert. ef. 9-30-91; DEQ 5-1996, f. & cert. ef. 3-7-96

340-041-0026

Policies and Guidelines Generally Applicable to All Basins

(1) In order to maintain the quality of waters in the State of Oregon, the following is the general policy of the EQC:

(a) Antidegradation Policy for Surface Waters. The purpose of the Antidegradation Policy is to guide decisions that affect water quality such that unnecessary degradation from point and nonpoint sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to protect all existing beneficial uses. The standards and policies set forth in OAR 340-041-0120 through 340-041-0962 are intended to implement the Antidegradation Policy;

(A) High Quality Waters Policy: Where existing water quality meets or exceeds those levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, and other designated beneficial uses, that level of water quality shall be maintained and protected. The Environmental Quality Commission, after full satisfaction of the intergovernmental coordination and public participation provisions of the continuing planning process, and with full consideration of sections (2), (3) and (5) of this rule, however, may allow a lowering of water quality in these high quality waters if they find:

(i) No other reasonable alternatives exist except to lower water quality; and

(ii) The action is necessary and justifiable for economic or social development benefits and outweighs the environmental costs of lowered water quality; and

(iii) All water quality standards will be met and beneficial uses protected.

(B) The Director or a designee may allow lower water quality on a short term basis in order to respond to emergencies or to otherwise protect public health and welfare;

(C) Water Quality Limited Waters Policy: For water quality limited waterbodies, the water quality shall be managed as described in section (3) of this rule;

(D) Outstanding Resource Waters Policy: Where existing high quality waters constitute an outstanding state or national resource such as those waters designated as extraordinary resource waters, or as critical habitat areas, the existing water quality and water quality values shall be maintained and protected, and classified as "Outstanding Resource Waters of Oregon". The Commission may specially designate high quality waterbodies to be classified as Outstanding Resource Waters in order to protect the water quality parameters that affect ecological integrity of critical habitat or special water quality values that are vital to the unique character of those waterbodies. The Department will develop a screening process and establish a list of nominated waterbodies for Outstanding Resource Waters designation in the Bienniel Water Quality Status Assessment Report (305(b) Report). The priority waterbodies for nomination include:

(i) National Parks;

(ii) National Wild and Scenic Rivers;

(iii) National Wildlife Refuges;

(iv) State Parks; and

(v) State Scenic Waterways.

(E) The Department will bring to the Commission a list of waterbodies which are proposed for designation as Outstanding Resource Waters at the time of each Trienniel Water Quality Standards Review;

(F) In designating Outstanding Resource Waters, the Commission shall establish the water quality values to be protected and provide a process for determining what activities are allowed that would not affect the outstanding resource values. After the designation, the Commission shall not allow activities that may lower water quality below the level established except on a short term basis to respond to emergencies or to otherwise protect human health and welfare.

(b) Point source discharges shall follow policies and guidelines in sections (2), (5) and (6) of this rule, and nonpoint source activities shall follow guidelines in sections (7), (8), (9), (10), and (11) of this rule.

(2) In order to maintain the quality of waters in the State of Oregon, it is the general policy of the EQC to require that growth and development be accommodated by increased efficiency and effectiveness of waste treatment and control such that measurable future discharged waste loads from existing sources do not exceed presently allowed discharged loads except as provided in section (3) of this rule.

(3) The Commission or Department may grant exceptions to sections (2) and (6) of this rule and approvals to section (5) of this rule for major dischargers and other dischargers, respectively. Major dischargers include those industrial and domestic sources that are classified as major sources for permit

fee purposes in OAR 340-045-0075(2).

(a) In allowing new or increased discharged loads, the Commission or Department shall make the following findings:

(A) The new or increased discharged load would not cause water quality standards to be violated;

(B) The new or increased discharged load would not unacceptably threaten or impair any recognized beneficial uses. In making this determination, the Commission or Department may rely upon the presumption that if the numeric criteria established to protect specific uses are met the beneficial uses they were designed to protect are protected. In making this determination the Commission or Department may also evaluate other state and federal agency data that would provide information on potential impacts to beneficial uses for which the numeric criteria have not been set;

(C) The new or increased discharged load shall not be granted if the receiving stream is classified as being water quality limited under OAR 340-041-0006(30)(a), unless:

(i) The pollutant parameters associated with the proposed discharge are unrelated either directly or indirectly to the parameter(s) causing the receiving stream to violate water quality standards and being designated water quality limited; or

(ii) Total maximum daily loads (TMDLs), waste load allocations (WLAs) load allocations (LAs), and the reserve capacity have been established for the water quality limited receiving stream; and compliance plans under which enforcement action can be taken have been established; and there will be sufficient reserve capacity to assimilate the increased load under the established TMDL at the time of discharge; or

(iii) Effective July 1, 1996, in waterbodies designated water-quality limited for dissolved oxygen, when establishing WLAs under a TMDL for waterbodies meeting the conditions defined in this rule, the Department may at its discretion provide an allowance for WLAs calculated to result in no measurable reduction of dissolved oxygen. For this purpose, "no measurable reduction" is defined as no more than 0.10 mg/L for a single source and no more than 0.20 mg/L for all anthropogenic activities that influence the water quality limited segment. The allowance applies for surface water DO criteria and for Intergravel DO if a determination is made that the conditions are natural. The allowance for WLAs would apply only to surface water 30-day and seven-day means, and the IGDO action level; or

(iv) Under extraordinary circumstances to solve an existing, immediate, and critical environmental problem that the Commission or Department may consider a waste load increase for an existing source on a receiving stream designated water quality limited under OAR 340-041-0006(30)(a) during the period between the establishment of TMDLs, WLAs and LAs and their achievement based on the following conditions:

(I) That TMDLs, WLAs and LAs have been set; and

(II) That a compliance plan under which enforcement actions can be taken has been established and is being implemented on schedule; and

(III) That an evaluation of the requested increased load shows that this increment of load will not have an unacceptable temporary or permanent adverse effect on beneficial uses; and

(IV) That any waste load increase granted under subparagraph (iv) of this paragraph is temporary and

does not extend beyond the TMDL compliance deadline established for the waterbody. If this action will result in a permanent load increase, the action has to comply with sub-paragraphs (i) or (ii) of this paragraph.

(D) Effective July 1, 1996, in any waterbody identified by the Department as exceeding the relevant numeric temperature criteria specified for each individual water quality management basin identified in OAR 340-041-0205, OAR-340-041-0245, OAR-340-041-0285, OAR-340-041-0325, OAR-340-041-0365, OAR-340-041-0445, OAR-340-041-0485, OAR-340-041-0525, OAR-340-041-0565, OAR-340-041-0605, OAR-340-041-0645, OAR-340-041-0685, OAR-340-041-0725, OAR-340-041-0765, OAR-340-041-0805, OAR-340-041-0845, OAR-340-041-0885, OAR-340-041-0925, OAR-340-041-0965, and designated as water quality limited under Section 303(d) of the Clean Water Act, the following requirements shall apply to appropriate watersheds or stream segments in accordance with priorities established by the Department. The Department may determine that a plan is not necessary for a particular stream segment or segments within a water-quality limited basin based on the contribution of the segment(s) to the temperature problem:

(i) Anthropogenic sources are required to develop and implement a surface water temperature management plan which describes the best management practices, measures, and/or control technologies which will be used to reverse the warming trend of the basin, watershed, or stream segment identified as water quality limited for temperature;

(ii) Sources shall continue to maintain and improve, if necessary, the surface water temperature management plan in order to maintain the cooling trend until the numeric criterion is achieved or until the Department, in consultation with the Designated Management Agencies (DMAs), has determined that all feasible steps have been taken to meet the criterion and that the designated beneficial uses are not being adversely impacted. In this latter situation, the temperature achieved after all feasible steps have been taken will be the temperature criterion for the surface waters covered by the applicable management plan. The determination that all feasible steps have been taken will be based on, but not limited to, a site-specific balance of the following criteria: protection of beneficial uses; appropriateness to local conditions; use of best treatment technologies or management practices or measures; and cost of compliance;

(iii) Once the numeric criterion is achieved or the Department has determined that all feasible steps have been taken, sources shall continue to implement the practices or measures described in the surface water temperature management plan in order to continually achieve the temperature criterion;

(iv) For point sources, the surface water temperature management plan will be part of their National Pollutant Discharge Elimination System Permit (NPDES);

(v) For nonpoint sources, the surface water temperature management plan will be developed by designated management agencies (DMAs) which will identify the appropriate BMPs or measures;

(vi) A source (including but not limited to permitted point sources, individual landowners and land managers) in compliance with the Department or DMA (as appropriate) approved surface water temperature management plan shall not be deemed to be causing or contributing to a violation of the numeric criterion if the surface water temperature exceeds the criterion;

(vii) In waters the Department determines to be critical for bull trout recovery, the goal of a bull trout surface water temperature management plan is to specifically protect those habitat ranges necessary to

maintain the viability of existing stocks by restoring stream and riparian conditions or allowing them to revert to conditions attaining the coolest surface water temperatures possible under natural background conditions;

(E) Waters of the state exceeding the temperature criteria will be identified in the Clean Water Act (CWA), Section 303(d) list developed by the Department according to the schedule required by the Clean Water Act. This list will be prioritized in consul-tation with the DMAs to identify the order in which those waters will be addressed by the Department and the DMAs;

(F) In basins determined by the Department to be exceeding the numeric temperature criteria, and which are required to develop surface water temperature management plans, new or increased discharge loads from point sources which require an NPDES permit under Section 402 of the Clean Water Act or hydro-power projects which require certification under Section 401 of the Clean Water Act are allowed a 1.0°F total cumulative increase in surface water temperatures as the surface water temperature management plan is being developed and implemented for the water quality limited basin if:

(i) In the best professional judgment of the Department, the new or increased discharge load, even with the resulting 1.0°F cumulative increase, will not conflict with or impair the ability of a surface water temperature management plan to achieve the numeric temperature criteria; and

(ii) A new or expanding source must demonstrate that it fits within the 1.0°F increase and that its activities will not result in a measurable impact on beneficial uses. This latter showing must be made by demonstrating to the Department that the temperature change due to its activities will be less than or equal to 0.25°F under a conservative approach or by demonstrating the same to the EQC with appropriate modeling.

(G) Any source may petition the Department for an exception to paragraph (F) of this subsection, provided:

(i) The discharge will result in less than 1.0°F increase at the edge of the mixing zone, and subparagraph (ii) or (iii) of this paragraph applies;

(ii) The source provides the necessary scientific information to describe how the designated beneficial uses would not be adversely impacted; or

(iii) The source demonstrates that:

(I) It is implementing all reasonable management practices;

(II) Its activity will not significantly affect the beneficial uses; and

(III) The environmental cost of treating the parameter to the level necessary to assure full protection would outweigh the risk to the resource.

(H) Any source or DMA may petition the Commission for an exception to paragraph (F) of this subsection, provided:

(i) The source or DMA provides the necessary scientific information to describe how the designated beneficial uses would not be adversely impacted; or

(ii) The source or DMA demonstrates that:

(I) It is implementing all reasonable management practices;

(II) Its activity will not significantly affect the beneficial uses; and

(III) The environmental cost of treating the parameter to the level necessary to assure full protection would outweigh the risk to the resource.

(I) In waterbodies designated by the Department as water-quality limited for bacteria, and in accordance with priorities established by the Department, development and implementation of a bacteria management plan shall be required of those sources that the Department determines to be contributing to the problem. The Department may determine that a plan is not necessary for a particular stream segment or segments within a water-quality limited basin based on the contribution of the segment(s) to the problem. The bacteria management plans will identify the technologies, BMPs and/or measures and approaches to be implemented by point and nonpoint sources to limit bacterial contamination. For point sources, their National Pollutant Discharge Elimination System permit is their bacteria management plan. For nonpoint sources, the bacteria management plan will be developed by designated management agencies (DMAs) which will identify the appropriate BMPs or measures and approaches.

(J) The activity, expansion, or growth necessitating a new or increased discharge load is consistent with the acknowledged local land use plans as evidenced by a statement of land use compatibility from the appropriate local planning agency.

(b) Oregon's water quality management policies and programs recognize that Oregon's water bodies have a finite capacity to assimilate waste. Unused assimilative capacity is an exceedingly valuable resource that enhances in-stream values specifically, and environmental quality generally. Allocation of any unused assimilative capacity should be based on explicit criteria. In addition to the conditions in subsection (a) of this section, the Commission or Department shall consider the following:

(A) Environmental Effects Criteria:

(i) Adverse Out-of-Stream Effects. There may be instances where the non-discharge or limited discharge alternatives may cause greater adverse environmental effects than the increased discharge alternative. An example may be the potential degradation of groundwater from land application of wastes;

(ii) Instream Effects. Total stream loading may be reduced through elimination or reduction of other source discharges or through a reduction in seasonal discharge. A source that replaces other sources, accepts additional waste from less efficient treatment units or systems, or reduces discharge loadings during periods of low stream flow may be permitted an increased discharge load year-round or during seasons of high flow, as appropriate;

(iii) Beneficial Effects. Land application, upland wetlands application, or other non-discharge alternatives for appropriately treated wastewater may replenish groundwater levels and increase streamflow and assimilative capacity during otherwise low streamflow periods.

(B) Economic Effects Criteria. When assimilative capacity exists in a stream, and when it is judged that increased loadings will not have significantly greater adverse environmental effects than other alternatives to increased discharge, the economic effect of increased loading will be considered. Economic effects will be of two general types:

(i) Value of Assimilative Capacity. The assimilative capacity of Oregon's streams are finite, but the potential uses of this capacity are virtually unlimited. Thus it is important that priority be given to those beneficial uses that promise the greatest return (beneficial use) relative to the unused assimilative capacity that might be utilized. In-stream uses that will benefit from reserve assimilative capacity, as well as potential future beneficial use, will be weighed against the economic benefit associated with increased loading;

(ii) Cost of Treatment Technology. The cost of improved treatment technology, non-discharge and limited discharge alternatives shall be evaluated.

(4)(a) A receiving stream shall be designated as water quality limited through the biennial water quality status assessment report prepared to meet the requirements of Section 305(b) of the Water Quality Act. Appendix A of the Status Assessment report shall identify: what waterbodies are water quality limited, the time of year the water quality standards violations occur, the segment of stream or area of waterbody limited, the parameter(s) of concern, whether it is water quality limited under OAR 340-041-0006(30)(a), (b) or (c). Appendix B and C of the Status Assessment report shall identify the specific evaluation process for designating waterbodies limited;

(b) The WQL list contained in Appendix A of the Status Assessment report shall be placed on public notice and reviewed through the public hearing process. At the conclusion of the hearing process and the evaluation of the testimony received, Appendix A will become the official water quality limited list. The Department may add a waterbody to the water quality limited list between status assessment reports after placing that action out on public notice and conducting a public hearing;

(c) For interstate waterbodies, the state shall be responsible for completing the requirements of section (3) of this rule for that portion of the interstate waterbody within the boundary of the state;

(d) For waterbodies designated WQL under OAR 340-041-0006(30)(c), the Department shall establish a priority list and schedule for future water quality monitoring activities to determine: if the waterbody should be designated WQL under OAR 340-041-0006(30)(a) or (b), if estimated TMDLs need to be prepared, and if an implementation plan needs to be developed and implemented;

(e) For waterbodies designated WQL under OAR 340-041-0006(30)(b), requests for load increases shall be considered following subsection (3)(b) of this rule.

(5) For any new waste sources, alternatives which utilize reuse or disposal with no discharge to public waters shall be given highest priority for use wherever practicable. New source discharges may be approved subject to the criteria in section (3) of this rule.

(6) No discharges of wastes to lakes or reservoirs shall be allowed except as provided in section (3) of this rule.

(7) Log handling in public waters shall conform to current EQC policies and guidelines.

(8) Sand and gravel removal operations shall be conducted pursuant to a permit from the Division of State Lands and separated from the active flowing stream by a watertight berm wherever physically practicable. Recirculation and reuse of process water shall be required wherever practicable. Discharges, when allowed, or seepage or leakage losses to public waters shall not cause a violation of water quality standards or adversely affect legitimate beneficial uses.

(9) Logging and forest management activities shall be conducted in accordance with the Oregon Forest Practices Act so as to minimize adverse effects on water quality.

(10) Road building and maintenance activities shall be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

(11) In order to improve controls over nonpoint sources of pollution, federal, state, and local resource management agencies will be encouraged and assisted to coordinate planning and implementation of programs to regulate or control runoff, erosion, turbidity, stream temperature, stream flow, and the withdrawal and use of irrigation water on a basin-wide approach so as to protect the quality and beneficial uses of water and related resources. Such programs may include, but not be limited to, the following:

(a) Development of projects for storage and release of suitable quality waters to augment low stream flow;

(b) Urban runoff control to reduce erosion;

(c) Possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows;

(d) Stream bank erosion reduction projects.

Stat. Auth: ORS 183.500, ORS 468.020, ORS 468B.048, ORS 468.705, ORS 468.710 & ORS 468.735

Stats. Implemented: ORS 468B.048

Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 1-1980, f. & ef. 1-9-80; DEQ 13-1989, f. & cert. ef. 6-14-89; DEQ 22-1990, f. & cert. ef. 7-6-90; DEQ 17-1991, f. & cert. ef. 9-30-91; DEQ 5-1996, f. & cert. ef. 3-7-96

Appendix B: DEQ Guidance on Temperature Monitoring

Oregon Department of Environmental Quality

Procedural Guidance for Water Temperature Monitoring

18 September 1996

Purpose:

Revisions to the water temperature standard were adopted by the Environmental Quality Commission on January 11, 1996, and become effective July 1, 1996. This guidance was developed by the Department's Water Quality Monitoring staff to ensure statewide consistency in the collection of water temperature data.

Data Objectives:

The Oregon Administrative Rules (OAR 340-41) give "Numeric Temperature Criteria" which prohibit "measurable surface water temperature increase resulting from anthropogenic activities". The criteria are specific to the waterbodies and the beneficial uses being protected. The following table gives a brief summary of the numeric criteria. These criteria are the basis for the temperature monitoring and data quality protocols described in this guidance. The DEQ is working with the Oregon Department of Fish and Wildlife to generate maps which will be useful when applying the numeric temperature criteria.

Designated Beneficial Use or Waterbody	Numeric Criteria -- No Increase above	
	Temperature °F	Temperature °C
Oregon Bull Trout habitat.	50.0	10.0
Native salmonid spawning, egg incubation, fry emergence.	55.0	12.8
Salmonid fish rearing.	64.0	17.8
Columbia River, its sloughs and channels, river mile 0 to 309.	68.0	20.0
Willamette River, its sloughs and channels, river mile 0 to 50.	68.0	20.0
Significant cold-water refugia.	No increase.	
Stream segments with temperature sensitive Threatened and Endangered species.	No increase.	
Waters when dissolved oxygen (DO) levels are within 0.5 mg/l or 10% saturation of the water column or intergravel DO criterion.	No increase.	
Natural lakes.	No increase.	

According to the OAR, the numeric temperature criteria "are measured as the seven-day moving average of the daily maximum temperatures. If there is insufficient data to establish a seven-day average of maximum temperatures, the numeric criteria shall be applied as an instantaneous maximum. The measurements shall be made using a sampling protocol appropriate to indicate impact to the beneficial uses;".

Water temperatures vary in both space and time. Monitoring must record daily maxima at locations which represent general conditions -- not pockets of cold water refugia or hot spots. Also, one must use caution when extrapolating data from a monitoring site to an upstream or downstream location. There are many variables such as confluences with tributaries, groundwater inflow, channel morphology, elevation, and stream shading that confound data interpretation. Frequently, data from additional monitoring sites will be necessary to document the geographic boundaries of a standard violation.

Monitoring Equipment:

Monitoring equipment must have a temperature range which is appropriate for the applicable standard. Instruments with a measurement range of -5 °C to 35 °C are available from a variety of manufacturers, and are applicable for monitoring all numeric criteria. Instruments with different temperature ranges could be used, provided that the instrument's range brackets the appropriate numeric criteria by ± 5 °C. All temperature monitoring equipment must have a resolution of 0.2 °C or better; and an accuracy of ± 0.3 °C or better.

Maximum recording thermometers designed for total immersion may be used, but require daily site visits during the entire sampling period. Thermographs or dataloggers set to record either hourly temperatures or the daily maximums are the preferred monitoring method.

The advantage of collecting data hourly is that the maximum temperature and it's duration can be documented. Sampling intervals as short as 15 minutes can be valuable when comparing a dataset to audit values, but more frequent sampling has no practical application.

Monitoring should generally be conducted from June through September, but a three month period including July and August may be more practical depending on local conditions. For example, east of the Cascades temperature violations may occur between mid-June and early September, whereas coastal areas are unlikely to violate standards in June and often experience seasonal maxima in mid-September.

Monitoring Site Selection:

In reference to temperature measurements, the OAR state that "measurements shall be made using a sampling protocol appropriate to indicate impact to the beneficial uses;". This statement implies that temperature monitoring must be done in a manner which is representative of the waterbody or stream segment of interest. In order to collect representative temperature data, sampling site selection must minimize the influence of confounding factors. For example, the location and influence of tributaries, springs, wetlands, water withdrawals, effluent discharges, and other hydrologic factors must be considered.

Install monitoring equipment at river sites with turbulence and mixing (such as riffles, runs, or cascades), toward the thread or "Thalwag" of the channel. *Do not place monitoring equipment in pools, glides, or other areas which may be subject to thermal stratification or other confounding variables as noted above.* A hand-held thermometer must be used to document sufficient mixing at the selected site. Monitoring equipment must be installed such that the temperature sensor is

completely submerged, but not in contact with the bottom. For non-wadable streams, the sensor should be placed one meter below the surface, but not in contact with a large thermal mass like a bridge abutment or boulder.

Precautions against vandalism, theft, and accidental disturbance should be considered when installing equipment. In areas frequented by the public it is advisable to secure or camouflage equipment. Visible tethers are not advisable since they attract attention. When equipment can not be protected from disturbance, an alternative monitoring site should be considered.

Once a site is selected, it is important to record descriptive information such as general flow conditions and depths, and references to landmarks such as tributary names, river mile, roads, and bridges. The latitude and longitude of the site is an important piece of information that can be obtained from a topographic map, or from a global positioning device (GPS).

Miniature dataloggers frequently become coated with algae or silt, and can be difficult to locate when one returns to retrieve the unit or perform an audit. A photograph of the monitoring site can be useful for locating equipment.

Data Quality:

The following procedures must be followed to ensure that temperature data is of acceptable quality. These procedures document instrument accuracy, test for proper functioning during the sampling period, and set criteria for data acceptance.

Accuracy Testing and Recording

A National Institute of Standards and Technology (NIST) traceable thermometer, with a resolution of 0.1 °C or better, and an accuracy of 0.1 °C or better must be used to test the accuracy of temperature monitoring equipment. The NIST thermometer should be calibrated annually, with at least two calibration points between 10 °C and 20 °C.

The accuracy of temperature monitoring instruments must be tested pre- and post-deployment, at one or more calibration temperatures, preferably between 10 °C and 20 °C. Testing is done using a stable thermal mass, such as a water-filled thermos bottle or ice chest. The stable temperature of the insulated water mass allows direct comparison of the unit's readout with that of the NIST thermometer. Accuracy must be within ± 0.5 °C.

Monitoring equipment with detachable sensors must be marked in order to match sensors with dataloggers. This allows an instrument and sensor to be tested pre-deployment, and also makes malfunctions easier to diagnose and correct. A logbook must be kept which documents each unit's calibration date, test results, and the reference thermometer used.

Field Auditing of Instrument Performance

In addition to laboratory calibrations, temperature monitoring equipment must be audited during the deployment period. A minimum of two field temperature audits should be taken during the sampling period – one after deployment when the instrument has reached thermal equilibrium, and one prior to recovery. A third, mid-deployment audit is recommended.

Thermometers used for auditing must have an accuracy of ± 0.5 °C, and resolution of 0.1 °C. An audit is performed by placing the auditing thermometer's sensor close to the monitoring instrument's sensor. The audit value is recorded when a stable reading is obtained. A stable reading is usually achieved within ten thermal time constants. For example, an auditing thermometer with a ten second time constant should give a stable reading within 100 seconds.

Most general purpose data loggers allow the user to connect a computer in the field and view "real-time" temperature data without interfering with the datalogger's sampling schedule. This feature allows immediate comparison of the datalogger's reading with the audit thermometer's reading. Real-time audit accuracy must be within ± 1.0 °C.

Conversely, most brands of miniature dataloggers interrupt data collection when the unit is connected to a computer. With this type of unit, field audit data can only be applied by "post-processing", i.e. the stored data are off-loaded and later compared to audit values. For this type of equipment, auditing times should be reasonably close to the datalogger's logging time. Otherwise, the equipment may fail the audit criteria due to rapidly changing water temperatures. Post-processing audit accuracy must be within ± 1.0 °C.

Dataloggers typically set date and time based on the set-up computer's clock. It's important that field personnel synchronize their watches to this time. Otherwise, a poorly timed audit could cause valid data to be rejected.

Data Analysis:

Only data which meets quality control requirements may be used for comparison to the numeric temperature criteria. Data are considered valid if the instrument's pre- and post-deployment calibration checks are within ± 0.5 °C of the NIST thermometer as described above, and the data are bracketed by field audits which meet the ± 1.0 °C criteria.

The 7-day moving average of daily temperature maximums can be calculated with most spreadsheet, database, or statistical software.

Data Storage:

Public agencies are encouraged to store temperature data in the Environmental Protection Agency's STORET database. STORET resides on EPA's mainframe computer, and can be accessed by anyone with a STORET account, a modem, and a terminal. The value of STORET is that it provides a readily accessible, centralized data archive. Use of STORET facilitates data transfer, and provides an archive to backup local databases.

Information on STORET accounts for federal, state, or local government can be obtained from Jim Hileman at the EPA Region 10 office in Seattle, Washington. (206) 553-1640.

EPA does not charge a fee for governmental accounts.

Commercial accounts can be obtained through NTIS (703) 487-4808.

Temperature Monitoring Questions?

Contact: Larry Caton, (503) 229-5983 Email: Larry.Caton@state.or.us

Appendix C:
In-Stream Monitoring Equipment Manufacturing Data

ACWA does not endorse the following equipment manufacturers. These are examples of equipment currently being used in Oregon by other municipalities.

VEMCO Limited, 100 Osprey Drive, Shad Bay, Nova Scotia, Canada, B3T 2C1
Phone: 902-852-3047 Fax: 902-852-4000

This is the first of 5 Pages of information you requested. Please call us at 902-852-3047, fax us at 902-852-4000 or email sales@vemco.com if you require more detail.

To: STEPHANIE

Fax: 1-503-227-1747

From: BEV. MURPHY

Date: JAN. 17/00

MINILOG PRICE LIST - US DOLLARS (April 1999)

		Quantity 1-9	Quantity 10+
Minilog-TR	Temperature vs Time (rugged PVC case)	$135.00	$121.50
Minilog-TX	Temperature vs Time (smaller, less rugged)	$135.00	$121.50
Minilog TDR	Temperature and Depth vs Time	$550.00	$495.00
Minilog-TDX	Temperature Depth vs Time	$550.00	$495.00
Minilog PC	Optical interface and PC software	$135.00	$121.50
Minilog12-TR-16K	12 bit Temperature vs Time	$350.00	$315.00

Additional memory for 8 bit and 12 bit available, please contact us.

Custom Temperature Range set up fee per order $100.00

Our R & D engineers constantly work with scientists to help them achieve the best results. Minilogs have been designed to meet the needs of researchers and have been from the high Arctic to the ocean floor. We have made Minilogs with external probes, fast probes, "J" probes, as well as Minilogs that go to full ocean depth (4500M). If you have an application that requires special attention, please call us.

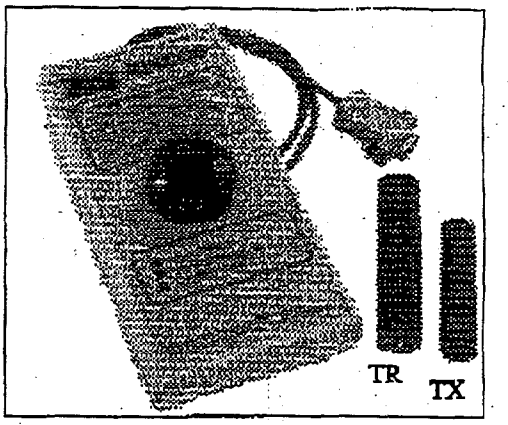
WHEN WHAT'S BELOW THE SURFACE COUNTS !

VEMCO has been a leader in acoustic telemetry & tracking systems since 1979.

VEMCO was formed in 1979 to build miniature fish tracking pingers for marine biology research. Since that time, the company has provided equipment to customers on all the earths continents. The product line has grown to include automated pinger monitoring, towed gear telemetry, and acoustic modems. Applications range from fish tracking to ocean current data telemetry for the Americas Cup race. VEMCO telemetry is used in towed systems for fisheries research and by the U.S. Navy.

Minilog 8-Bit Temperature & Depth Logger

The Minilog is a miniature microprocessor controlled temperature & depth logger that stores data in non-volatile memory. The temperature and depth transducers are mounted on one end of the Minilog in a polycarbonate end cap. Data is transferred from the Minilog to a personal computer by an RS-232 interface using an infrared optical link. An infrared transistor is mounted in the Minilog's end cap and eliminates the need for expensive and unreliable waterproof connectors. A visible light LED is mounted in the end cap to transfer data from the Minilog to the PC interface. The LED also indicates the Minilog's operational status to the user.



Minilog-TR, -TX and PC Interface

STANDARD MODELS

-TX: Temperature, Expendable (battery not replaceable).
-TR: Temperature, Factory replaceable battery.
-TDX: Temperature and Depth, Expendable (battery not replaceable).
-TDR: Temperature and Depth, Factory replaceable battery.

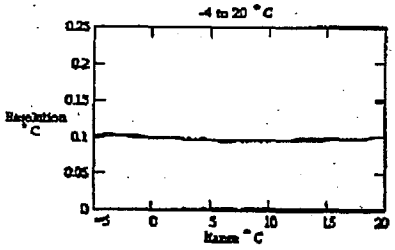
SPECIFICATIONS

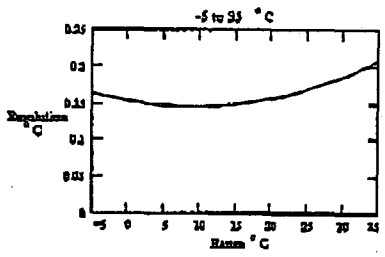
Memory:	Non-volatile EEPROM.		
Data Retention:	20 years.		
Standard Memory Capacity:	8064 readings of Temperature (TR, TX). 8128 readings of Temperature and Depth (TDR,TDX).		
Battery Life:	5 years or 1000 full deployments (TR, TX), 700 full deployments (TDR, TDX) from a single lithium cell.		
Logging Interval:	1 second to 6 hours.		
Logging Duration:	2¼ hours to 5 years.		
Temperature Ranges:	Factory preset to one of the following:		
	-4 to 20 °C	0.1 °C resolution	± 0.2 °C accuracy
	-5 to 35 °C	0.2 °C resolution	± 0.3 °C accuracy
	-30 to 40 °C	0.3 °C resolution	± 0.5 °C accuracy
Thermal Time Constant:	Typically 45 seconds in stirred liquid.		
Depth Ranges:	Factory preset to one of the following:		
	17 m (25 psi)	0.1 m resolution	± 0.5 m accuracy
	34 m (50 psi)	0.2 m resolution	± 1.0 m accuracy
	68 m (100 psi)	0.4 m resolution	± 2.0 m accuracy
	136 m (200 psi)	0.8 m resolution	± 4.0 m accuracy
	204 m (300 psi)	1.2 m resolution	± 6.0 m accuracy
	340 m (500 psi)	2.0 m resolution	± 10.0 m accuracy
	680 m (1000 psi)	4.0 m resolution	± 20.0 m accuracy (Available in TDR only)
Case:	TX, TDX - Thin walled epoxy cylinder 16 mm diameter x 71 mm length. Minimum diameter case, can be fastened with nylon cable tie loop in non-sensor end TR, TDR - PVC cylinder, 22 mm diameter x 95 mm length. More robust than TX, TDX case. Can be fastened through a ¼" hole in the non-sensor end.		
Weight:	TX, TDX - 23 g in air, 10 g in water. TR, TDR - 41 g in air, 12 g in water.		
Maximum Depth:	1000 m (TR), 340 m (TX), maximum rated value of depth sensor + 50% for TDR and TDX.		
Full Memory Download:	Standard 8 k TX or TR - 3 minutes. Standard 16 k TDX or TDR - 6 minutes.		

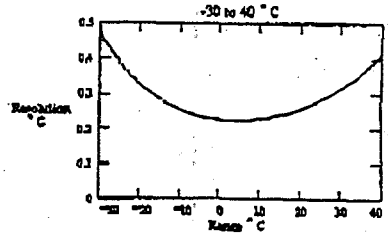
VEMCO Limited, 100 Osprey Drive, Halifax, Nova Scotia, Canada, B3T-2C1, Tel:902-852-3047 Fax:902-852-4000 www.vemco.com

TEMPERATURE RANGES AND RESOLUTION

The temperature resolution depends on the temperature range the Minilog can record. The following graphs show the resolution for the standard ranges, *-4 to 20 °C, -5 to 35 °C and -30 to 40 °C.*







MINILOG-PC INTERFACE SPECIFICATIONS

The Minilog-PC Interface connects the Minilog to a PC via the computer's RS-232 port. This allows setup information and data to be transferred between the Minilog and the PC. The Minilog-PC system includes an interface, 1 m cable terminated with a 9 pin "D" connector and Windows or DOS based Minilog software on 3.5" diskette. A user replaceable 9 V battery (included) powers the Minilog-PC Interface. For first time purchasers of Minilogs, at least one Minilog-PC interface is required. For users with large numbers of Minilogs (i.e. 20 or more), purchasing additional PC interfaces can decrease the time required to download data by using several computers simultaneously.

MINILOG WINDOWS SOFTWARE OVERVIEW

VEMCO's Minilog Windows software is designed to be used in a Windows '95, '98 or NT environment and is included with the Minilog-PC interface. Minilog Windows software is compatible with both 8-bit and 12-bit Minilogs. DOS software is still available upon request.

FEATURES:

Initialize a New Study: A text string may be entered to describe the study. A sample period from one second to six hours can be chosen and a delayed start option is available. When the Minilog is removed from the interface in recording mode, the LED flashes once every ten seconds.

Delayed Start: Delayed start allows the user to setup the Minilog, initialize a study and have the Minilog begin recording data at some time in the future. This option is useful for starting studies in several Minilogs at the same time or when the study is to take place a large distance from where the user's PC is located . When the Minilog is in delay mode the LED flashes once every five seconds until the start time is reached, then the LED flashes once every ten seconds.

Load Data From a Minilog: Data is downloaded from the Minilog and stored in a binary file on disk. The file name is based on the Minilog serial number and is stored in the default data directory.

Process Data: The binary data file can be displayed graphically or converted to an ASCII data file. Specific areas of the graphs can be viewed using mouse controlled zoom and pan. Files converted to ASCII format can be viewed with a text editor that is integrated in the Minilog Windows software or the file can be imported into spreadsheet software.

CUSTOM OPTIONS

External Probe: External temperature probes are available in one and two meter lengths.

TDR-FP: A temperature, depth logger with a fast response temperature transducer.

Additional Memory: Minilogs are available with 16, 32 and 64 kbytes of memory.

Custom Temperature Ranges: Custom temperature ranges are available. A setup fee is charged per order.

MINILOG-PC INTERFACE SPECIFICATIONS

The Minilog-PC Interface connects the Minilog12 to a PC via the computer's RS-232 port. This allows setup information and data to be transferred between the Minilog12 and the PC. The Minilog-PC system includes an interface, 1 m cable terminated with a 9 pin "D" connector and Windows or DOS based software on 3.5" diskette. A user replaceable 9 V battery (included) powers the Minilog-PC Interface. For first time purchasers of Minilog12s, at least one Minilog-PC interface is required. For users with large numbers of Minilog12s (i.e. 20 or more), purchasing additional PC interfaces can decrease the time required to download data by using several computers simultaneously.

MINILOG WINDOWS SOFTWARE OVERVIEW

VEMCO's Minilog Windows software is designed to be used in a Windows '95, '98 or NT environment and is included with the Minilog-PC interface. Minilog Windows software is compatible with both 8-bit and 12-bit Minilogs. DOS software is still available upon request.

FEATURES:

Initialize a New Study: A text string may be entered to describe the study. A sample period from one second to six hours can be chosen and a delayed start option is available. When the Minilog12 is removed from the interface in recording mode, the LED flashes once every ten seconds.

Delayed Start: Delayed start allows the user to setup the Minilog12, initialize a study and have the Minilog12 begin recording data at some time in the future. This option is useful for starting studies in several Minilog12s at the same time or when the study is to take place a large distance from where the user's PC is located . When the Minilog12 is in delay mode the LED flashes once every five seconds until the start time is reached, then the LED flashes once every ten seconds.

Load Data From a Minilog12: Data is downloaded from the Minilog12 and stored in a binary file on disk. The file name is based on the Minilog12 serial number and is stored in the default data directory.

Process Data: The binary data file can be displayed graphically or converted to an ASCII data file. Specific areas of the graphs can be viewed using mouse controlled zoom and pan. Files converted to ASCII format can be viewed with a text editor that is integrated in the Minilog Windows software or the file can be imported into spreadsheet software.

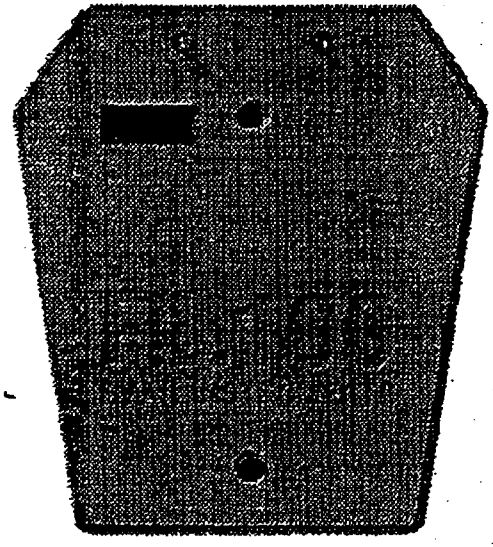
CUSTOM OPTIONS

Minilog12-TR-Plus 15 to 150C-SS J Probe: Extended stainless steel J probe temperature sensor (+15 to 150 °C span).

Additional Memory: Minilog12s are available with 32 and 64 kbytes of memory.

Custom Temperature Ranges: Custom temperature ranges are available. A setup fee is charged per order.

RL 100



RECOGNIZED PERFORMANCE IN TEMPERATURE MONITORING

The RL100 delivers recognized high performance in a small, totally self-contained waterproof or non-waterproof unit. This single channel temperature monitor offers non-volatile memory so you can be assured your data is well protected. Its easy-to-use software gives you the ability to analyze and graph data. A unique temperature window allows you to set a minimum/maximum range – letting you know immediately when your data exceeds those ranges. The RL 100 delivers accuracy, durability and quality performance.

PERFORMANCE SPECIFICATIONS

Temperature Range:	-39° to 189° F (-39° to 87° C)	
Temperature Accuracy:	±0.9° F (±0.5° C) between 32° F to 189° F (0° C to 87° C) ±1.8° F (±1.0° C) between -39° F to 32° F (-39° C to 0° C)	
Temperature Resolution:	0.9° F (0.5° C)	
Temperature Precision:	0.1° F/C	
Repeatability:	±0.9° F (±0.5° C)	
Sample Rate:	**Interval**	**Day Span**
	4 seconds	2 hours
	3 Minutes	3 days
	15 Minutes	18 days
	30 minutes	37 days
	1 hour	75 days
	5 hours	375 days
Data Capacity:	1800 samples, Loop Memory Overwrite	

OPERATIONAL SPECIFICATIONS

Output:	9-pin parallel port interface to PC or Ryan printer
Power:	6 VDC Lithium battery
Software:	DOS ver. 3.3 or greater, Windows® 3.1, Windows® 95
Option:	Ryan printer

PHYSICAL SPECIFICATIONS

Weight:	8 oz (230gm)
Size:	2.7" x 2.9" x 1.0" (69mm x 74mm x 25 mm)
Enclosure:	ABS Plastic, waterproof

Ryan Instruments

North America
8801 – 148th Avenue NE
P.O. Box 599
Redmond, WA 98073-0599
Tel: (425) 883-7926
Fax: (425) 883-3766
email: ryan@ryaninst.com
www.ryaninst.com

Europe
Jagtlustkade 12C
P.O. Box 169
2170 AD Sassenheim
THE NETHERLANDS
Tel: 31 252-211108
Fax: 31 252-231032
email: ryaneuro@wxs.nl

Ryan Instruments

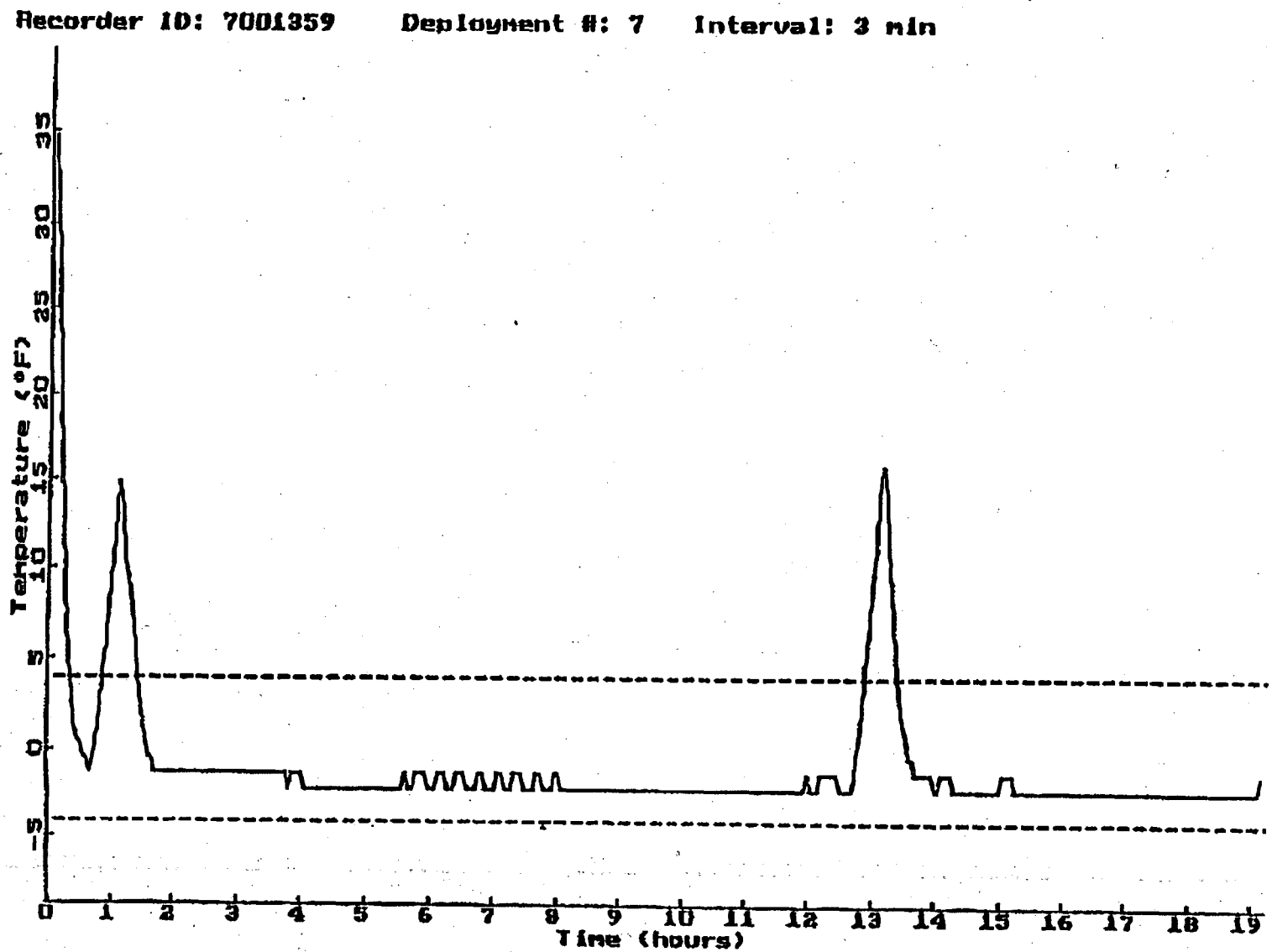
8801 148TH AVENUE N.E. P.O. BOX 599
REDMOND, WASHINGTON 98073-0599 USA
(425) 883-7926 FAX (425) 883-3766
www.ryaninst.com
E-MAIL - ryaninst@ryaninst.com

RL100 Temperature Monitor

Ryan Instruments' single channel temperature monitor, the RL100, is small, totally self-contained and is offered in two style configurations, either a waterproof or non-waterproof unit. The RL100 monitor was designed to provide accurate data at a low-cost and record under many environmental conditions. The temperature range is -39°F to 189°F (-39°C to 87°C) and, with a non-volatile memory, one can be assured the data is well protected. Small in size 2.7" x 2.9" x 1.0", (only 13 oz.) the RL100 is big on data with a capacity for 1800 samples and an option for continuous loop memory overwrite if necessary. The RL100 Software (RLSoft) is available in both DOS and Windows versions. The DOS version offers a basic function key operation that will produce both graphical and tabular report formats. The Windows version can run in Windows 3.1 or Windows 95 and offers all the ease and functionality of the Windows programs from enhanced graphics to printer selection.

The RL100 provides a visual alert system to tell when temperatures are outside the desired temperature parameters. This all happens with just a glance at the monitor. For analysis, the easy-to-use RLSoft software provides graphic as well as numeric data. The RL100 is ideal for use in any quality control program or to meet required regulations such as HACCP. In short, the RL100 delivers the accuracy, durability and quality performance you would expect from Ryan Instruments.

****


Recorder ID: 7001359 Deployment #: 7 Interval: 3 min
Temperature (°F)
35
30
25
20
15
10
5
0
-5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Time (hours)

RYAN® INSTRUMENTS PRICE LIST

039-0001

RL100™ Beige Non-Waterproof Temperature Recorder DOS - Package 1
RL100™ Beige Non-Waterproof Temperature Recorder WIN - Package 1
Package includes PC interface cable, software, user manual, port cover and bracket tape

Quantity Purchase Schedule		Purchase Price
1 - 99	76065 (DOS)	$99.00
	76084 (WIN)	99.00
100+		90.00

RL100 Beige Non-Waterproof Temperature Recorder - Package 2: Includes port cover and bracket tape

1 - 99	76066	$90.00
100+		80.00

RL100™ Blue Waterproof Temperature Recorder for DOS- Package 1
RL100 ™ Blue Watrproof Temperature Recorder for WIN - Package 1
Package includes PC interface cable, software, user manual and waterproof port cover

Quantity Purchase Schedule		Purchase Price
1 - 99	76037 (DOS)	$125.00
	76083 (WIN)	125.00
100+		115.00

RL100 Blue Waterproof Temperature Recorder - Package 2: includes waterproof port cover

1 - 99	76038	115.00
100+		105.00

RL100 Supplies:

Interface Cable(parallel)	76026	$25.00
DOS Software	46003	10.00
Manual (DOS)	46004	2.00
WINSoft	46013	10.00
WINSoftware and Manual	46011	15.00
Manual (WIN)	46012	5.00
Bracket Tape	46005	0.00
Port Cover	76029	0.00
A/B Box (parallel)	76036	40.00
A/B Cable (parallel)	76039	25.00
Waterproof Port Cover (metal clamp)	76041	5.00
Serial/Parallel Adapter	76051	25.00
25-PIN Male to 9-PIN Female Adapter	76081	5.00
Serial/Parallel Adapter with 25-PIN Male to 9-PIN Female Adapter	76085	30.00
Portable Printer (serial/parallel adapter and interface cable)	76052	295.00
Ribbon Cassette Printer	76056	5.00
Printer Paper (12 rolls per box)	76057	10.00
Underwater Plug	76067	5.00

PRICES EFFECTIVE JUNE 1, 1998 IN US DOLLARS. PRICES SUBJECT TO CHANGE WITHOUT NOTICE
Ryan Instruments, PO Box 599, Redmond, WA 98073-0599 Tel: (800) 999-7926, (425) 883-7926, FAX: (425) 883-3766
Minimum order: Domestic - $30.00; International - $100.00
$20 processing & handling fee (instruments only) added to all international orders

HOBO/StowAway Temperature Logger Comparison Chart

	Environment	Battery Life	Measurement Capacity	Temperature Range	Accuracy at 70°F	Typical Response Time	Shuttle Compatible
HOBO H8 Family H08-001-02 H08-002-02 H08-003-02 H08-004-02 H08-006-04 H08-007-02 H08-008-04	Indoor	1 yr user replaceable	7944 32,520	-4°F to +158°F (internal sensor) -40°F to +212°F (external sensor) +32°F to +110°F (external sensor)	±1.27°F ±0.9°F ±0.7°F	15 min. in air (internal sensor in case) 1 min. in air (internal sensor out of case) 4.5 to 7.5 min. in air (external sensor) 5 sec. to 1 min. in water (external sensor)	HOBO Shuttle
HOBO Pro Series H08-030-08 H08-031-08 H08-032-08	Indoor Outdoor	3 yr user replaceable	65,291	-22°F to +122°F (internal sensor) -40°F to +212°F (external sensor)	±0.33°F	34 min. in air (internal sensor) 4.5 min. in air (external sensor)	HOBO Shuttle
HOBO Temp H01-001-01	Indoor Outdoor* Underwater*	1 yr user replaceable	1800	-4°F to +158°F	±1.27°F	15 min. in air (internal sensor in case) 1 min. in air (internal sensor out of case)	NO
StowAway TidbiT	Indoor Outdoor Underwater	5 yr non replaceable	32,520	+24°F to +99°F -4°F to +122°F	±0.4°F ±0.8°F	3 min. in water 30 min. in air	Optic Shuttle
Optic StowAway	Indoor Outdoor Underwater	10 yr factory replaceable	7944 32,520	+24°F to +99°F -32°F to +167°F	±0.4°F ±0.9°F	4 min. in water 24 min. in water	Optic Shuttle
HOBO Temp Ext	Indoor Outdoor* Underwater*	2 yr user replaceable	1800	+24°F to +99°F -35°F to +115°F -40°F to +253°F	±0.4°F (+24°F to +99°F range)	3 min. in air 15 sec. in water	NO
StowAway XTI	Indoor Outdoor* Underwater*	2 yr user replaceable	1800 7944 32,520	+24°F to +99°F -35°F to +115°F -40°F to +253°F	±0.4°F (+24°F to +99°F range)	3 min. in air 15 sec. in water (with external sensor)	NO
StowAway TidbiT XT	Indoor Outdoor*	7 yr factory replaceable	7944	-4°F to +158°F	±0.7°F	6 min. in air 10 sec. in water	Optic Shuttle

* Requires the use of a Submersible case, sold separately. Return to Product Pages.

D-4220-C

Home | Contact Onset

Optic StowAway Temp logger

Completely Sealed Underwater Temperature Logger with Optic Communication

Order Now!

Features and Specifications

- Waterproof to 100 feet
- 10-year, factory replaceable battery (typical use**)
- Dark translucent case keeps logger camouflaged
- Capacity: 7943 or 32,520 measurements
- Streamlined design: 5.2" long x 0.8" tall x 1.0" thick (132 x 20 x 25 mm) and 1.9 oz.
- Two measurement ranges†: +24°:F to +99°F (-4°C to +37°C), -32°F to +167°F (-35°C to +75°C)
- User-selectable sampling interval: 0.5 seconds to 9 hours, recording times up to several years
- Blinking LED light shows if temperature goes out of user-determined limits
- Uses optic communications through Optic Base Station for launch and readout
- Readout and relaunched in the field with optional Optic Shuttle
- Precision components eliminate the need for user calibration
- Programmable start time/date
- Triggered start with Optic coupler or magnet
- Memory modes: stop when full, wrap-around when full
- Nonvolatile EEPROM memory retains data even if battery fails
- Multiple sampling with minimum, maximum or averaging
- Blinking LED light confirms operation
- Time accuracy: ±1 minute per week at +68°F (+20°C)
- Mounting tab
- Compliance certificate available
- NIST-traceable temperature accuracy certification available

View our Temperature Logger Comparison Chart

**32 three-month deployments in water (+35° F to +80°F) with 4 minute or longer intervals (no multiple sampling)

Notice: To guarantee specified accuracy, the TidbiT and Optic StowAway units should not be used in condensing environments and water temperatures higher than +30°C (+86°F) for more than 8 weeks cumulatively. Prolonged exposure will lead to measurement drift and eventual failure. If your application temperatures and environment are

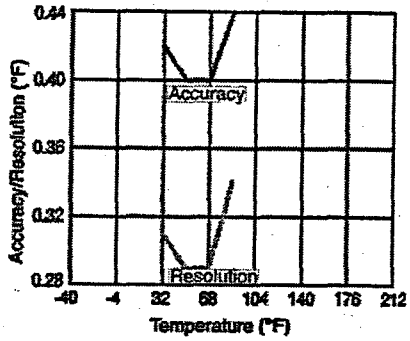
questionable based on the above statement, please contact Onset for more information.

Measurement specifications

-5°C to +37°C Models

- Range†: +24°F to +99°F (-4°C to +37°C)
- Accuracy: ±0.4°F (±0.2°C) at +70°F, see plot at right
- Resolution: 0.29°F (0.16°C) at +70°F, see plot at right
- Response time in water: 4 min. typical
- Response time in still air: 24 min. typical

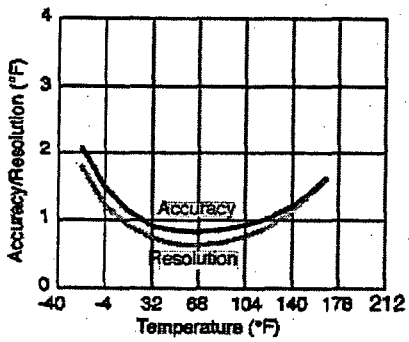
Temperature Accuracy and Resolution
-5°C to +37°C Models



-39°C to +75°C Models

- Range†: -32°F to +167°F (-35°C to +75°C)
- Accuracy: ±0.9°F (±0.5°C) at +70°F, see plot at right
- Resolution: 0.7°F (0.4°C) at +70°F, see plot at right
- Response time in water: 4 min. typical
- Response time in still air: 24 min. typical

Temperature Accuracy and Resolution
-39°C to +75°C Models



† Specified range is narrower than nominal range due to precision calibration process. Using Optic StowAway Temp loggers in wet environments (over 90% RH) for extended periods may lead to premature failure.

Ordering Information

Description	Part No.	Qty 1-9	10-99	100+	500+
8K Optic StowAway Temp (-5°C to +37°C)	WTA08-05+37	$129	$119	$110	$99
8K Optic StowAway Temp (-39°C to +75°C)	WTA08-39+75	$129	$119	$110	$99
32K Optic StowAway Temp (-5°C to +37°C)	WTA32-05+37	$189	$174	$161	-
32K Optic StowAway Temp (-39°C to +75°C)	WTA32-39+75	$189	$174	$161	-
Optic Base Station	DSA	$70	$64	$60	-
Optic Shuttle (optional)	DTA128B	$199	$183	$169	-
Software Starter Kits					
BoxCar Pro 4.0 Starter Kit (Windows)	BCP4.0-ON	$95	$88	$81	-
BoxCar 3.6 Starter Kit (Windows)	BC3.6-ON	$14	$13	$12	-
BoxCar Pro for Macintosh	Available at no charge on this web site				

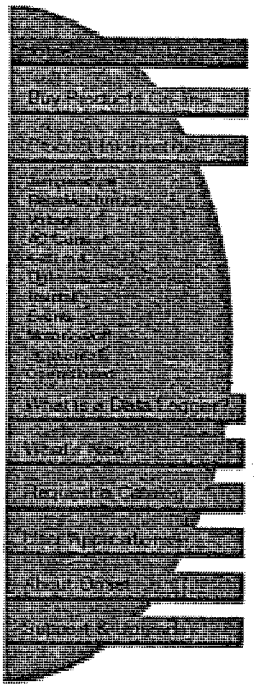
A software starter kit and an Optic Base Station are required for operation
BoxCar Pro 4.0+ or BoxCar 3.6+ starter kits are available. Each starter kit includes software, computer interface cable and software manual. If you already have logger software, you can refer to the Logger Software Compatibility Chart. The Optic Base Station includes an Optic Coupler and TidbiT Coupler.

Shipping costs will be added to order.

Order Now!

D-3931-E

Product Information



StowAway TidbiT

Completely Sealed Underwater Temperature Logger with Optic Communication

Order Now!

Features and Specifications

- Waterproof to 1000 feet
- 5 year non-replaceable battery (typical use*)
- Completely sealed in epoxy; very durable
- Capacity: 32,520 measurements
- Small size: 1.2" wide x 1.6" tall x 0.65" thick (30 x 41 x 17 mm) and 0.8 oz.
- Two measurement ranges†: +24°:F to +99°F (-4°C to +37°C) and -4°F to +122°F (-20°C to +50°C)
- User-selectable sampling interval: 0.5 seconds to 9 hours, recording times up to several years
- Blinking LED light shows if temperature goes out of user-determined limits
- Uses optic communications through Optic Base Station for launch and readout
- Readout and relaunched in the field with optional Optic Shuttle
- Precision components eliminate the need for user calibration
- Programmable start time/date
- Triggered start with coupler or magnet
- Memory modes stop when full or wrap-around when full
- Nonvolatile EEPROM memory retains data even if battery fails
- Multiple sampling with minimum, maximum or averaging
- Blinking LED light confirms operation
- Time accuracy: ±1 minute per week at +68°F (+20°C)
- Mounting tab
- Compliance certificate available
- NIST-traceable temperature accuracy certification available

View our Temperature Logger Comparison Chart

*16 three-month deployments in water (+35°F to +80°F) with 4 minute or longer intervals (no multiple sampling)

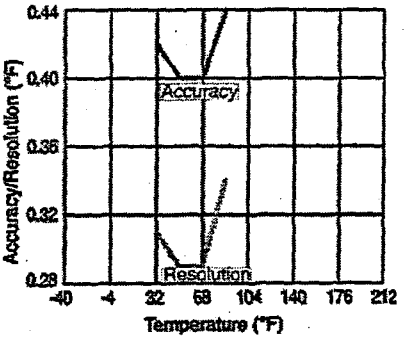
Notice: To guarantee specified accuracy, the TidbiT and Optic StowAway units should not be used in condensing environments and water temperatures higher than +30°C (+86°F) for more than 8 weeks cumulatively. Prolonged exposure will lead to measurement drift and eventual failure. If your application temperatures and environment are questionable based on the above statement, please contact Onset for more information.

Measurement specifications

-5°C to +37°C Models

- Range†: +24°F to +99°F (-4°C to +37°C)
- Accuracy: ±0.4°F (±0.2°C) at +70°F, see plot at right
- Resolution: 0.29°F (0.16°C) at +70°F, see plot at right
- Response time in water: 3 min. typical
- Response time in still air: 30 min. typical

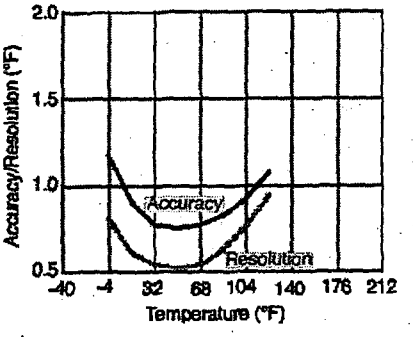
Temperature Accuracy and Resolution
-5°C to +37°C Models



-20°C to +50°C Model

- Range†: -4°F to +122°F (-20°C to +50°C)
- Accuracy: ±0.8°F (±0.4°C) at +70°F, see plot at right
- Resolution: 0.6°F (0.3°C) at +70°F, see plot at right
- Response time in water: 3 min. typical
- Response time in still air: 30 min. typical

Temperature Accuracy and Resolution
-20°C to +50°C Model



† Specified range is narrower than nominal range due to precision calibration process. Using TidbiT Temp loggers in wet environments (over 90% RH) for extended periods may lead to premature failure.

Ordering Information

Description	Part No.	Qty 1-9	10-99	100+
32K StowAway TidbiT (-5°C to +37°C)	TBI32-05+37	$99	$91	$84
32K StowAway TidbiT (-20°C to +50°C)	TBI32-20+50	$99	$91	$84
Optic Base Station	DSA	$70	$64	$60
Optic Shuttle (optional)	DTA128B	$199	$183	$169
Software Starter Kits				
BoxCar Pro 4.0 Starter Kit (Windows)	BCP4.0-ON	$95	$88	$81
BoxCar 3.6 Starter Kit (Windows)	BC3.6-ON	$14	$13	$12
BoxCar Pro for Macintosh	Available at no charge on this web site			

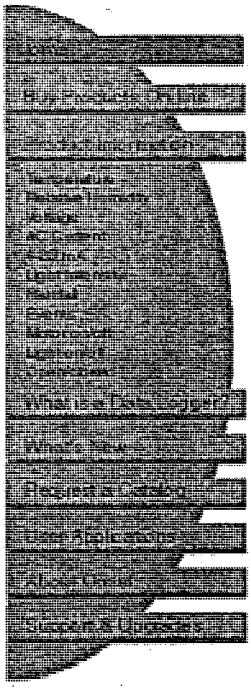
A software starter kit and an Optic Base Station are required for operation
BoxCar Pro 4.0+ or BoxCar 3.6+ software starter kits are available. Each starter kit includes software, computer interface cable and software manual. If you already have logger software, you can refer to the Logger Software Compatibility Chart. The Optic Base Station includes an Optic Coupler and TidbiT Coupler.

Shipping costs will be added to order.

Order Now!

D-1671-P

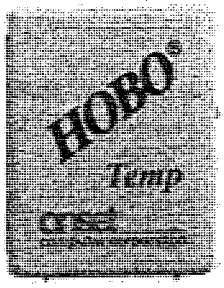
Home | Contact Onset



HOBO® H8 Temp Logger

Measure: Temperature

HOBO Shuttle Compatible



Order Now!

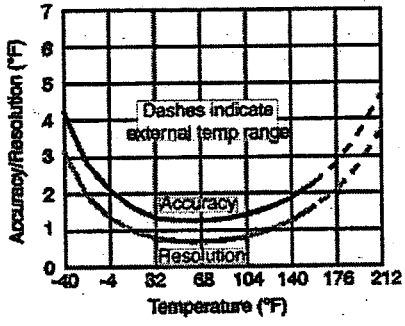
Features and specifications

- Capacity: 7943 measurements total
- User-selectable sampling interval: 0.5 seconds to 9 hours, recording times up to 1 year
- Readout and relaunch with optional HOBO Shuttle
- Internal temperature sensor on 4" wire can extend from case
- Models with external input accept external sensors for temperature, AC current, 4-20 mA and 0-2.5 Volts DC
- Precision components eliminate the need for user calibration
- Drop-proof to 5 feet
- Mounting kit included (hook/loop, magnet, and tape)
- Programmable start time/date
- Memory modes: stop when full, wrap-around when full
- Nonvolatile EEPROM memory retains data even if battery fails
- Blinking LED light confirms operation
- User-replaceable battery lasts 1 year

Measurement specifications

Temperature (internal sensor)

- Range: -4°F to +158°F (-20°C to +70°C)
- Range for internal sensor when used outside of case: -40°F to +248°F (-40°C to +120°C)
- Accuracy: ±1.27°F (±0.7°C) at +70°F, see plot below
- Resolution: 0.7°F (0.4°C) at +70°F
- Response time still in air: 15 min. typical with sensor inside case; 1 min. typical with sensor outside case



View our Temperature Logger Comparison Chart

- Battery level indication at launch
- Operating range: -4°F to +158°F (-20°C to +70°C), 0 to 95% relative humidity, non-condensing, non-fogging
- Time accuracy: ±1 minute per week at +68°F (+20°C)
- Size/Weight: 2.4 x 1.9 x 0.8" (68 x 48 x 19 mm)/approx. 1 oz.(29 gms)
- Compliance certificate available
- NIST-traceable temperature accuracy certification available

CE

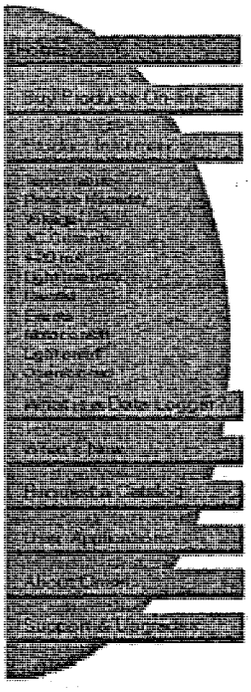
Ordering Information

Description	Part No.	Qty. 1-9	10-99	100+
HOBO Temp	H08-001-02	$59	$55	$51
HOBO Shuttle (optional)	H09-002-08	$159	$146	$135
Software Starter Kits				
BoxCar Pro 4.0 Starter Kit (Windows)	BCP4.0-ON	$95	$88	$81
BoxCar 3.6 Starter Kit (Windows)	BC3.6-ON	$14	$13	$12
BoxCar Pro for Macintosh	Available at no charge on this web site			
Accessories				
Replacement batteries (box of 10)	HRB-TEMP	$15	-	-
Waterproof case for H08-001-02	SUBCASE-WH	$20	$15	$12

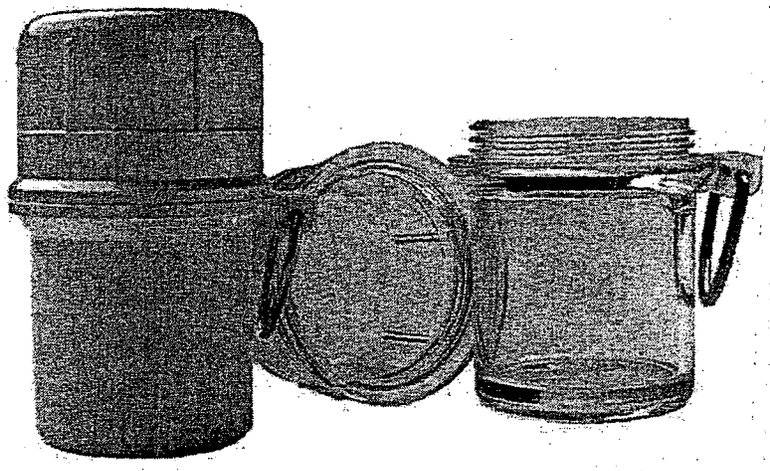
A software starter kit is required for operation
BoxCar Pro 4.0+ or BoxCar 3.6+ starter kits are available. Each starter kit includes software, computer interface cable and software manual. If you already have logger software, you can refer to the Logger Software Compatibility Chart.

Shipping costs will be added to order.

Product Information



HOBO®/StowAway™ Submersible case



The Submersible case will hold one HOBO® or one StowAway data logger. The polycarbonate screw top case is a rugged waterproof enclosure which includes a durable D-ring for case anchoring.

Features

- Physical dimensions 21/4" diameter x 4" long and 5.8 oz.
- Depth rating 400 feet
- One inch 316 stainless steel attachment D-ring
- Available in five styles:
  - SUBCASE-WH - white case (temperature loggers)
  - SUBCASE-CLR - clear case (light intensity loggers)
  - SUBCASE-A - white case with attached 12" thermistor cable
  - SUBCASE-B - white case with 3.5" stainless steel thermistor sensor probe
  - SUBCASE-D - clear case with attached 12" thermistor
- O-ring and lubricant included

Ordering Information

Description	Part No.	Qty 1-9	10-99	100+
Submersible case, white	SUBCASE-WH	$20	$15	$12
Submersible case, clear	SUBCASE-CLR	$20	$15	$12
Submersible case, white, with attached 1 foot thermistor cable*	SUBCASE-A	$42	$34	$30
Submersible case, clear, with attached 1 foot thermistor cable*	SUBCASE-D	$42	$34	$30
Submersible case, white, with 3.5" stainless steel probe*	SUBCASE-B	$90	$73	$62

*Used in combination with an HTEA or XTI temperature logger.

Shipping costs will be added to order.

Order Now!

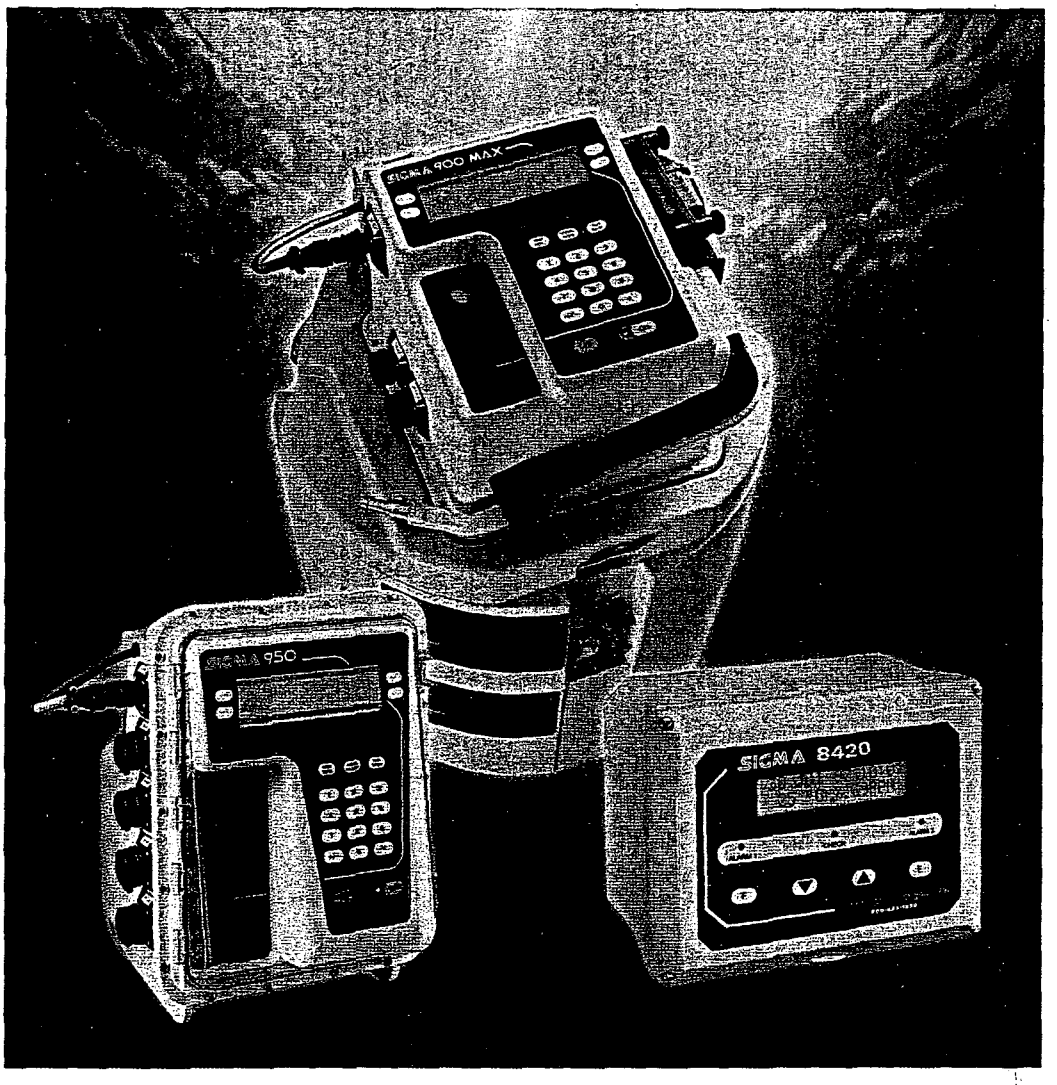
D-2373-F

Appendix D: Collection System Monitoring Equipment Manufacturing Data

ACWA does not endorse the following equipment manufacturers. These are examples of equipment currently being used in Oregon by other municipalities.

AMERICAN SIGMA PRODUCT PROFILE

FLOW METERS, SAMPLERS, AND WATER QUALITY INSTRUMENTATION



AMERICAN SIGMA

Innovation in water monitoring

SAMPLERS

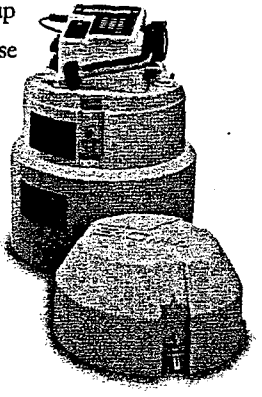
900 & 900 MAX Samplers

The 900 Series Samplers can be supplied with either 900 or 900 MAX features. The 900 makes sampling simple. It's the most convenient, durable, and affordable solution for accurate and repeatable wastewater sampling.

The 900 MAX monitors as well as manages, taking your sampling program to the next level. Designed to serve as a full-fledged management tool, the 900 MAX has options for level, flow, velocity, rainfall, pH or ORP, temperature, D.O., and conductivity monitoring.

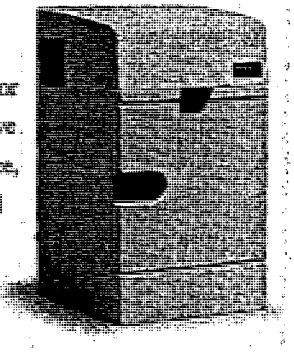
900 Portable Liquid Samplers

Weighing as little as 28 lbs., our portable samplers feature a compact or standard size base and flip-up handles for easy carrying. The compact base model is specifically designed for an 18" manhole. Its rugged molded ABS exterior withstands the toughest use and harshest environments, and its sealed controller withstands humidity and corrosion. The high sample integrity of these easy-to-use samplers yields defendable data every time.



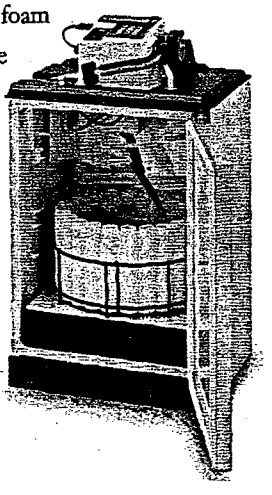
900 All Weather Refrigerated Sampler

For high integrity, worry-free sampling, the All Weather Refrigerated Sampler is beyond compare. Featuring completely self-contained fiberglass construction, it operates in temperatures ranging from -40 to 120°F (-40 to 49°C). Samples are preserved at a constant 4°C with an advanced micro-processor control system. The key to the unit's design is the placement of the compressor on top in order to avoid floor-level corrosive gases for longer life. Its UV-resistant surface, side wall ventilation, sturdy door locks, and stainless steel anchoring rails allow you to place it anywhere.



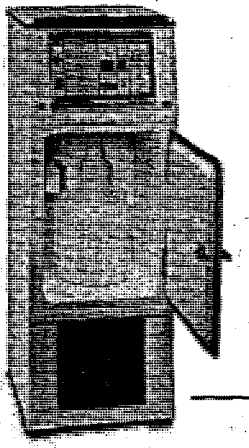
900 Refrigerated Liquid Samplers

These fixed-site samplers feature a custom-designed air sensing thermostat, and employ a high-efficiency compressor/condenser assembly, wraparound evaporator and rigid foam insulation to maintain an optimum temperature of 39°F (4°C). The unit can be positioned against a wall or inside a sampler enclosure, due to the flexibility afforded by its front ventilation system and forced air blower. These extremely accurate and durable samplers are equipped with a sealed controller to withstand humidity and corrosion.



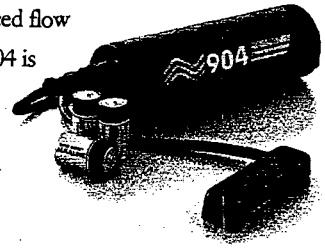
1600 Automatic Liquid Sampler

The 1600's continuous flow-through system provides superior solids handling by simulating a grab sample collection. The dipper arm passes through the full cross section of the flow and keeps the liquid in the chamber well mixed to ensure representative results. The 1600 can be located where most convenient, while pumps or gravity deliver a wastewater stream. The high efficiency refrigeration of the 1600 assures 39°F (4°C) sample temperature in ambients up to 120°F (49°C).

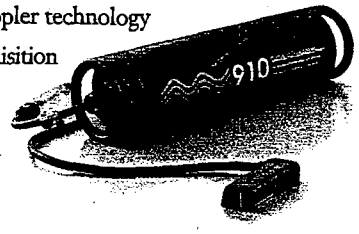


FLOW METERS

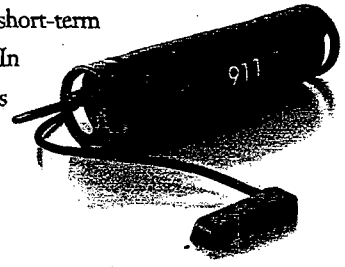
904 The 904 is the most economical area velocity flow meter in the Sigma family of advanced flow meters. With a 3.5" diameter, the 904 is both lightweight and easy to install. For reliable short-term monitoring, it's the simplest solution available.



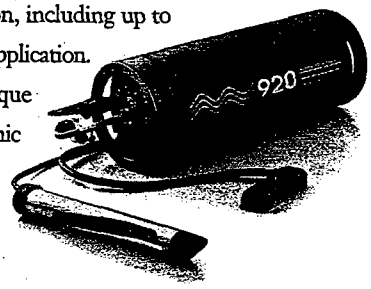
910 For maximum short-term monitoring accuracy, the answer is the 910 area velocity flow meter. Its lightweight, portable design and advanced Doppler technology allow simple and accurate data acquisition in the field. Weighing only 8 lbs. with a 4.5" diameter, the 910 is easy to transport and install.



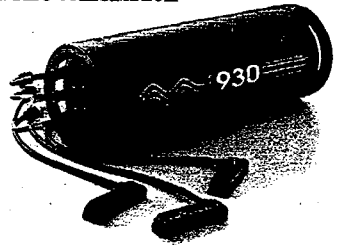
911 The industry's smallest Intrinsically Safe area velocity flow meter, the 911 is designed for short-term monitoring in hazardous locations. In addition to safety and simplicity, this lightweight flow meter delivers the accuracy and durability your field flow monitoring demands.



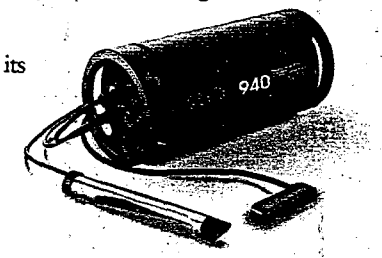
920 The 920 delivers powerful, portable or long-term sewer system monitoring. Ideal for demanding site conditions, it allows you to choose the multiple sensor option, including up to 2 AV sensors, that best suits the application. Thanks to its easy setup and unique deadband, the 920 makes ultrasonic level sensor flow monitoring simpler than ever.



930 For permanent collection system monitoring, the 930 is unmatched. In addition to providing a rare combination of maximum accuracy and minimum maintenance, the 930 offers the versatility of up to three area velocity sensors. Its one-year battery life greatly reduces site time.

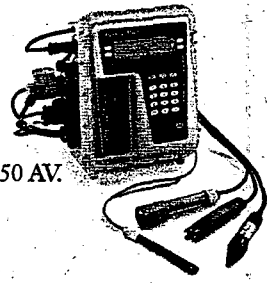


940 The 940 area velocity flow meter offers an Intrinsically Safe solution for long-term collection system monitoring in hazardous areas. Multiple sensor options give the 940 versatility, and its rugged design, low-profile probes and long battery life keep maintenance to a minimum.



950 Open Channel Flow Meter

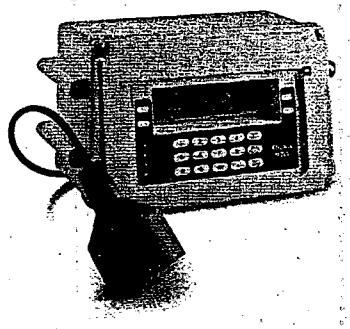
The 950 Series is designed to operate in a broad range of site conditions. Three depth measurement technologies provide versatility. The 950 is simple to set up and features advanced monitoring capabilities for pH or ORP, temperature, rainfall, D.O., and conductivity applications. For accurate area velocity flow measurements, specify Sigma 950 AV.



970 Permanent Ultrasonic Flow Meter

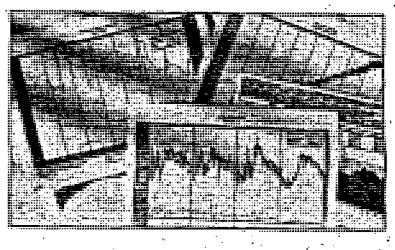
The 970 Ultrasonic flow and level meter features simple, menu-driven programming; a large graphics display; 4-20 mA outputs; optional water quality monitoring; alarms; and a durable, sealed design to provide maximum accuracy and versatility. For accurate area velocity flow measurement, specify Sigma 970 AV.

Specify the Sigma 1100 for multi-point level monitoring of up to 16 individual sites.



Data Analysis Software

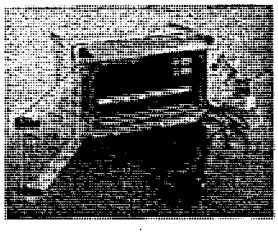
Sigma's InSight™ and the more advanced Vision™ software provides remote communications, automated data acquisition, analysis and reporting for total sewer system management.



LOSED-PIPE FLOW METERS

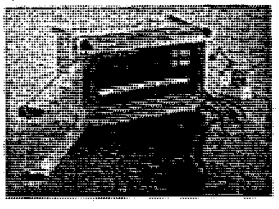
400 Clamp-On Doppler Flow Meter

The 2400 Series achieves reliable measurements in a wide variety of low monitoring applications. It is equipped with Intelligent Doppler Signal Recognition (IDSR), which utilizes proven algorithms and advanced signal filtering to produce accurate flow readings even in difficult applications. The 2400's non-contacting, clamp-on ultrasonic sensors install in minutes, without costly piping modifications.



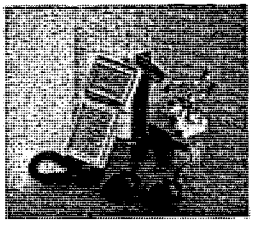
2410 Clamp-On Doppler Flow Meter

The 2410 displays spectral profiles, which are further enhanced by special signal-to-noise filters that provide superior flow pattern recognition and uncompromising accuracy. The unit's sealed controller withstands humidity and corrosion. The externally mounted transducers require minimal maintenance to ensure accurate flow readings.



2450 Portable Clamp-On Doppler Flow Meter

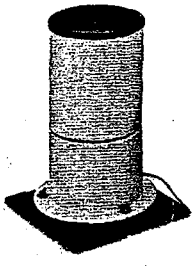
The 2450 provides 18 continuous hours of operation at maximum power on a single charge. Advanced technology allows the 2450 to identify the unique Doppler profile of each fluid type and flow pattern, producing flow accuracies of ± 2%.



Automatic Rain Gauge

With Rain Logger

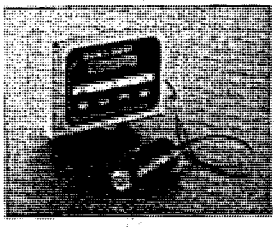
Built to National Weather Service standards, the Rain Gauge accurately measures rainfall in .01" increments. This versatile tool can be used for stand-alone long-term rainfall recording as well as for portable use in storm water runoff monitoring. The Rain Gauge works in conjunction with the Sigma Rain Logger, which stores weeks of data, or with a Sigma sampler or flow meter.



WATER QUALITY MONITORS

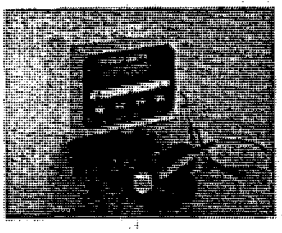
8420 PPM Dissolved Oxygen Monitor

The 8420 maintains consistent D.O. levels, with monitoring accuracy down to .01 ppm. Automatic probe sensitivity monitoring and gain adjustment result in reduced maintenance and superior stability.



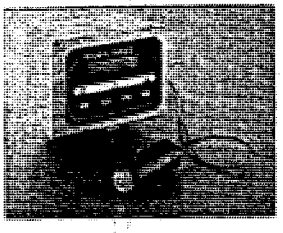
8421 PPB Dissolved Oxygen Monitor

Featuring innovative microprocessor technology, integrated software and an advanced D.O. probe, the 8421 accurately traces levels of D.O. concentrations to parts per billion. It also features programmable altitude correction, automatic temperature compensation and integral flow cell assembly.



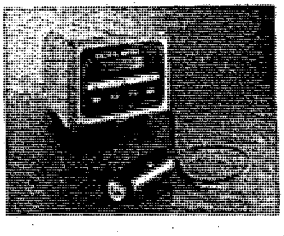
8422 PPM Dissolved Ozone Monitor

The 8422 accurately monitors dissolved ozone to levels as low as 10 ppb, using automatically computed probe sensitivity detection and gain-control circuitry. Its highly specific amperometric sensor leaves ozone measurements virtually free of interference from other ions. Ideal for monitoring applications where trace D.O. levels are critical.



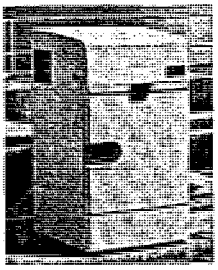
8450/8451 Residual Chlorine Monitor

The 8450/8451 combines a microprocessor based controller and a field-proven chlorine probe to cost-effectively monitor chlorine amounts. The direct-measuring amperometric probe is designed to provide accurate readings without the use of costly buffering solutions or reagents.



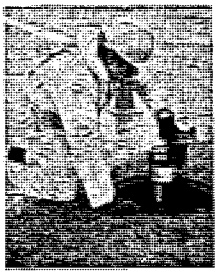
MUNICIPAL WASTEWATER TREATMENT

Wastewater Treatment



- Influent & Effluent – Open-Channel Flow Monitoring & Sampling
- Influent – Closed-Pipe Flow Monitoring
- Bar Screen – Differential Level
- Aeration Basin – Dissolved Oxygen Monitoring
- Sludge Flow – Closed-Pipe Flow Monitoring

Collection System



- Combined/Sanitary Sewer Overflow Monitoring – Sampling, Rainfall & Flow Monitoring
- Stormwater – Sampling, Rainfall & Flow Monitoring
- Inter-Agency Billing – Flow Monitoring

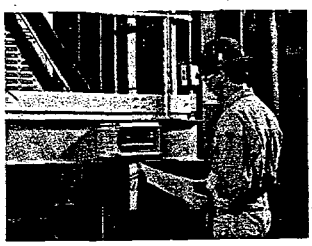
Clean Water Treatment

- Chemical Feed – Residual Chlorine Monitoring & Level Monitoring
- Filtration – Level Monitoring
- Sludge Flow & Dewatering – Closed-Pipe Flow Monitoring

ONLY SIGMA COMBINES SAMPLERS, FLOW METERS, AND RAIN AND WATER QUALITY MEASUREMENT INTO A SEAMLESS MANAGEMENT SYSTEM.

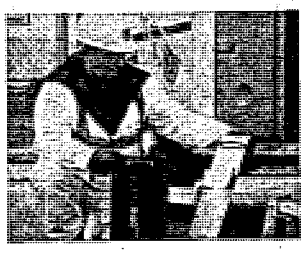
ALL PRODUCTS ARE BACKED BY SIGMA CARE ™ – A HOST OF SERVICES INCLUDING 24 HOUR HELP LINE, NO FAULT WARRANTY AND 30 DAY QUIBBLE-FREE RETURN POLICY.

PRETREATMENT/INDUSTRIAL



- Effluent – Open-Channel Flow, Sampling & Water Quality Monitoring
- Bar Screen – Differential Level
- Influent – Open-Channel Flow Monitoring
- Aeration Basin – Dissolved Oxygen Monitoring

GOVERNMENT



- Government Regulatory Agencies (Pollution Elimination Enforcement, Nonpoint Source Monitoring, River & Stream Gauging) – Sampling, Rainfall & Flow Monitoring
- Local Agencies and Universities (Pollution Elimination Enforcement, Nonpoint Source Monitoring, River & Stream Gauging) – Sampling, Rainfall & Flow Monitoring

FLOW MONITORING

Model	Flow Sensors[1]	Rating	Battery Life (days) [2]	Drawdown Correction[3]	User Interface	Data Logging	Optional Interfaces
904	1 Sub AV	NEMA 6P (IP67)	30	No	PC	Yes	None
910	1 Sub AV	NEMA 6P (IP67)	60	Yes	PC	Yes	None
920	2 AV U/S	NEMA 6P (IP67)	90 (A/C opt.)	Yes	PC	Yes	Rainfall, Sampler, Modem
930	3 AV U/S	NEMA 6P (IP67)	365 (A/C opt.)	Yes	PC	Yes	Rainfall, Sampler, Modem
911	1 AV	NEMA 6P (IP67), Intrinsically Safe [5]	60	Yes	PC	Yes	None
940	2 AV U/S	NEMA 6P (IP67), Intrinsically Safe [5]	60 (A/C opt.)	Yes	PC	Yes	Rainfall, Sampler, Modem
950	AV, Bub, U/S, Sub, OptiFlo [4]	NEMA 4X,6	150 (A/C or DC)	Yes	PC, Keypad & Graphics Display	Yes	Rainfall, Sampler, pH or ORP, D.O., Conductivity, Temp.
970	AV, Bub, U/S, Sub	NEMA 4X,6	A/C	Yes	PC, Keypad & Graphics Display	Yes	Rainfall, Sampler, pH or ORP, D.O., Conductivity, Temp.

WASTEWATER SAMPLING

Model	Use	Controller Rating	Bottle Configurations	Flow Meter Interface	User Interface
900 Portable	Portable – A/C or Battery Power	NEMA 4X,6	1, 2, 4, 8, 12 or 24 Bottle Sets	Yes	PC, Keypad and Display
900 Refrigerated	Stationary – A/C Power	NEMA 4X,6	1, 2, 4, 8 or 24 Bottle Sets	Yes	PC, Keypad and Display
900 All Weather	Outdoors & Corrosive Areas – A/C Power	NEMA 4X,6	1, 2, 4, 8 or 24 Bottle Sets	Yes	PC, Keypad and Display

900 MAX Features	
Standard	Optional
Large Graphics Display	Flow Monitoring
Datalogging	Water Quality Monitoring
Trouble Bottle	Up to 7 Analog Inputs
Setpoint Sampling	Communications (RS232, Modem, Cellular & Pager)

WATER QUALITY MONITORING

Model	Range	Power	Enclosure Rating	Outputs	User Interface
8420 PPM Dissolved Oxygen Monitor	0-2 ppm (mg/l)	A/C	NEMA 4X	(2) 4-20 mA outputs, 0-1 or 0-5 VDC outputs, (3) SPDT Relays	Keypad & Backlit LCD Display
8421 PPB Dissolved Oxygen Monitor	0-20 ppb 20-199 ppb 0.02-1.99 ppm 2-20 ppm	A/C	NEMA 4X	(2) 4-20 mA outputs, 0-1 or 0-5 VDC outputs, (3) SPDT Relays	Keypad & Backlit LCD Display
8422 Dissolved Ozone Monitor	0-2 ppm 0-20 ppm	A/C	NEMA 4X	(2) 4-20 mA outputs, 0-1 or 0-5 VDC outputs, (3) SPDT Relays	Keypad & Backlit LCD Display
8450/8451 Free or Total Chlorine Monitor	0-2 ppm 0-20 ppm	A/C	NEMA 4X	(2) 4-20 mA outputs, 0-1 or 0-5 VDC outputs, (3) SPDT Relays	Keypad & Backlit LCD Display

CLOSED-PIPE DOPPLER FLOW MONITORING

Model	Pipe Sizes	Range	Accuracy	Enclosure Rating	Outputs	User Interface	Data Logging	Power
2400 Clamp-On Doppler Flow Monitor	0.5" to 300" (13 mm to 7600 mm)	0.2 to 30 fps (0.06 to 9.14 m/s)	± 2% of full scale velocity	NEMA 4X	Two 4-20 mA, 0-1 or 0-5 VDC, RS232, (3) Alarm Relays	Keypad & Backlit LCD Display	No	A/C
2410 Clamp-On Doppler Flow Monitor	0.5" to 300" (13 mm to 7600 mm)	0.2 to 30 fps (0.06 to 9.14 m/s)	± 2% of full scale velocity	NEMA 4X	Two 4-20 mA, 0-1 or 0-5 VDC, RS232, (3) Alarm Relays	Keypad & Backlit LCD Display	10,000 points	A/C
2450 Portable Clamp-On Doppler Flow Monitor	0.5" to 300" (13 mm to 7600 mm)	0.2 to 30 fps (0.06 to 9.14 m/s)	± 2% of full scale velocity	NEMA 4X	4-20 mA, RS232	Keypad & Backlit LCD Display	100,000 points	A/C or DC

1. Flow Sensors: Sub – Submerged Level Sensor; AV – Area Velocity; U/S – Ultrasonic Level Sensor; Bub – Bubbler Level Sensor.
2. Typical battery life is based on 15 minute recording intervals, one level/velocity sensor and one data download per week.
3. Drawdown correction: Corrects for the effects of velocity on level measurement.
4. 950 OptiFlo model can be configured with field interchangeable submerged, bubbler and ultrasonic level sensors in one unit.
5. CSA-NRTL/c – Class 1, Div. 1, Groups C & D, Intrinsically Safe – CENELEC approved, Eex ia IIB T3.

AMERICAN SIGMA 11601 MAPLE RIDGE ROAD • P.O. BOX 820 • MEDINA, NEW YORK 14103-0820 USA
IN U.S. AND CANADA CALL 800-635-4567 • FAX: 716-798-5599

SALES ASSISTANCE **800-635-4567**
24 HOUR HELP LINE **800-635-1230**
WORLDWIDE PHONE **716-798-5580**
Email: sigma@americansigma.com
Web site: www.americansigma.com

AMERICAN SIGMA
Innovation in water monitoring

Appendix E:
Solar Irradiation Monitoring Equipment Information

ACWA does not endorse the following equipment manufacturers. These are examples of equipment currently being used in Oregon by other municipalities.

THE EPPLEY LABORATORY, INC.

12 Sheffield Avenue, PO Box 419
Newport, Rhode Island 02840 USA
Tel: 401-847-1020 Fax: 401-847-1031
Email: eplab@mail.bbsnet.com

SOLAR RADIATION MEASUREMENT INSTRUMENTATION

Located in Newport, Rhode Island USA, the Eppley Laboratory has been committed to developing the finest scientific instrumentation for precision measurements since 1917. The Meteorology Department produces radiometer, pyranometers, pyrheliometers and pyrgeometers that measure solar and terrestrial radiation. Many National Meteorological Authorities are using Eppley Instrumentation as their standards for radiometric measurements.

In addition to Atmospheric Radiation Measuring Equipment, the Eppley Laboratory manufactures and calibrates:

- *Standard Lamps*
- *Blackbodies*
- *Laboratory Thermopiles*

EPLAB

INTRODUCTION TO SOLAR RADIATION

Solar radiation is a term used to describe visible and near-visible (ultraviolet and near-infrared) radiation emitted from the sun. The different regions are described by their wavelength range within the broad band range of 0.20 to 4.0 μm (microns). Terrestrial radiation is a term used to describe infrared radiation emitted from the atmosphere. The following is a list of the components of solar and terrestrial radiation and their approximate wavelength ranges:

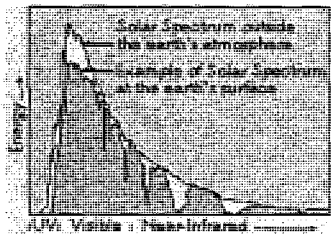
- Ultraviolet: 0.20 - 0.39 μm
- Visible: 0.39 - 0.78 μm
- Near-Infrared: 0.78 - 4.00 μm
- Infrared: 4.00 - 100.00 μm

Approximately 99% of solar, or short-wave, radiation at the earth's surface is contained in the region from 0.3 to 3.0 μm while most of terrestrial, or long-wave, radiation is contained in the region from 3.5 to 50 μm.

Outside the earth's atmosphere, solar radiation has an intensity of approximately 1370 watts/meter^2. This is the value at mean earth-sun distance at the top of the atmosphere and is referred to as the Solar Constant. On the surface of the earth on a clear day, at noon, the direct beam radiation will be approximately 1000 watts/meter^2 for many locations.

The availability of energy is affected by location (including latitude and elevation), season, and time of day. All of which can be readily determined. However, the biggest factors affecting the available energy are cloud cover and other meteorological conditions which vary with location and time.

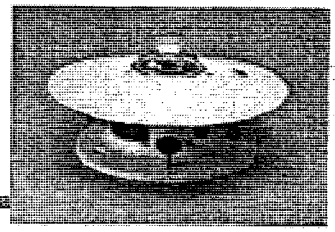
Historically, solar measurements have been taken with horizontal instruments over the complete day. In the Northern US, this results in early summer values 4-6 times greater than early winter values. In the South, differences would be 2-3 times greater. This is due, in part, to the weather and, to a larger degree, the sun angle and the length of daylight.



EPLAB

PRECISION SPECTRAL PYRANOMETER

Model PSP



The Precision Spectral Pyranometer is a World Meteorological Organization First Class Radiometer designed for the measurement of sun and sky radiation, totally or in defined broad wavelength bands. It comprises a circular multi-junction wire-wound Eppley thermopile which has the ability to withstand severe mechanical vibration and shock. Its receiver is coated with Parson's black lacquer (non-wavelength selective absorption). This instrument is supplied with a pair of removable precision ground and polished hemispheres of Schott optical glass. Both hemispheres are made of clear WG295 glass which is uniformly transparent to energy between 0.285 to 2.8μm. For special applications, other Schott glasses and Infrasil II quartz hemispheres are available. Included is a spirit level, adjustable leveling screws and a desiccator which can be readily inspected. The instrument has a cast bronze body with a white enameled guard disk (shield) and comes with a transit/storage case. A calibration certificate traceable to the World Radiation Reference and a temperature compensation curve is included.

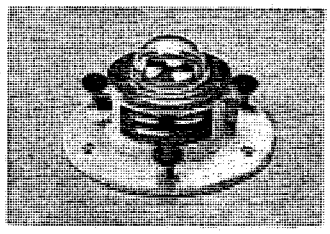
SPECIFICATIONS

- Sensitivity: approx. 9 $\mu V/Wm^{-2}$.
- Impedance: approx. 650 Ohms.
- Temperature Dependence: ±1% over ambient temperature range -20 to +40°C
- (temperature compensation of sensitivity can be supplied over other ranges at additional charge).
- Linearity: ±0.5% from 0 to 2800 Wm^{-2}.
- Response time: 1 second (1/e signal).
- Cosine:
  - ±1% from normalization 0-70° zenith angle;
  - ±3% 70-80° zenith angle.
- Mechanical Vibration: tested up to 20 g's without damage.
- Calibration: integrating hemisphere.
- Size: 5.75 inch diameter, 3.75 inches high.
- Weight: 7 pounds.
- Orientation: Performance is not affected by orientation or tilt.

EPLAB

BLACK AND WHITE PYRANOMETER

Model 8-48



The Black & White Pyranometer has a detector consisting of a differential thermopile with the hot-junction receivers blackened and the cold-junction receivers whitened. The receiver is of radial wire-wound plated construction with the black segments coated with a flat black coating and the white with Barium Sulfate. Built-in temperature compensation with thermistor circuitry is incorporated to free the instrument from effects of ambient temperature. A precision ground optical glass hemisphere of Schott glass WG295 uniformly transmits energy from 0.285 to 2.8 μm.

The cast aluminum case carries a circular spirit level and adjustable leveling screws. Also supplied is a desiccator, which can be readily inspected.

A calibration certificate traceable to the World Radiation Reference is included.

SPECIFICATIONS

- Sensitivity: approx. 10 $\mu V/Wm^{-2}$.
- Impedance: approx. 350 Ohms.
- Temperature Dependence: ±1.5% over ambient temperature range -20 to +40°C.
- Linearity: ±1% from 0 to 1400 Wm^{-2}.
- Response time: 5 seconds (1/e signal).
- Cosine:
  - ± 2 % from normalization 0-70° zenith angle;
  - ± 5 % 70-80° zenith angle.
- Mechanical Vibration: tested up to 20 g's without damage.
- Calibration: integrating hemisphere.
- Size: 5.75 inch diameter, 2.75 inches high.
- Weight: 2 pounds.

EPLAB

Welcome to LI-COR

Environmental Division

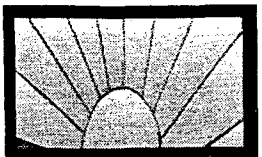
Founded in 1971, LI-COR is a leading manufacturer of electronic instrumentation for environmental, agricultural and ecological research. LI-COR instruments are used in over 100 countries in a variety of disciplines including: agronomy, biotechnology, botany, ecology, forestry, horticulture, limnology, meteorology, oceanography, optics research, plant physiology, and solar research.

At LI-COR, our goal is to provide innovative, technologically advanced instruments that are rugged, portable, reliable and easy to use. We also guarantee the highest level of service and support available. At LI-COR, we don't just sell instruments, we become research partners with our customers.

PRODUCTS	WHAT'S NEW
Photosynthesis Measurement Systems, Gas Analyzers, Area Meters, Sensors & Calibrators, Spectroradiometers, Dataloggers, Light Meters, Flow Control, Dew Point Generators, and Weather Stations.	LI-COR's NEW GasHound Model LI-800 is packed with more value than any other CO_2 analyzer in its price range. Low noise and automatic temperature and pressure compensation combine to provide high accuracy for the entire measurement range.
DISTRIBUTORS	**SUPPORT**
LI-COR has an extensive support system of international distributors to handle the needs of our international customers. Click on the link above to view a list of distributor countries. Each country is linked to contact information for the distributor serving the area.	When you purchase a LI-COR product, you're not just buying an instrument, you're also investing in a complete support system. We're here to help you. Check out our CORE Support, LI-6400 Training and general instrument support and see the faces behind the phones.
TRADE SHOWS	**JOB OPPORTUNITIES**
Test our products and talk to our application scientists. LI-COR's Environmental Division attends more than 15 trade shows a year	LI-COR is a great place to work. The Environmental Division has several employment opportunities. You may also want to check

trade shows a year. Come see us at any of these upcoming events.	You may also want to check out the Biotechnology Division opportunities with our direct link.
APPLICATION NOTES	**WEATHER STATIONS**
Soil CO_2 Flux Paper. If you're measuring soil CO_2 flux you'll be interested in this recently published paper; "Measurements of Soil CO_2 Flux", and the Soil Respiration Chamber for the LI-6400. Request other publications here.	LI-COR now has two new weather stations that feature the LI-1400 Datalogger; the LI-1401 Agro-Meteorological Station and the LI-1405 Basic Weather Station.

LI-COR, inc.
Environmental Division
4421 Superior St.
Lincoln, NE 68504 U.S.A.
402-467-3576
Fax: 402-467-2819
1-800-447-3576 (U.S. & Canada)
E-mail: envsales@env.licor.com
www.licor.com



Other Sensors:

Photometric Sensors
Quantum Sensors

LI-200SA Data Sheet

Sensor Accessories

Literature Request

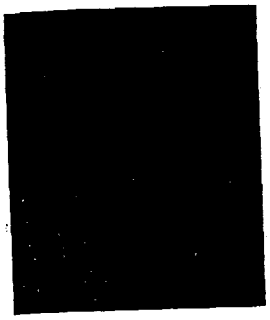
Home

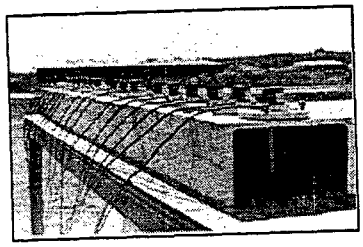
Pyranometers

A pyranometer is an instrument for measuring solar radiation received from a whole hemisphere. It is suitable for measuring global sun plus sky radiation. Solar radiation varies significantly among regions. Season and time of day are major considerations, but surrounding terrain elevation, man-made obstructions, and surrounding trees can also cause large variations in locations with a small area. Often, the most required measurement is energy flux density of both direct beam and diffuse sky radiation passing through a horizontal plane of known unit area (i.e. global sun plus sky radiation).

The LI-COR pyranometer may be handheld or mounted at any required angle, provided that reflected radiation is not a significant portion of the total. In its most frequent application, the pyranometer sensor is set on a level surface free from any obstruction to either direct or diffuse radiation. The sensor may be most conveniently leveled using the 2003S Mounting and Leveling Fixture.

The LI-200SA Pyranometer Sensor measures global solar radiation (sun plus sky). Click here (23K) for a spectral response graph. The LI-200SA is used extensively in meteorological studies, passive solar system analysis, irrigation scheduling, hydrologic studies and many other environmental studies. For clear unobstructed daylight conditions, the LI-200SA compares favorably with first class thermopile pyranometers, but is priced at a fraction of the cost.



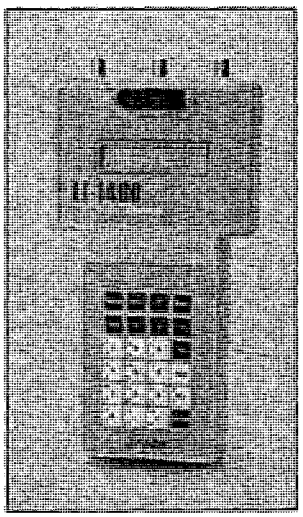


LI-200SA Pyranometers

LI-1400 Datalogger
LI-1405 Basic
Home

LI-1400 Datalogger

The LI-1400 Datalogger combines simple operation, compact size, and 10 channel datalogging to produce an instrument that is both powerful and easy to use.



A variety of sensors can be used with the LI-1400 including LI-COR radiation sensors, air and soil temperature sensors, and many meteorological sensors. Three external light sensor connectors allow fast setup with LI-COR radiation sensors. Two additional current channels, one pulse counting channel, and several regulated and unregulated voltage supplies provide high input impedance for measuring a wide range of sensors. Menu driven software allows the LI-1400 to be quickly configured to meet your application.

The flexibility of the software allows it to be operated as either a simple meter or as a datalogger. The output of a given sensor can be viewed on the LCD display or stored in memory by simply pressing the ENTER key on the keypad.

Fast Setup

Channel setup is simplified by the use of *Log Routines* that eliminate entering repetitive information. Log Routines allow you to enter the logging period, start/stop times and other information, and then apply that log routine to as many channels as required. Channel setup also includes choosing from a list of *math functions* that can be applied to sensor inputs. In addition to sensor input scaling and linearization, calculations can be performed using math functions, including math operators, Steinhart-Hart function, saturation vapor pressure, dew point temperature, natural log, and a fifth

order polynomial for sensor linearization. Nine math channels extend logging and calculation capabilities by performing additional logging or math routines using any other current, voltage, or math channel.

Data Output

Simple Windows® 95 communication software is included for rapid binary and ASCII data transfer, or to upload configuration changes from a computer.

Appendix F: Data Conversion Macro Instructions

OREGON DEPARTMENT OF
ENVIRONMENTAL QUALITY

WESTERN REGION - MEDFORD

INSTRUCTIONS FOR EXCEL® DATA CONVERSION MACROS PRE-RELEASE VERSIONS

Table Of Contents

Page

Disclaimer and Limitations

This software has been tested, and is believed to be stable. However, no testing can cover all machine configurations or input data sets. If a problem is observed, please report it to:

Andy Ullrich
DEQ-Medford
201 W. Main, Suite 2-D
Medford, OR 97501
(541) 776-6010 extension 246

Please try to record as much detail as possible as to the circumstances surrounding the problem. A copy of the data set being processed when the problem occurred will also be helpful.

Introduction

There are a number of different temperature data loggers in field use. While all the loggers and their associated software can produce ASCII data files for use in other programmes, the format of the data files vary from manufacturer to manufacturer. In addition, one or more days at the beginning and end of each data set often need to be deleted as those days can contain invalid temperature data.

In an effort to streamline this process, this collection of data conversion macros (programmes) was written for Microsoft Excel 5.0. Each macro converts a specific data type into the standard format as required by the TEMPTURE data analysis programme. The programme can optionally remove the first and last day of the data set if desired. The data can be graphed to see if addition days need to be deleted. The data can also be checked to see if it is consistent with the requirements of the TEMPTURE programme, if further processing of the data set is desired. The programme will store the data sets into an Excel 5.0 workbook, and multiple data sets can be combined in the same data workbook, each on its own sheet. Finally, each data set can be saved in an ASCII data file, using the standard TEMPTURE format.

Programme Use

Using the programme is quite simple. Users of TEMPTURE will notice the similarity in the user interface. This is because portions of TEMPTURE were recycled in this programme to expedite development.

Starting the programme

1. Select which data conversion protocol is required, and copy the appropriate file to your local hard drive or network drive. The various conversions available are listed below. Note that the list of data loggers that use a given format may not be complete.

Conversion file	Import file characteristics	Data logger
DATA-CON.XLS	3 column. Date in first column, Time in second column, degrees F in third column. **Date only appears for first sample of each day. Comma delimited**	Ryan
DATA2.XLS	4 column. Date/time in first column, degrees C in second column, degrees F in third column, A-D info in fourth column. **Comma delimited**	Hobo
DATA3.XLS	2 column. Date/time in first column, degrees F in second column. **Comma delimited**	
DATA4.XLS	3 column. Date in first column, time in second column, degrees F in third column. **7 lines of header information. Comma delimited**	Minilog

2. Start Windows and start Excel as per your normal practice.

3. Load the appropriate conversion file per normal practice. The opening screen will appear. Each option on the screen will be discussed in order of processing.

Open data file

1. Click the *Open Data File* button

2. The standard Excel *open file* dialogue box appears. Select the file you wish to convert and click OK. Note that you may have to change the file specification to ***All Files*** ***.*** in order to see the listing of the data files, since their extension likely won't be .xl*.

3. The data file will be opened and imported into Excel

Delete first and last day

Frequently the data on the first and last day of a data set is not complete, due to logger deployment and retrieval. This data must be deleted, and this option will do that.

1. Click on the *Delete first and last day* button. The programme will delete the first and last day of the data set and return to the Main Menu when complete.

Format data set

NOTE: For DATA-CON.XLS, if you wish to delete the first and last day using the option button described above, you must do that before running the *Format data set* option. If you format the data set, you will no longer be able to delete the first and last day of data using this programme.

1. Click on the button *Format data set* to format the data. The data set will be formatted into the standard TEMPTURE format. Depending on the amount of formatting a data set requires, this may take a few moments. Please be patience.

2. Once the data is formatted, the user is asked for the name of the sample site, the latitude, longitude, and agency responsible for collecting the data set. This information is then written to the data sheet, where it can be used by TEMPTURE during subsequent processing.

Data check

This function is identical to the data check function in TEMPTURE, and can be used to ensure that the data set is ready for further processing.

1. Click on the *Data check* button to run the check. If the tests are successful, the programme returns to the main menu.

2. If the programme finds a problem in the data, the programme will report which test failed. The various test numbers are listed below:

   a) **Test 1:** Checks to make sure Cell A1 and B1 do NOT contain valid data. Data must start on row 2 of the data sheet.

   b) **Test 2:** Checks to make sure each column has the same number of data points, and that there is no non-numeric cells in the data columns. Failure of this test indicates that the data was not properly imported into the *Excel* workbook.

   c) **Test 3:** Checks to make sure that the number of data points can be evenly divided by the number of days. Failure of this test indicates that the data was not properly truncated from the raw data set.

   d) **Test 4:** Checks to make sure that each day in the data set has the same number of data points. Each day *must* have the same number of data points to be properly processed.

Graph first 4000 points

This step provides a quick visual check of the data, and will show if additional days need to be deleted from the data set.

1. Click on the *Graph first 4000 points* button. The first 4000 points will be graphed.

2. Note if addition day(s) require deletion.

3. Press the *Delete* key to erase the graph. Failure to erase the graph will cause the saved file to be somewhat larger, especially if several plots are made.

4. Manually delete the 'bad data' days. Note the following:

   a) You cannot delete only part of a day. Whole days only must be deleted.

   b) If deleting data at the beginning of the data set, be careful not to delete the column headers, or the data in Column C.

5. Click on the *Main* sheet tab to return to the **Main Menu**. Click on the *Graph first 4000 points* to regraph the data. Repeat the manual editing process as needed.

6. Repeat Steps 1-6 using the *Graph 2nd 4000 data points* if the data set is over 4000 points long.

7. It is a good idea to click on the *Data check* button when all editing is complete. This will ensure that the data set is still properly formatted.

Save data file to workbook

1. Click on this button to save the data.

2. A dialogue box opens that asks if the data is to be saved to a new workbook or appended to an existing workbook. Click the appropriate response

Save to new workbook

1. The programme will open a dialogue box to get the new data file name. Type a name and click OK.

Append to existing workbook

1. The programme will display the stand Excel *Open File* dialogue box.

2. Select the file you wish the data to be appended to and click OK.

3. The data sheet will be copied into the data workbook, and then the data workbook will be closed.

Save clean ASCII file

Use this option to save an ASCII version of the data file.

1. Click on the *Save clean ASCII file* button.

2. An ASCII version of the file will be saved on disc. It will be saved in the same subdirectory as the original data file, and have the same name as the original data file with the extension **.csv**. The data sheet will then be removed from Excel. **The original data file on disc will not be modified.**

3. You can now process a different data file starting with the first option.

Exit macro

1. Click this button to exit from the programme. **Save your work before exiting the macro. This is your only warning -- the programme will *not* warn you to save your work before exiting.**

Appendix G: Data Submittal Procedure Guidance

DEPARTMENT OF ENVIRONMENTAL QUALITY

DATA SUBMITTAL PROCEDURE GUIDANCE

The Department of Environmental Quality (DEQ) has developed data forms and quality assurance guidelines to assist organizations and watershed councils collecting water quality data. This guidance explains the content of the accompanying forms and tables. The only form that monitoring groups will submit to DEQ is the "Data Form" worksheet in the "dataforms.xls" file. Other forms are included in this package for monitoring groups to use, but need not be submitted to DEQ.

Quality assurance (QA) applies to each step of the environmental monitoring process, not only to quality control (QC) procedures performed in laboratories. Because environmental monitoring data are collected under uncontrolled conditions, field measurements should be validated by detailed documentation of procedures, continual evaluations of precision and accuracy, and regular independent audits.

The data submittal form asks for several categories of metadata (e.g. site location, identification number, date, time), as well as documentation of the QA level attained. Level A is the highest level of the three levels and will be used by DEQ for compliance with water quality standards, permitting requirements, or regulatory activities. Level B is the next highest and will be used by DEQ for early warning of potential problems or for screening information. Level C is the least stringent level and will be used primarily for educational purposes. Accuracy and precision levels have been assigned to each data quality level for each field parameter in the accompanying Data Quality Matrix.

Data received by DEQ will be considered to meet the lowest level of quality control or method selection. For example, if no QA plan was submitted (Level B), but the pH method used a calibrated pH electrode with accuracy = +/- 0.2 and with precision = +/- 0.3 (Level A), the data quality level would be Level B.

DATA FORM

DEQ requests that all volunteer-collected data, both continuous and grab, be submitted in this format, which will allow the most efficient uploading into the DEQ database.

If recording continuous data from more that one parameter (e.g. temperature, pH, and dissolved oxygen), record each parameter in a separate vertical block, even if the times correspond among the parameters.

The data cannot be uploaded into the DEQ database unless all the metadata categories are completed. The DEQ Water Quality Monitoring section of the Laboratory can assist organizations having trouble supplying the necessary metadata.

1) **ORGANIZATION.** The name of the Organization or Watershed Council submitting data.

2) **SITE DESCRIPTION (Location).** The text description of the sample site location. (*Example:* BEAR CREEK @ KIRTKAND RD 0.5 mi. D/S OF JACKSON CK CONFLUENCE. Where @ means "at", mi. means "miles", D/S or U/S means "down or up stream").

3) **ELEVATION.** The elevation in feet of the sample site. The elevation is used to calculate the percent of dissolved oxygen saturation and is useful when interpreting temperature data. Elevations can be estimated from US Geological Survey (USGS) topographic maps, generally with contour intervals of 40 or 100 feet. Elevations can be estimated in the field with an altimeter calibrated at the nearest USGS benchmark or site of known elevation.

4) **LATITUDE DEGREES.** The degrees of latitude of the sample site. Read from USGS topographic maps, determine with a GPS unit, or utilize a mapping software package.

5) **LAT MINUTES.** The minutes of latitude of the sample site.

6) **LAT SECONDS.** The seconds of latitude of the sample site.

7) **LONGITUDE DEGREES.** The degrees of longitude of the sample site. Read from USGS topographic maps, determine with a GPS unit, or utilize a mapping software package.

8) **LONGITUDE MINUTES.** The minutes of longitude of the sample site.

9) **LONGITUDE SECONDS.** The seconds of longitude of the sample site.

10) **LL SOURCE.** The source of sample site location latitude and longitude. *Examples:* Uncorrected GPS; Corrected GPS; USGS Topo Map, 1:100,000 or 1:24,000; or specify other method.

11) **RIVER BASIN.** The Oregon Water Resources Department (WRD) river basin name. *Example:* Rogue, Deschutes, or North Coast.

12) **SUB-BASIN.** The WRD/DEQ sub-basin name. The names are based on the USGS Hydrologic Unit Codes (HUCs), fourth field boundaries.

13) **HUC.** The eight digit fourth field USGS HUC designating river basin and sub-basin.

14) **RIVER MILE.** The WRD river mile of the sample site from WRD maps or USGS 7.5 minute topographic maps. This field is optional, but helpful for locating the sampling site.

15) **RIVER MILE SOURCE.** The title of the USGS or WRD map from which the river mile was read.

16) **STATION ID.** The station identification number/code for the sample site, assigned by the organization collecting the data. This code must be unique for each sampling site and identical each time data is reported because it will be used as the primary identification code in the DEQ database. *Example:* BEAR001 or 402728.

17) **DATE.** The date the sample was taken in MM/DD/YYYY format. *Example:* 05/31/1998.

18) **TIME.** The time the sample was taken in HH:MM format and using the 24 hour clock. *Example:* 14:35 to designate 2:35 p.m.

19) **TEMP.** The temperature value of the water sample reported to the nearest tenth digit. *Example:* 17.5.

20) **UNITS.** The units of the temperature data point. *Example:* C* or F*.

21) **AUDITS OR DUPLICATES.** Quality assurance recordings made with National Institute of Standards and Technology (NIST) thermometers to confirm continuously collected temperature data; or temperature measurements of duplicate samples collected at 10% of grab sample stations.

22) **DQL.** The Data Quality Level (DQL) of the temperature parameter based on the Data Quality Matrix. *Example:* A, B, or C.

23) **pH.** The pH value of the water sample.

24) **AUDITS OR DUPLICATES.** Quality assurance pH measurements from grab samples to confirm continuously collected data; or pH value of duplicate samples collected at 10% of grab sample stations.

25) **DQL.** The Data Quality Level for the pH based on the Data Quality Matrix. *Example:* A, B, or C.

26) **DIS OXYGEN.** The dissolved oxygen value of the water sample in milligrams per liter (mg/L).

27) **AUDITS OR DUPLICATES.** Quality assurance dissolved oxygen measurements from grab samples to confirm continuously collected data; or dissolved oxygen value of duplicate samples collected at 10% of grab sample stations.

28) **DQL.** The Data Quality Level for dissolved oxygen based on the Data Quality Matrix. *Example:* A, B, or C.

29) **SPEC. COND.** The specific conductance (conductivity temperature-corrected to 25 * C) of the water sample.

30) **AUDITS OR DUPLICATES.** Quality assurance specific conductance measurements from grab samples to confirm continuously collected data; or specific conductance value of duplicate samples collected at 10% of grab sample stations.

31) **DQL.** The Data Quality Level for specific conductance based on Data Quality Matrix. *Example:* A, B, or C.

32) **TURBIDITY.** The turbidity value of the water sample, in whole numbers (round to nearest whole number).

33) **AUDITS OR DUPLICATES.** Quality assurance turbidity measurements from grab samples to confirm continuously collected data; or turbidity value of duplicate samples collected at 10% of grab sample stations.

34) **DQL.** The Data Quality Level for turbidity based on the Data Quality Matrix. *Example:* A, B, or C.

35) **SALINITY.** The salinity value of a seawater-influenced sample.

36) **AUDITS OR DUPLICATES.** Quality assurance salinity measurements from grab samples to confirm continuously collected data; or salinity value of duplicate samples collected at 10% of grab sample stations.

37) **DQL.** The Data Quality Level for salinity will be the same as for specific conductance and based on the Data Quality Matrix. *Example:* A, B, or C.

38) **E. COLI:** The estimated concentration (most probably number/100 mL) of *E. coli* organisms in the sample as measured with a Colilert ® Quantitray™ system or determined by an analytical laboratory.

39) **DUPLICATES.** Quality assurance E. coli estimated concentration from samples collected at 10% of sample stations.

40) **DQL.** The Data Quality Level based on the Data Quality Matrix. *Example:* A, B, or C.

41) **RESPONSIBLE PERSON(S).** The person(s) who collected the data.

42) **DATA REVIEWED.** The date that the data was reviewed to insure accuracy and completeness of all data points.

43) **COMMENTS.** Any comments if appropriate.

TEMPERATURE QUALITY ASSURANCE FORM

A separate QA form is provided for temperature monitors because other instruments' QA information is generally included in log books kept with the instruments. Monitoring groups may use this form to document QA procedures for individual temperature loggers or may use their own form containing the same information. Monitoring groups do not need to send this form to DEQ, but QA information should be maintained to improve the validity of the collected data.

12/30/98

Return to Data Report Format Page

ORGANIZATION	SITE DESCRIPTION (Location)	ELEVATION	LATITUDE DEG.	LAT MIN.	LAT SEC.	LONGITUDE DEG.	LONG MIN.	LONG SEC.	LAT/LONG SOURCE
Volunteer Creek WSC	Volunteer Creek @ Highway 10	1500	45	15	7	123	10	27	USGS, Juniper Butte, OR, 7.5 " Quad, 1:24,000

RIVER BASIN	SUB-BASIN	HUC (4th field)	RIVER MILE	RIVER MILE SOURCE	STATION ID	DATE	TIME	TEMP	UNITS	AUDITS/DUPLICATES	DQL	pH (s.u.)	AUDITS/DUPLICATES
Willamette	Yamhill	17090008	25.5	WRD, Hood Drainage Basin, Map 4.6	VC-5	06/09/98	10:30	15.3	C	15.5	A	7.4	7.4

DQL	DIS OXYGEN (mg/L)	AUDITS/DUPLICATES	DQL	SPEC. COND. (uS/cm)	AUDITS/DUPLICATES	DQL	TURBIDITY (ntu)	AUDITS/DUPLICATES	DQL	SALINITY (ppt)	AUDITS/DUPLICATES	DQL
A	10.5	10.7	A	106	110	A	7	7	A			

E. COLI (MPN/100 mL)	DUPLICATES	DQL	RESPONSIBLE PERSON	DATA REVIEWED	COMMENTS
			Data Collector	7/12/98	

Project/Study Name:

Temperature Logger ID:

Data File Name:

Date of Battery Installation:

Start Date:

Interval:

Duration:

Site Name:

STATION ID:

USGS Quad Name & #: (OPTIONAL)

Site Latitude:

Site Longitude:

Site Description:

Pre- Deployment Temperature Check

Date of Check:

Master thermometer ID: DEQ (Tag #)

Low Temp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
	-	-	-	-

Pre- Deployment Temperature Check

Date of Check:

Master thermometer ID: DEQ (Tag #)

Room Temp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
	-	-	-	-

AUDIT VALUES		Water Temperature		Air Temperature		**Audit Thermometer ID**		
Date	**Time**	**Audit**	**Logger**	**Audit**	**Logger**		**Comments**	**STATUS**

COMMENT:

Post- Deployment Temperature Check

Date of Check:

Master thermometer ID: DEQ (Tag #)

Low Temp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
	-	-	-	-

Post- Deployment Temperature Check

Date of Check:

Master thermometer ID: DEQ (Tag #)

RoomTemp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
	-	-	-	-

Project Name: Bear Creek Temperature Study "98"

Temperature Logger ID: 6332

Data File Name: BC6332

Date of Battery Installation: 1997

Start Date: 09 June 97 10:00

Interval: 30 min

Duration: 165 days

Site Name: Bear Creek @ Kirtland Rd.

STATION ID: 402728

USGS Quad Name & #: Burn Butte 1240

Site Latitude: 43 20 36.2 N

Site Longitude: 121 53 02.1 W

Site Description: D/S 75ft. from road 5830 crossing. wetted width= 5ft 5in. ave. depth 1.5 ft

Pre- Deployment Temperature Check

Date of Check: 6/9/98

Master thermometer ID: DEQ 50515

Low Temp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
D0715	-	-	-	-
0720	11.42	12.6	-1.18	-
0721	11.41	11.8	-0.39	PASS
0722	11.50	11.5	0.00	PASS
0723	11.52	11.5	0.02	PASS
0724	11.56	11.5	0.06	PASS
0725	11.58	11.5	0.08	**PASS**

Pre- Deployment Temperature Check

Date of Check: 6/9/98

Master thermometer ID: DEQ 50515

Room Temp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
D0750	-	-	-	-
0755	28.29	27.5	0.79	-
0756	28.24	28.0	0.24	PASS
0757	28.19	28.2	-0.01	PASS
0758	28.14	28.0	0.14	PASS
0759	28.11	28.0	0.11	PASS
0800	28.06	28.0	0.06	**PASS**

AUDIT VALUES

		Water Temperature		Air Temperature		Audit Thermometer ID		
Date	**Time**	**Audit**	**Logger**	**Audit**	**Logger**		**Comments**	**STATUS**
6/17/98	12:38	6.1	6.4	20.9		c205550		**PASS**
8/5/98	9:00	6.55	6.7	17		50524		**PASS**
9/29/98	15:32	6	5.6	18.42		50524	Buried in soft sand.	**PASS**

Post- Deployment Temperature Check

Date of Check: 10/20/98

Master thermometer ID: DEQ 50515

Low Temp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
D1330	-	-	-	-
1335	6.22	8.6	-2.38	-
1336	6.29	6.5	-0.21	PASS
1337	6.34	6.4	-0.06	PASS
1338	6.39	6.4	-0.01	PASS
1339	6.44	6.4	0.04	PASS
1340	6.48	6.5	-0.02	**PASS**

Post- Deployment Temperature Check

Date of Check: 10/20/98

Master thermometer ID: DEQ 50515

RoomTemp TIME	TEMP MASTER	TEMP UNIT	Difference	STATUS
D1400	-	-	-	-
1405	28.54	27.3	1.24	-
1406	28.47	28.4	0.07	PASS
1407	28.41	28.4	0.01	PASS
1408	28.36	28.4	-0.04	PASS
1409	28.29	28.4	-0.11	PASS
1410	28.26	28.2	0.06	**PASS**

Appendix H:
Sample Quality Assurance Project Plan

Quality Assurance Project Plan

Project Name: Draft Example

Responsible Agency/Organization/Group

Draft No. & Date

Project Manager Signature: _____

Name/Date:

Project QA Officer Signature: _____

Name/Date:

Analytical Laboratory Officer: _____

Name/Date:

Project Safety Officer: _____

Name/Date:

Data Manager: _____

Name/Date:

2. Table of Contents:

Attachments

3. Distribution List: (Names & telephone numbers of all those receiving copies of this plan.)

i.

ii.

iii.

4. Project/Task Organization: (List all key personnel and organizations involved in this project.)

(For Example Purposes Only)

Name:	Project Title/Responsibility	Telephone Number
	Watershed Council Tech. Advisory Chair	
	Project Officer	
Larry Marxer	DEQ HSP Monitoring Coordinator	
	Laboratory QA Officer	
	Field Crew & Research Leader	
(And so on)		

5. Problem Definition/Background:

This watershed/sub-basin is located somewhere in Oregon. It has a combination of urban communities, privately owned agricultural lands and public forest and range land. The watershed contains approx. 2500 miles of permanent and intermittent streams, most of which have populations of anadromous and resident salmon and trout population, as well as assorted warm water fish species. The impact on water quality in the streams in the watershed continues to grow as a result of increased runoff from urban development, agricultural production and logging. Local residents within the watershed have become concerned about the increased threat to water quality and are making plans to work with government agencies and local business and industries to address problems through the development of best management plans.

The basin assessment completed by the watershed council revealed that there is very little baseline water quality data available which could be used to identify specific problems, or be used for planning purposes and future comparisons. The participants in this project, including the watershed council, Oregon DEQ, ODA, and State Forestry, want to document the baseline ambient water quality conditions of surface water streams in the basin.

The data collected will be used by the watershed council and state agency staff to characterize current water quality conditions, identify specific water quality problem areas, and begin the development of enhancement and restoration projects. The watershed council will also use the data to educate and inform local residents on the connections between land use and water quality.

6. Project Task/Description: (Describe the work to be done, where it will be done, what kind of samples/field measurements will be collected, how the data will be analyzed.)

This project will involve regularly scheduled field sampling events to collect data on water temperature, dissolved oxygen, pH, conductivity, turbidity and macroinvertebrates. From January through March of 1999, the watershed council will conduct initial volunteer recruitment and training with technical assistance being provided by staff from the Oregon DEQ and ODA.

Monthly water quality sampling of temperature, dissolved oxygen, pH, conductivity, and turbidity will be conducted during the calendar year at 20 sites throughout the watershed. Continuous temperature monitoring will also be conducted at these same sites from June 1st to October 15th. In addition, macroinvertebrate samples and habitat assessments will be collected in May, August and October at selected sites from the original 20 water quality sampling sites. The staff in the Biology Dept. at the State University will do Macroinvertebrate taxonomy.

The data produced by this project will be entered and stored in a project computerized database established by the watershed council. It will also be shared with all participating state agencies. Members of the WSC technical advisory committee, together with state agency staff, will analyze the data by comparing it to state water quality standards. They will write and distribute a final, year-end report by January of each succeeding year.

MAJOR TASKS	J	F	M	A	M	J	J	A	S	O	N	D
Volunteer Recruitment/Training	x	x	X									
Monthly Ambient WQ Monitoring	x	x	x	x	x	x	x	x	x	x	x	X
Seasonal Macroinvertebrate Sampling					x			x		x		
Lab Analysis						x			x		x	
Data Processing, Analysis, Reporting	x								x	x	x	x

7. Measurement Quality Objectives: (Quantitative & qualitative statements to describe the quality of data required to meet the objectives of the project.)

All data will be gathered and handled in accordance with the *Oregon Plan for Salmon and Watersheds* "Water Quality Monitoring Guide Book". The DEQ Data Quality Matrix is shown in Attachment 1 for reference. Data Quality will be assessed by the following QA/QC parameters:

Matrix	Parameter	Precision	Accuracy	Measurement Range
Water	Temperature	± 1.0 ° C	± 0.5 ° C	-5 to 35 ° C
	pH	± 0.3 SU	± 0.2 SU	0 to 14 SU
	Conductivity	± 2% of Std. Value	± 7% of Std. Value	0 to 4999 µ S/cm
	Turbidity	± 5% of Std. Value	± 5% of Std. Value	0 1000 NTU
	Dissolved Oxygen	± 0.5 mg/l	± 0.3 mg/l	1 to 20 mg/l

Representativeness: For the purpose of this project, representativeness will depend on the parameter being monitored. For the parameters of dissolved oxygen, pH, conductivity and turbidity, samples will be collected at or near the center of the stream channel where the water is well-mixed and most representative of the ambient conditions. For macroinvertebrate collection, field staff will collect samples from two randomly selected locations in each of two riffle habitats within the study reach. The four kick samples will then be combined into one composite sample most representative of the entire riffle habitat.

Comparability: This monitoring program will ensure comparability with similar projects by following the standardized sampling protocols and procedures developed by state agencies. These protocols are described in detail in the Governor's Watershed Enhancement Board.(GWEB) **Oregon Plan for Salmon and Watersheds Water Quality Monitoring Guidebook.** If field staff identifies macroinvertebrate samples, standardized taxonomic keys will be used.

Completeness: It is anticipated that samples will be collected from at least 90% of selected sites during all sampling events unless unanticipated weather-related events or safety issues prevent sampling.

8. Training Requirements and Certification: (Identify training and certification requirements for all field staff.)

All data gatherers and processors have received or will receive training from DEQ or other persons trained by DEQ, or by using DEQ guidelines. DEQ water quality staff on March 18 & 19, 1999, conducted an initial training workshop. During the evening session on Thursday, Mar. 18th, DEQ staff presented an overview of water quality monitoring and an introduction to macroinvertebrate sampling. During the day session on Friday, Mar. 19th, attendees were given hands-on experience in collecting

field measurements and collecting samples for dissolved oxygen, pH, conductivity, turbidity, temperature and macroinvertebrates.

Contact Karen Williams at the DEQ lab for additional information or training (1-503-229-5983).

9. Documentation and Records: (Include information on how field monitoring staff is to record and keep track of data and all other field information. Include field data sheet examples and recommendation for keeping field notebooks. See the example given on Page 29 of the EPA Volunteer Monitor's Guidebook.)

Separate field data sheets for ambient monitoring will be maintained for each sampling event. See Attachment 2 for illustration of typical ambient monitoring field data sheet. Information recorded on data sheets is to include: Project name, data and time of sampling events, water body name, basin name, general weather conditions, names of field staff, time of each sample or measurement, results and equipment and ID numbers. Field staff will also maintain field notebooks for recording of all pertinent field observations.

For continuous temperature monitoring, separate data sheets will be maintained for each continuous temperature logger. See example of typical data sheet in Chapter 6, Pg. 20 of the GWEB Water Quality Monitoring Guidebook. Information to be recorded on these data sheets should include: project name, logger ID number, data filename, site name and location (latitude/longitude), logging interval, start and end date of monitoring period, pre- and post-deployment accuracy check results, and field audit results.

A comprehensive database, available through state agencies or developed by the WSC technical advisory committee, will be used to store all data resulting from this project. All data will be shared among participating staff personnel, agencies, volunteer groups and interested private citizens.

10. Sampling Process Design: (This is one of the most important sections of the entire plan. It should include as much specific information as possible about: sample types, sampling frequency, the monitoring period, site selection and location.)

This Water Quality Monitoring Project consists of three parts: 1) ambient baseline water quality monitoring; 2) continuous temperature monitoring; & 3) the macroinvertebrate sampling.

Baseline Water Quality Monitoring Network:

Monthly samples or field measurements will be collected at the sites listed in the table below for temperature, dissolved oxygen, pH, conductivity and turbidity. These sites have been selected according the recommendations in Chapter 3 of the GWEB Monitoring Guidebook, and are identified by an individual ID number, site description and latitude/longitude.

Site ID #	Site Name/Location	River Mile	Latitude	Longitude
1	Desolation Cr. @ Mouth	0.0	45° 41' 28.4"	123° 52' 51.7"
2	Camas Cr. @ Mouth	0.0	45° 44' 2.0"	123° 52' 30.6"
3	Clear Cr. @ forks	10.0	45° 48' 49.5'	123° 46' 9.0"
	(Fill in all other sites)			
	Add Rows as necessary			

Field sampling work will be done by two-person teams that will collect field measurements according to the protocols and procedures described in the GWEB Monitoring Guidebook. Field data sheets will be completed for each sampling event and field staff will maintain field notebooks for recording observations and other information pertinent to the project. Monthly sampling will be the normal

monitoring schedule, unless weather or other environmental conditions create unsafe conditions for field staff. If conditions do prevent the field staff from conducting a sampling event, they should notify the Project Manager as soon as possible, record the current conditions in the project notebook, and re-schedule the sampling event for the earliest possible date.

Temperature Monitoring Network:

The temperature monitoring network is designed for the purpose of collecting water temperature data from June 1st through Oct. 15th (±). Temperature data will be collected using continuous recorders (Vemco and/or Hobo Temps) deployed at the sites shown in the table below. Monitoring sites have been or will be selected according to the recommendations described in Chapter 3 of the GWEB Monitoring Guidebook.

Site ID #	Site Name/Location	River Mile	Latitude	Longitude
4	Rock Cr. @ Mouth	0.0	45° 41' 79.3"	123° 50' 33.9"
5	JDR @ Picture Gorge	51.3	45° 42' 0.0"	123° 50' 44.7"
	(Fill in all other sites)			
	Add Rows as necessary			

Continuous temperature loggers will be checked for accuracy before and after field deployment according to the procedure outlined in Chapter 6 of the GWEB Water Quality Monitoring Guidebook. In addition, the field installation procedures also described in Chapter 6 will be followed. Loggers will be set to record a data point once an hour. After temperature loggers have been deployed, field staff will conduct independent field audits approximately one hour after deployment, at least once a month during the monitoring season, and just before removal from the field at the end of the season. The procedure for conducting a field audit on continuous temperature loggers is described in the section "Field Checking Instrument Performance" of Chapter 6 of the GWEB Monitoring Guidebook. A separate field data sheet will be maintained for each logger for recording the results of the accuracy checks and field audits.

Macroinvertebrate Sampling Program:

A team of 2-3 field staff will collect macroinvertebrate samples at the sites listed in the table below. Three sampling events will be scheduled: May, August and October. Macroinvertebrate samples will be collected according to the procedure described in Chapter 12 of the GWEB Monitoring Guidebook. Prior to final site selection, permission to access stream sites will be obtained from all property owners.

Site ID #	Site Name/Location	River Mile	Latitude	Longitude
6	Rock Cr. @ Mouth	0.0	45° 41' 79.3"	123° 50' 33.9"
7	Bug Cr. @ USFS boundary	51.3	45° 48' 59.0"	123° 50' 40.2"
	(Fill in all other sites)			
	Add Rows as necessary			

11. Sampling Method Requirements: (Include information on sampling method, WQ parameters, equipment & sample containers, preservation methods, and holding times)

Sampling will be accomplished using the standard protocols described in the GWEB Water Quality Monitoring Guidebook for Stream Temperature, pH, Turbidity, Conductivity, Dissolved Oxygen, and Macroinvertebrates. The monitoring equipment for this project has been provided by DEQ. Field measurements will be recorded immediately after the sample is collected. The only laboratory analysis

required will be for macroinvertebrate taxonomy. The table below lists the equipment used for each water quality parameter:

Matrix	Parameter	Equipment	Container	Preservation	Holding Time
Water	Temperature	NIST Traceable Thermometer	instream	none	immediately
Water	pH	Orion Model 210A Mtr.	500 ml poly	none	immediately
Water	Dissolved Oxygen	HACH OX-DT Kit	300 ml BOD btl.	Winkler Titr.	8 hr.
Water	Conductivity	YSI Model 30 Meter	1000 ml poly	none	immediately
Water	Turbidity	HACH 2100P Meter	Screw top bottle	none	immediately
Substrate	Macroinvertebrates	D-shape kick net	1 liter wide-mouth bottle	ethanol	6 weeks

12. Sample Handling and Custody Procedures: (Applies to samples brought from the field to the Lab for analysis, identification, or storage.)

Ambient water quality measurements will be taken immediately in the field after samples have been collected. Macroinvertebrate samples returned to the lab for identification and storage will be preserved and marked according to the protocols described in Chapter 12 of the GWEB Water Quality Monitoring Guidebook.

13. Analytical Methods Requirements: (List analytical methods and equipment required for analysis of each parameter, either in the field or in the Lab.)

All parameters are measured using the protocols previously mentioned in Paragraph 11 above.

14. Quality Control Requirements: (List the number & type of field and laboratory quality control samples to be collected.)

Duplicate quality assurance (QA) samples for all measurements will be taken at a minimum of 10% of the total number of monitoring sites (1 duplicate for every 10 sites) during each sampling period (i.e. monthly for pH, turbidity, D.O., and conductivity; seasonally for macroinvertebrates). Ten percent of the macroinvertebrate samples will be cross-checked by another taxonomist. The field team will check the continuous temperature loggers for accuracy before and after each field deployment and they will conduct independent field audits , using and NIST traceable thermometer or equal, at least once during the monitoring season (preferably once a month).

15. Instrument/Equipment Testing, Inspection, and Maintenance Requirements: (Describe routine inspection and preventative maintenance of field and laboratory equipment.)

All field monitoring equipment will be tested for accuracy and /or calibrated in accordance with the procedures outlined in the appropriate chapters of the GWEB Water Quality Monitoring Guidebook and the manufacturer's user's manuals. The NIST Traceable Thermometer will be returned to the manufacturer for an annual accuracy check. The manufacturer will complete the accuracy check and re-certify the thermometer to NIST standards.

16. Instrument Calibration and Frequency: (Describe routine calibration of field and laboratory equipment.)

The Orion pH meter will be calibrated (Two Buffer Calibration) prior to daily use according to method describe in manufacturer users manual. The YSI Model 30 Conductivity meter rarely requires calibration, but the procedure outlined in the users manual will be used when re-calibration is required. The Hach 2100P Turbidimeter will be re-calibrated with formazin standards quarterly. Daily accuracy

checks with field standards will also be done prior to collecting any field measurements. There is no calibration for the Hach DO Digital Titrator. However, split samples will be performed periodically with DEQ staff to check the accuracy of the field kit. The NIST Traceable Digital Thermometer is calibrated at the factory and will be returned to the factory for an accuracy check and re-certification once a year. Continuous temperature loggers are factory-calibrated, and they will be checked for accuracy by the field monitoring team before and after each field deployment.

17. Inspection/Acceptance Requirements: (Describe how monitoring equipment/supplies will meet project needs.)

The specific pieces of monitoring equipment that will be used to collect data for this project by the watershed council are listed in Paragraph 11 above. This equipment has been loaned to the WSC by Oregon DEQ, and was funded through a grant from GWEB. The WSC will be responsible for maintaining the equipment and restocking all field supplies when necessary. The names and telephone numbers of vendors and/or manufacturers' representatives are available upon request to the DEQ Laboratory Regional Monitoring Coordinators (1-503-229-5983).

For macroinvertebrate sampling, the field team will use D-frame kick nets (bug nets) supplied as part of the equipment loan agreement with Oregon DEQ. The net frame is heavy gauge steel wire, which is attached to a 5 ft. long cylindrical wooden handle. Net mesh is 500 micron and is consistent with nets used by the state monitoring program. Bug nets will be assembled by the monitoring field team and inspected for holes or other defects prior to sample collection.

A list of additional equipment needed for macroinvertebrate sampling includes the following:

Long sleeve rubber gloves	Fines Grid
Sample Viewing Bucket w/mesh bottom	Ziplock plastic bags
Sample labels	Clipboard
1 ltr. Wide-mouth plastic sample jars	Ethanol sample preservative
Bug brush	Random Number table
Caton Sub-sampler	Bug sorting tray
Small shovel scoop & sqr. cookie cutter	Tripod w/tray platform
Hand magnifying lens	Tweezers
Sample vials	Permanent markers
Paintbrush	Hand-held counters

18. Data Acquisition Requirements: (List type & sources of historical/background information, maps, aerial photos or reports. Discuss limits on use of certain types of data as a result of quality questions.)

U.S.G.S. 7.5 minute topographic maps will be used to identify site locations, land-use activities, and landscape features during the initial watershed assessment survey. Hand-held GPS units may be used, when available, to collect latitude and longitude readings on site.

For macroinvertebrate sample analysis & assessment, pollution tolerance values assigned to organisms and metric calculation formulas will be obtained from documentation provided by state water quality agencies.

19. Data Management: (Trace the data path from field collection, analysis and verification to storage and use.)

The field team lead worker will check all field data sheets for completeness and accuracy at the end of each field day. Errors will be corrected prior to delivering the data sheets to the project manager and/or data manager. All data will be entered into the comprehensive database designed for this project by the watershed council. This database will be compatible with hardware and software used by state water quality agencies. As required by the project QA/QC program, all data will be examined and evaluated again by a second review person from the Technical Advisory Committee.

20. Assessment and Response Actions: (Describe process for evaluating field, lab and data management activities, and the activities of organizations and individuals involved in the project.)

The Project Manager and the Quality Assurance Officer will be responsible for reviewing the entire monitoring project on a regular basis. The Project Officer will also receive guidance and advice from state agencies. The PM will coordinate the training of all volunteers before any monitoring activities are done, and schedule refresher training sessions as needed.

All field activities may be reviewed by state agency QA staff at the request of the Project Manager. Data quality audits will be performed by the QA Officer once a year, and any/all identified procedural problems will be corrected based on the recommendations by the QA Officer.

21. Reports: (Identify the frequency, content and distribution of project reports to data users and other interested parties. Include information on project status, assessments and audits, problem resolution.)

Project reports will be developed through a joint effort by the field monitoring team, the project manager and the QA Officer. The reporting process will begin after the end of the field monitoring season and final reports will be ready for distribution by January of the succeeding year. Reports will be submitted to DEQ and all other participating agencies and groups on a regular basis, or whenever such reports are requested. All data will be submitted to DEQ as part of the equipment loan agreement, and it will be maintained and available for public use on request.

Reports will include the data results, data analysis and interpretation, pertinent field observations, QA/QC assessments.

22. Data Review, Validation, and Verification: (State how data will be reviewed, and how decisions regarding accepting or rejecting data will be made.)

All data resulting from this project will be reviewed by the Project Officer, the QA Officer and the Data Manager to determine if it meets the QA Plan objectives. At the discretion of the watershed council, state agency staff may be asked to review and comment on the data. Decisions to accept, qualify or reject data will be made by the Project Manager and QA Officer.

23. Validation and Verification Methods: (Describe procedures to validate and verify data.)

As required by the project QA Program, duplicate samples will be collected at a rate of 1 duplicate per 10 samples collected. Any data or sample values outside of the expected range for the parameter being measured will be rechecked for validity in the field by the field team, and if necessary, the field team will re-sample. Data that continue to be outside expected values will be further investigated to determine the cause, using alternate methodology, if available.

At macroinvertebrate sample sites, duplicate samples are collected at 10% of the total number of sample sites. The same rate is used during the taxonomic identification (bug ID) process.

Once the data has been entered in the project database, the Data Manager will print a paper copy of the data and proofread it against the original field data sheets. Errors in data entry will corrected at that time. Outliers and inconsistencies will be flagged for further review or be discarded. Data quality problems will be discussed as they occur and in the final report to data users.

24. Reconciliation with Data Quality Objectives: (Describe process for determining whether data meets project objectives.)

As soon as possible after each sampling event, calculations and determinations for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators do not meet the project's specifications, data may be discarded and re-sampling may occur. The cause of the failure will be evaluated. If the cause is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, team members will be retrained. Any limitations on data use will be detailed in both interim and final reports, and other documentation as needed. If failure to meet project specifications is found to be unrelated to equipment, methods, or sample error, specifications may be revised for the next sampling season. Revisions will be submitted to state agencies for review and/or approval.

Return to Data Report Format Page

Appendix I: TempTure Program Instructions and Data Format

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

WESTERN REGION - MEDFORD

INSTRUCTIONS FOR EXCEL® TEMPERATURE MACRO VERSION 1.00

TABLE OF CONTENTS

PAGE

Disclaimer and Limitations

THIS VERSION OF *TEMPTURE* (VERSION 1.0) SUPERSEDES THE PREVIOUS VERSION (PRE-RELEASE VERSION 0.50). VERSION 0.50 SHOULD BE REPLACED BY THIS VERSION.

This software has been tested, and is believed to be stable. However, no testing can cover all machine configurations or input data sets. If a problem is observed, please report it to:

Andy Ullrich
DEQ-Medford
201 W. Main, Suite 2-D
Medford, OR 97501
(541) 776-6010 extension 246

Please try to record as much detail as possible as to the circumstances surrounding the problem. A copy of the data set being processed when the problem occurred will also be helpful.

Introduction

Background

Tempture is a programme to process the data files produced by automatic temperature loggers. Typically, these loggers are placed in water bodies for periods up to several months, and collect a temperature value every 15 to 30 minutes. Data from the loggers is then downloaded to a file or files on a desktop computer. This programme analyzes these data files, and summarises the information in several ways. Output from the programme can be saved to a new file for further manipulation by the user.

What's New In This Release

There are some significant enhancements to the programme compared with the previous release. These changes include:

- ***Tempture*** now reads the input data from external data files. It is no longer necessary to copy the data into a ***Tempture*** worksheet.
- ***Tempture*** can automatically process all worksheets in a given workbook (data file).
- A check is made of the input data before processing to help ensure correct data formatting.
- The user no longer needs to supply the number of days and the number of samples per day in the data set.
- Status messages have been added to a number of areas to advise the user on ***Tempture's*** progress.
- ***Tempture*** is now smaller and runs faster than the previous release.

System Requirements

Minimum System Requirements

Tempture is designed to run on an IBM-compatible computer. The computer must have *Windows 3.1* and *Microsoft Excel 5.0* loaded onto the system. *Windows* and *Excel* have their own hardware requirements. Please consult with *Microsoft* for details.

Other Platforms

Excel 4.0

Tempture was developed on *Excel 5.0*. It has not been tested on Excel 4.0. In general, however, earlier versions of a package do not run programmes developed on a later package very well, if at all. The user is cautioned that this programme may crash if it is run on Excel 4.0.

Windows 95, Excel 7.0, and Excel 97

Tempture has not been tested on any of these platforms. Forward compatibility of Microsoft products is usually quite good, however, so there is a reasonable chance that the programme will work correctly. The user is cautioned to carefully verify their results until they are sure the programme is working correctly.

Programme Installation

Tempture requires no special installation procedure. Copy the file *TEMPTURE.XLS* to your Excel subdirectory or another directory of your choice. It is now ready to use.

Data Preparation

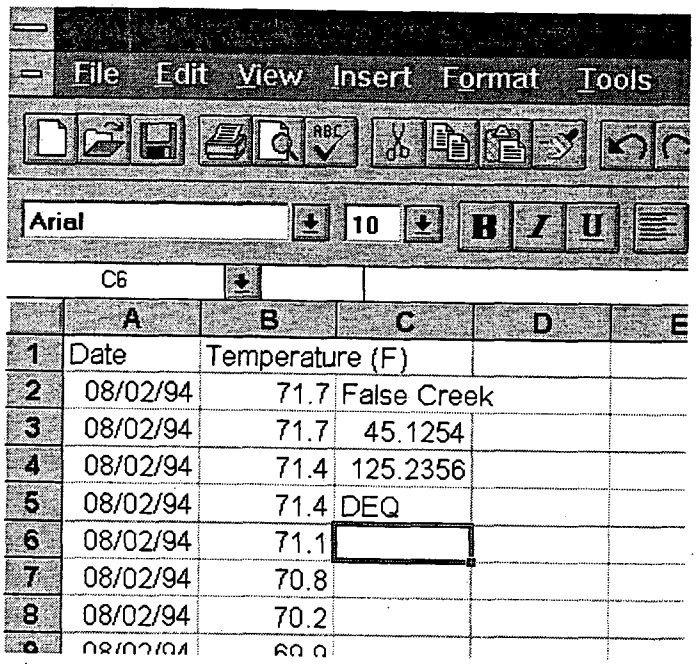
Before ***Tempture*** can be used to process the data files, the files must be properly formatted. Use the following steps to format your data:

1. Download your data files to a hard drive or floppy disc using the software supplied by your data logger manufacturer.

2. Start *Windows* and start *Excel* as you normally do.

3. Open each data file. Most likely, *Excel* will use the **File Import Wizard** to format the raw data file into an Excel format. The Wizard will take you through this process step by step.

4. Format the data as shown in **Figure One**.



	A	B	C	D	E
1	Date	Temperature (F)			
2	08/02/94	71.7	False Creek		
3	08/02/94	71.7	45.1254		
4	08/02/94	71.4	125.2356		
5	08/02/94	71.4	DEQ		
6	08/02/94	71.1			
7	08/02/94	70.8			
8	08/02/94	70.2			
9	08/02/94	69.9			

Figure One: *Required data format*

Please note the following points:

a) The data must contain data sets for **whole days only**. If there are partial days (typically at the beginning or end of the data set), those days must be deleted completely. It is also the responsibility of the user to edit out any days that do not contain valid data. Examples of days like this are days that the data logger was activated, but not actually deployed in the stream.

b) Dates must go in Column A. The dates must start on Row 2, and go sequentially down. Cell A1 should contain text identifying the column contents. **Cell A1 cannot contain a valid date.**

c) Temperature data must go in Column B. The temperatures also must start on Row 2, and be in degrees Fahrenheit (^{O}F). There must be the same number of temperature values as dates. Cell B1 should contain text identifying the column contents. **Cell B1 cannot contain a valid numeric value.**

d) (Optional, but highly recommended) The name of the site can be put in Cell C2. This name will appear on the summary sheet. Failing to put a site name in Cell C2 will make the summary sheet hard to interpret.

e) (Optional) The latitude of the site can be put in Cell C3. This value will appear on the summary sheet.

f) (Optional) The longitude of the site can be put in Cell C4. This value will appear on the summary sheet.

g) (Optional) The agency collecting the data may be put in Cell C5. This value will appear on the summary sheet.

5. Multiple data sheets can be put in the same workbook. ***Tempture*** can work through multiple data sheets in a workbook automatically. See below for more details. It is suggested that each data sheet in the workbook be given a descriptive name on the sheet tab. ***Tempture*** uses this name to display status messages while it is processing.

NOTE: *TEMPTURE* WILL NOT ACCEPT MORE THAN THIRTY-FIVE (35) DATA SHEETS IN ONE WORKBOOK.

6. The data file *must* be saved in the Excel format. It is suggested that **File -> Save As ...** be used, specifying the Excel format.

Data Processing

Overview

After the data is properly formatted, it is ready to be processed through ***Tempture***. The user can select one of two processing modes. These two modes are:

Manual Mode: This mode allows the greatest control over the data manipulation process. One data sheet in a given workbook is selected at a time. The user has the option of reviewing intermediate calculations before proceeding to the next step.

Automatic Mode: This mode allows large amounts of data to be processed rapidly. Each data sheet in the workbook is processed through the entire series of calculations without input from the user, and the results placed on the summary page. Intermediate calculations are not available for review or manipulation.

Manual Mode

Use the following steps to process data in the manual mode:

1. Start *Windows* and start *Excel.*

2. Load ***Tempture*** by using either **File -> Open** or by clicking on the "File Open" button on the toolbar.

3. The opening menu appears. There are six (6) options, and these will be described in order.

Enter Data

1. Click on this button to begin the data entry process. The user will be presented with the standard "open file" dialogue box. Select the data file you wish to process.

2. The user will then be asked to select from *Manual Mode*, *Automatic Mode*, or *Cancel and Return to Main Menu.* Select *Manual Mode* to continue, or select *Cancel...* to return to the Main Menu to select a different data file. *Automatic Mode* will be discussed below.

3. The user will then be asked to select which data sheet in the workbook is to be processed. Select the desired sheet name.

4. The selected data sheet will then be loaded and the data checked for proper formatting. If the data checks okay, the user will be returned to the Main Menu for further options. If the data does not check okay, ***Tempture*** will not load the data sheet and will indicate which test failed. The user should check the data, fix as necessary and re-run the data set. The various tests are summarised below:

   a) **Test 1:** Checks to make sure Cell A1 and B1 do NOT contain valid data. Data must start on row 2 of the data sheet.

   b) **Test 2:** Checks to make sure each column has the same number of data points, and that there is no non-numeric cells in the data columns. Failure of this test indicates that the data was not properly imported into an *Excel* workbook.

   c) **Test 3:** Checks to make sure that the number of data points can be evenly divided by the number of days. Failure of this test indicates that the data was not properly truncated from the raw data set.

d) **Test 4:** Checks to make sure that each day in the data set has the same number of data points. Each day *must* have the same number of data points to be properly processed.

Calculated daily min/max

1. After the data has passed the data check and has been loaded, click on this button to begin the actual data analysis. This option must be run before calculating the 7-day averages.

2. After the daily min/max calculations are complete, the user is presented with the min/max sheet for review. There is a button at the top of the sheet to return to the Main Menu when the review is complete.

7-Day Average Calculations

1. Clicking this button will begin the 7-day average calculations. Results will be placed on the summary sheet. If this is the first data run, a new summary sheet will be created. If a summary sheet already exists, the user will be given the following options:

   a) Delete the existing summary sheet and create a new sheet. The summary data will then be stored on the new sheet.

   b) Append the data to the existing sheet. The summary data will be appended to the end of the existing data set. Note that a maximum of 35 data sets can be stored on the summary sheet. **Attempting to store more than 35 data sets will result in unpredictable results when printing the summary sheet.**

   c) Cancel and return to the Main Menu. The 7-day calculations will not be made, and no results posted to the summary sheet. Use this option to save the existing summary sheet before either appending new data to the sheet or creating a new sheet.

2. After the 7-day calculations are complete, the user is presented with the summary sheet for review. There is a button at the top of the sheet to return to the Main Menu when the review is complete.

Once the data has been placed on the summary sheet, a new data sheet may be selected using the *Enter Data* option and repeating the above sequence. An Automatic data run may also be performed. **A maximum of 35 data sets may be placed on a given output sheet.** If more than 35 data sheets are to be processed, the summary sheet should be saved when it is full and a new sheet started.

Print Results

Clicking on this button will print the current summary sheet. This option may be used between any data runs, or at the end of all the data runs. The output will be split across two pages.

Save Worksheets

1. Clicking on this button presents the user with three options:

   a) **Save the min/max sheet:** This option will save the "min/max" data sheet from the last data run. The programme will prompt for a file name.

   b) **Save the summary sheet:** This option will save the summary sheet. The programme will prompt for a file name.

   c) **Cancel and Return:** This option will return to the Main Menu without saving any files.

   Note: Either save option can be run multiple times if the data is to be saved to a number of different files. This option can also be used between data runs, or at the end of all the data runs. As with all computer applications, it is strongly recommended to save work often.

Exit Macro

Use this button to exit from the macro when processing is complete. You must save any work with *Save Worksheets* option before exiting the macro. **No work is saved with the Exit option.**

Automatic Mode

Automatic mode can be used to process multiple data sheets in a data workbook quickly and easily. Use the following steps to process data in the automatic mode:

Enter data

1. Click on this button to begin the data entry process. The user will be presented with the standard "open file" dialogue box. Select the data file you wish to process.

2. The user will then be asked to select from *Manual Mode*, *Automatic Mode*, or *Cancel and Return to Main Menu*. Select *Automatic Mode* to continue, or select *Cancel...* to return to the Main Menu to select a different data file. *Manual Mode* is discussed above.

3. The programme will then retrieve each data sheet in the workbook, and perform the following operations:

   a) Perform a data check. If errors are found in the data sheet, the user will be alerted, and no further processing of that sheet will occur. The error messages and their possible resolution are discussed in the *Manual Mode* section, above.

   b) Calculate the daily min/max values

   c) Calculate the 7-day parameters. If a summary sheet does not exist, a new summary sheet is created. If a summary sheet already exists, the values for all the sheets in the data run may be appended to the existing sheet, or the existing sheet may be deleted and a new summary created.

   Note: No more than 35 data sets should be stored on a given summary sheet.

Print Results

Clicking on this button will print the current summary sheet. This option may be used between any data runs, or at the end of all the data runs. The output will be split across two pages.

Save Worksheets

1. Clicking on this button presents the user with three options:

   a) **Save the min/max sheet:** This option will save the "min/max" data sheet from the *last data sheet processed.* The programme will prompt for a file name. If min/max

data sheets from other data sheets in the workbook need to be saved, use the manual mode to process one data sheet at a time.

b) **Save the summary sheet:** This option will save the summary sheet. The programme will prompt for a file name.

c) **Cancel and Return:** This option will return to the Main Menu without saving any files.

Note: Either save option can be run multiple times if the data is to be saved to a number of different files. This option can also be used between data runs, or at the end of all the data runs. As with all computer applications, it is strongly recommended to save work often.

Exit Macro

Use this button to exit from the macro when processing is complete. You must save any work with *Save Worksheets* option before exiting the macro. **No work is saved with the Exit option.**

Appendix J: Supplemental Information on Cover Manufacturers

CAROLLO engineers

Route	

Interoffice Memorandum

To: Stephanie Bullock

From: Kipp Martin

Date: November 8, 1999

Subject: Basin Covers

WO#: 4862A.00

For covering rectangular and circular basins with insulating covers, you have five realistic options:

1. Aluminum flat or dome covers.
2. Fiberglass Reinforced Plastic (FRP) flat covers.
3. Cloth flat covers.
4. Wood flat covers.
5. Pre-engineered metal buildings.

Of these five, I would reject the wood covers and the pre-engineered metal building covers outright. I have seen an article about a large potable water reservoir in California that used a wood cover, but other than that, I have not seen or heard of any successful wood covers. The big problem is the life span of such a cover. I have seen wood covers on small tanks that only lasted one or two years. The wood is usually attacked by a fungus that rots the wood away. Proper selection of the wood species and pressure treatment will extend this lifetime, but I still don not like this option.

The metal building has a similar problem, except that it is corrosion not rot that does the damage. I have seen a metal building over a sedimentation basin on a potable water plant in Salt Lake City that was almost rusted away after about 5 years of use. These buildings are typically made from cold formed, light gage steel. This means that the steel thickness of the beams and columns is very thin (usually 18 to 20 gage or 0.048" to 0.036" thickness). As such, it doesn't take much to rust these sections away. The useful span of such buildings is usually about 120 feet, so larger basins would be difficult to cover.

I will now cover the first three options and give the strengths and weakness of each, along with the names of people you might contact for more information.

Aluminum Covers

Aluminum covers can take the form of flat covers for short spans or of domes and barrel vaults for longer spans. Aluminum is strong and light, and very resistant to corrosion. Flat covers are good for spans up to 25 feet. Domes and barrel vaults can span almost any reasonable distance. If flat covers are desired on basins that are wider than 25 feet, supplemental aluminum support beams or trusses can be provided. I have pictures of several installations of flat covers and domes. I have never seen flat covers insulated, but I do think that it is possible to insulate them. I have seen domes that have been insulated.

Advantages:

1. Strong and lightweight. Two men can easily remove a flat cover without any lifting equipment.
2. Corrosion resistant. No paint or other coating required. Exposed surface can be sandblasted to cut down on the sun's reflection if desired.
3. Several companies make these covers, so should get a good bid price. Carollo has used both flat covers and domes on several projects, and has good standard specifications for both.

Disadvantages:

1. Domes and barrel vaults create an enclosed environment. Over wastewater processes this could result in a hazardous entry space. This will require special equipment and procedures be used by the plant operators in order to enter this area.
2. Some people find the aesthetic to be objectionable. This is especially true with domes and truss supported flat covers.

Suppliers:

1. Temcor
   24724 S. Wilmington Ave.
   Carson, CA 90745 800-421-2263
   Contact: Doug Peterson (may have left company, but this is last name I have)
   Local Rep: EMA Marketing, 541-929-2277, Mike Gregg

2. Conservatek
   498 Loop 336 East
   P. O. Box 1678
   Conroe, TX 77305 409-539-1747
   Contact: Jerry Watson

3. Thermacon Enviro Covertite Systems
   111 West 40th Street
   New York City, NY 10018 212-704-2111

Fiberglass Reinforced Plastic

FRP covers will most likely take the form of flat covers made from FRP structural shapes and

corrugated deck. Useful spans of FRP components are generally less than similar sized aluminum products, on the order of 4 to 6 feet for decking and 10 to 15 feet for structural shapes. With the proper resin selection, FRP is extremely corrosion resistant. It is susceptible to UV degradation. FRP manufacturers now use various resin and surface veil combinations to improve UV performance, but it will be years before it can be seen if these measures work in the field. I have never heard of FRP covers being insulated, but it should not be hard to do.

Advantages:

1. Strong and lightweight.
2. Extremely corrosion resistant

Disadvantages:

1. Very flexible. Span lengths usually limited by deflection, not strength.
2. May weaken in sunlight (UV degradation).

Suppliers:

1. Enduro Composite Systems Tuff Span
   7100 Old Katy Rd.
   Houston, TX 77024-2112 800-231-7271
   Contact: Marvin Smith (Old name, may also be responsible for another geographic area.)

Structural Fabric

Structural fabric covers are less widely used. The manufacturers claim that they can support the same live loads as aluminum covers. I have a picture of one of these covers supporting over 30" of snow. I do not think span length could be much more than 5 feet without supplemental support such as aluminum trusses. The covers can be manufactured with zippered doors at weirs and baffles or other areas that need access. The covers are very light weight and are supposed to be easy to remove. I do not know if they can be insulated.

Advantages:

1. Light weight. Easy to remove.
2. Can be provided with easy access to area underneath.

Disadvantages:

1. Short spans require supplemental supports.
2. Difficult to insulate?

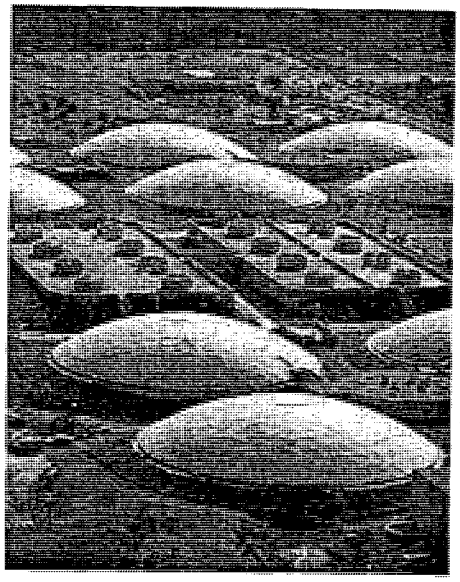
Suppliers:

1. ILC Dover Vapor Guard
   One Moonwalker Road (They also make space suites for astronauts)
   Frederica, DE 19946 800-631-9567

TEMCOR

24724 S. Wilmington Avenue, Carson, CA 90745
Tel: (310) 549-4311 or (800) 421-2263 *within US*
E-mail Us!

Dome Covers



Strength and Versatility Through Timeless Geometry

The Temcor Aluminum Dome's clear span design and integral tension ring eliminates the need for roof columns and extensive reinforcement of tank walls. And its triangulated space truss system of wide-flange extrusions skinned with triangular panels makes it flexible enough for any operational need. Panels can be removed at will, the entire dome can be removed when required, and features such as doors, vents, hatches and skylight panels are easily installed.

Protecting Resources and the Environment

Water, waste water plants, and storage facilities are increasingly turning to the Temcor Aluminum Dome advantage.

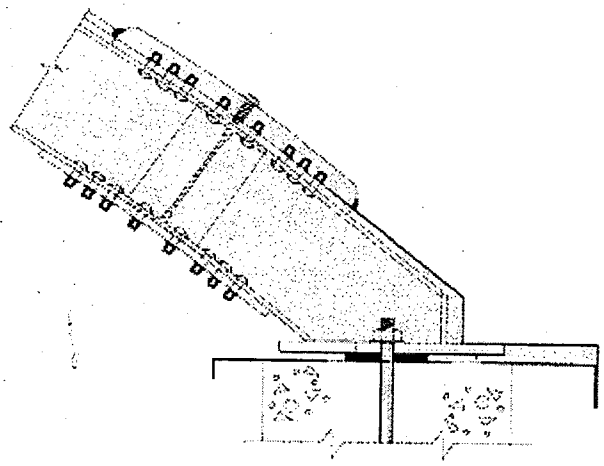
In addition to low maintenance, low cost and low profile advantages, Temcor Aluminum Domes are versatile enough to permit a wide range of accessories important to the water and waste water industry.

And it's the dome's design that gives it many of its advantages. Using proprietary variations of geodesic geometry, Temcor Aluminum Domes are noted for their ability to meet exacting live load requirements by providing greater stiffness and strength, pound-for-pound, then any other dome geometry system.

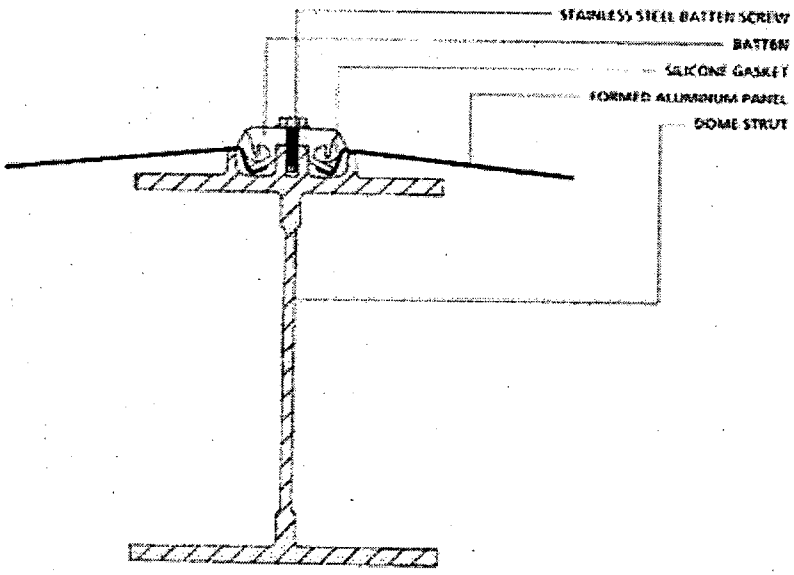
Temcor domes have been designed for snow loads up to 165 pounds per square foot and windloads of up to 150 mph. And Temcor's panel design is specifically engineered to support loads of up to 500 pounds on any one square foot. Yet, Temcor domes weigh a mere five percent of conventional concrete equivalents.

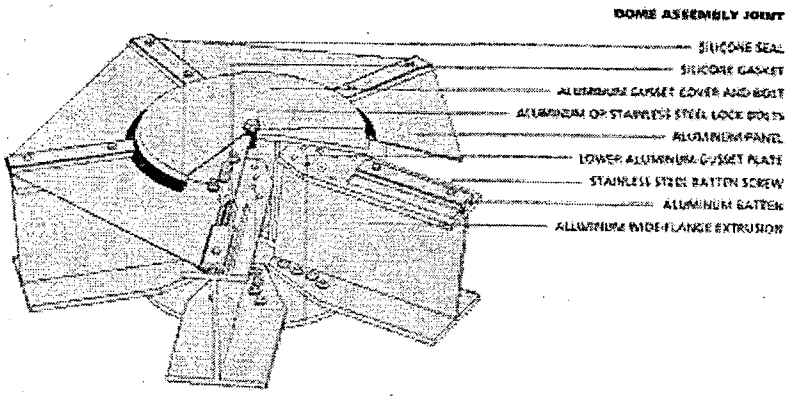
Temcor domes promote process efficiency in cold climates, and they can't be beat for containment of odors and vapors. In fact, their low profile reduces vapor space. And their all-aluminum construction is completely resistant to hydrogen sulfide, chlorine and other corrosive vapors found in water and waste water treatment plants.

DOME ATTACHMENT TO CONCRETE TANK



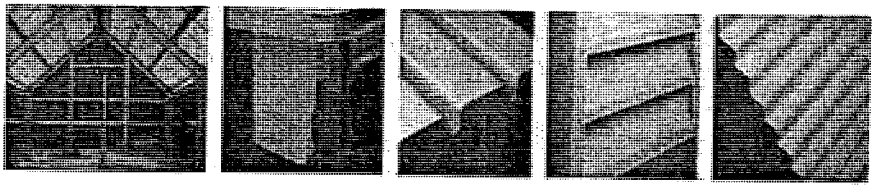
PATENTED PANEL CONNECTION JOINT



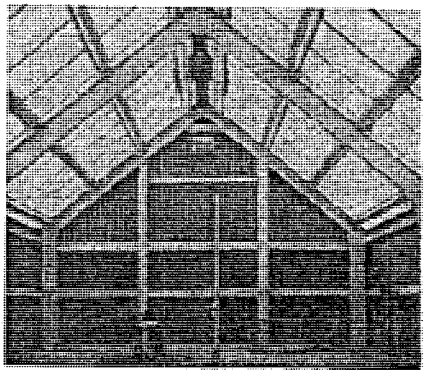

DOME ASSEMBLY JOINT
SILICONE SEAL
SILICONE GASKET
ALUMINUM GASKET COVER AND BOLT
ALUMINUM OR STAINLESS STEEL LOCK BOLTS
ALUMINUM PANEL
LOWER ALUMINUM GUSSET PLATE
STAINLESS STEEL BATTEN SCREW
ALUMINUM BATTEN
ALUMINUM WIDE-FLANGE EXTRUSION

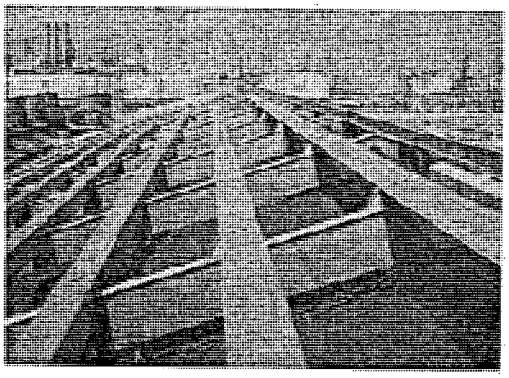
AN ESI DIVISION
Enduro
COMPOSITE SYSTEMS

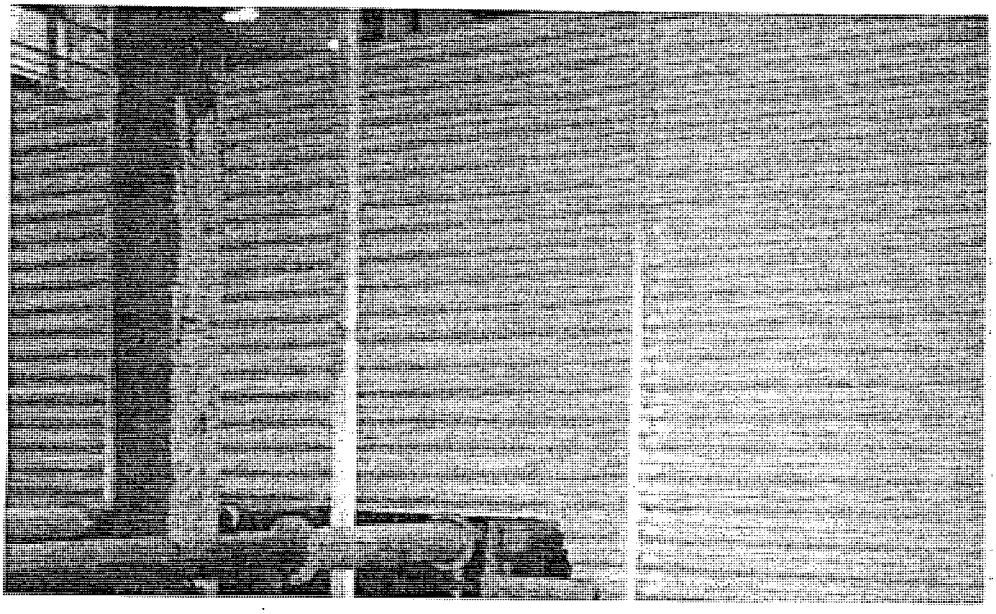
Roof & Wall

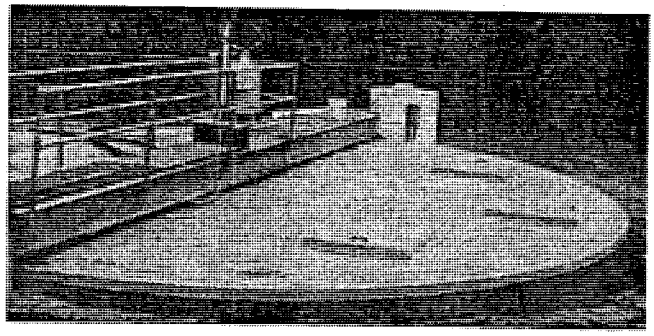


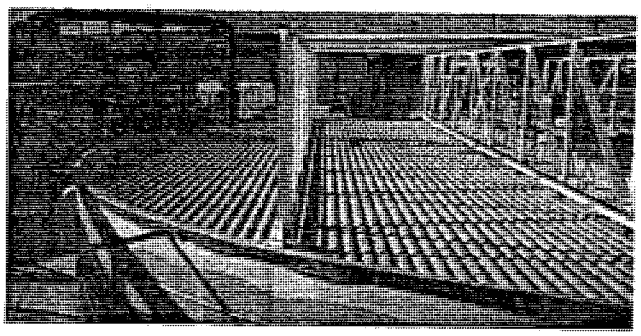
Enduro Products
Velcon Products
Vesca Products
Cable Tray
Strut
Lay-in Wireway
Stands
Roof & Wall
Grating
Flooring











Tuff Span - Fiberglass Roof and Wall Products

- **Roof & Wall Systems**
- **Insulated Wall/Roof Systems**
- **Roof Deck**
- **Structural Systems**
- **Louvers (fixed & op.)**
- **Ridge Vents (fixed & op.)**
- **Gutter Systems**
- **Tank Cover Systems**
- **Baffles**
- **Pre-Engineered Structures**

Tuff Span panels are absolutely the best building panels for harsh environments. Made for premium isophthalic and vinylester resins, these panels provide unmatched strength and corrosion resistance and will far outlast conventional materials. **Tuff Span** panels are one-to one replacements for metal, concrete and cement asbestos panels. They are made in a variety of profiles to match existing panel shapes. Various standard and custom colors are available, light translucency is optional.

Applications

- Any industry, new or existing structures, with a corrosive environment.
- Pulp and Paper
- Chemical
- Galvanizing/Plating
- Asbestos Replacement
- Rendering
- Aluminum Processing
- Water/Waste Treatment
- Food and Beverage
- Cement Plants
- Salt and Mining
- Agri-Chem
- Power Plants

Key Benefits

- **Cost Effective**--Extremely long life compared to metal & other plastics-with no maintenance.
- **Corrosion Resistance**--No rusting, peeling or flaking-even under the most aggressive conditions.
- **High Strength & Stiffness**- As provided by high glass content (47%) gives exceptional protection against leaks & blow-offs.
- **Superior Weatherability**--Tuff Span's four part UV protection system gives long term protection. Panels are impact resistant, too.
- **Fire Retardant**--ASTM E-84 Class 1 - FM and UL listed panels available.
- **Non-Conductive & Non-Interfering**--Also transparent to radio waves and non-magnetic.
- **Improved Facility Condition**--A long term answer for building appearance. Optional translucent panels can allow interior daylighting.
- **Lightweight**--Ease of handling make for a low cost installation.

Information Request Form

Select the items that apply, and then let us know how to contact you.

- [x] Send product literature
- [ ] Send company literature
- [ ] Have a salesperson contact me

POLLUTION ONLINE.COM
HOME

Visit Other Pollution Online Features:

site MAP

today's NEWS

buyer's GUIDE

online AUCTION

Manufacturer of

high technology

inflatables

chemical protective

clothing

equipment

shelters

WELCOME TO THE STOREFRONT OF...

ILC DOVER INC

PROTECTING MAN & HIS ENVIRONMENT

ILC Dover, Inc.

One Moonwalker Road
Frederica, Delaware 19946
United States
Phone: 800-6319567 (Ext. 486)
Fax: 302-335-1320
Contact: Debby Sokolovich

Keywords

Covers, Flat
Covers, Low Profile
Covers, Odor Control
Odor Containment Covers
Structural Fabric Cover
Vapor Guard

Products

Cisterns And Related Products

Tank Covers

Reservoirs, Lagoons And Related Storage

Covers, air/tension supported

Covers, floating

Water/Wastewater Process Systems/Equipment

Clarifiers & accessories

Digester covers

Odor control devices

Back to ILC Dover, Inc. Storefront

VerticalNet

Appendix K:
Oregon Regulations Pertaining to the Use of Reclaimed Water from Sewage Treatment Plants (OAR 340-55)

OREGON ADMINISTRATIVE RULES

CHAPTER 340. DEPARTMENT OF ENVIRONMENTAL QUALITY

MUNICIPAL WASTE WATER TREATMENT WORKS CONSTRUCTION GRANTS PROGRAM

DIVISION 55. REGULATIONS PERTAINING TO THE USE OF RECLAIMED WATER (TREATED EFFLUENT) FROM SEWAGE TREATMENT PLANTS

Current through April 30, 1996.

340-55-005 Purpose

The purpose of these rules is to protect the environment and public health in Oregon by prescribing the methods, procedures and restrictions required for the use for beneficial purposes of reclaimed waters.

Stat. Auth.: ORS 468.020, 468.705 & 468.710

Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-007 Policy

It is the policy of the Environmental Quality Commission to encourage the use of reclaimed waters for beneficial purposes using methods that assure that the health of Oregonians and the environment of the state are protected. Proper use of reclaimed waters for beneficial purposes enhances water quality by reducing discharges of treated effluents to surface waters and by conserving stream flows through reduced demand for withdrawals for out-of-stream use.

Stat. Auth.: ORS 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-010 Definitions

(1) "Sewage" means water-carried human wastes, including kitchen, bath and laundry waste from residences, buildings, industrial and commercial establishments, or other places, together with such groundwater infiltration, surface waters, or industrial wastewater as may be present.

(2) "Industrial Wastewater" means any liquid, gaseous, radioactive, or solid waste substance or a combination thereof resulting from any process of industry, manufacturing, trade, or business, or from the development or recovery of any natural resources.

(3) "Sewage Treatment System" means any facility or equipment used to alter the quality of sewage by physical, chemical or biological means or a combination thereof such that the tendency of said wastewater to cause any degradation in water quality or other environmental conditions is reduced.

(4) "Sewage Treatment System Owner" is any person who owns a sewage treatment system that provides reclaimed water for use.

(5) "Person" means the United States and agencies thereof, any state, any individual, public or private corporation, political subdivision, governmental agency, municipality, copartnership, association, firm, trust estate, or any other legal entity whatever.

(6) "NPDES Permit" means a waste discharge permit as defined in Oregon Administrative Rules Chapter 340, Division 45.

(7) "WPCF Permit" means a Water Pollution Control Facilities permit as defined in OAR Chapter 340, Division 45.

(8) "Reclaimed Water" means treated effluent from a sewage treatment system which, as a result of treatment, is suitable for a direct beneficial purpose or a controlled use that could not otherwise occur.

(9) "User" means any person who uses reclaimed water.

(10) "Oxidized Wastewater" means treated sewage in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen.

(11) "Biological Treatment" means methods of sewage treatment in which bacterial or biochemical action is promoted as a means of producing an oxidized wastewater.

(12) "Clarification" means the removal by gravity of settleable solids remaining in the effluent after the biological treatment or after flocculation as part of the coagulation process.

(13) "Coagulation" means a treatment process applied to oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated by the addition of suitable floc-forming chemicals or by an equally effective method.

(14) "Filtration" means a treatment process applied to oxidized, coagulated, clarified wastewater which has been passed through natural undisturbed soils or filter media, such as sand or diatomaceous earth, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 turbidity units and does not exceed 5 turbidity units more

than 5 percent of the time during any 24-hour period.

(15) "Disinfection" means a treatment process in which the pathogenic organisms have been destroyed or reduced to very low levels by chemical, physical or biological means. Disinfection is deemed to have occurred when total coliform and (where appropriate) turbidity limitations have been continuously met for the specific uses cited in Table 1.

(16) "Beneficial Purposes" means a purpose where the resource values of the reclaimed waters, such as but not limited to its nutrient or moisture value, are utilized for enhanced productivity or water conservation by the user.

(17) "Restricted Impoundment" means a body of reclaimed water in which recreation is limited to fishing, boating, and other non-body-contact water recreation activities. Restricted impoundments constructed and operated pursuant to these rules shall be considered part of a sewage treatment system and not waters of the state for water quality purposes.

(18) "Nonrestricted Impoundment" means a body of reclaimed water in which no limitations are imposed on body-contact water recreation activities. Nonrestricted impoundments constructed and operated pursuant to these rules shall be considered part of a sewage treatment system and not waters of the state for water quality purposes.

(19) "Landscape Impoundment" is a body of reclaimed water which is used for aesthetic enjoyment or which otherwise serves a function not intended to include public contact through such activities as boating, fishing, or body-contact recreation. Landscape impoundments constructed and operated pursuant to these rules shall be considered part of a sewage treatment system and not waters of the state for water quality purposes.

(20) "Potable Water Supply System" means a water supply system used to provide water for human consumption.

(21) "Controlled Use" means a use of reclaimed water for which the sewage treatment plant owner, either directly or through a written contract, has reasonable knowledge of the use and fate of the reclaimed water and is able to discontinue the use of the reclaimed water if it is determined that the requirements of the rules and the permit authorizing use of reclaimed water are not being met.

(22) "Processed Food Crops" means those crops which undergo thermoprocessing sufficient to kill spores of Clostridium botulinum. Washing, pickling, fermenting, milling or chemical treatments are not sufficient.

Stat. Auth.: ORS 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-013 Exemptions

Reclaimed water used at the treatment plant site where it is generated shall be exempt from these rules provided:

(1) The reclaimed water that is used is disinfected, oxidized wastewater; and

(2) Reclaimed water that is used for landscape irrigation shall be confined to the treatment plant site. No spray or drift shall be allowed off the treatment plant site. The treatment plant site shall not include property that is not contiguous to the parcel of land upon which the treatment plant is located.

Stat. Auth.: ORS 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-015 General Requirements for Use of Reclaimed Water

(1) No sewage treatment system owner shall release any reclaimed water for use unless so authorized by a WPCF or NPDES permit issued by the Department. Any application for a WPCF or NPDES permit that proposes to use reclaimed water shall provide sufficient information as necessary to evaluate and determine compliance with this Division.

(2) Except for use of reclaimed water already authorized by permit by the Department, no sewage treatment system owner shall release any reclaimed water for use until a reclaimed water use plan meeting the requirements of OAR 340-55-025 has been approved in writing by the Department. Before approving any plan, the Department shall submit the proposed plan to the Health Division for comment. For uses of reclaimed water already permitted, but for which no reclaimed water use plan has been approved, the sewage treatment system owner shall submit a reclaimed water use plan to the Department when requested in writing by the Department.

(3) Where the rules of this Division require limitations and conditions that are different or more stringent than conditions in existing permits, the existing permit limitations and conditions shall control until such time as the Department chooses to change the permit limitations and conditions through permit modification or renewal. When the Department does choose to change existing permit limitations and conditions to conform to these rules, the permittee shall be given a reasonable compliance schedule for achieving more stringent requirements. The compliance schedule shall be inserted in the permit at the time the permit is renewed or modified.

(4) Reclaimed water from sewage treatment systems used for agricultural and nonagricultural uses listed in Table 1 of this Division shall comply with the associated effluent quality limitations and the treatment, monitoring and other requirements for that use that are stated in Table 1:

(a) Where Table 1, for specified uses, requires that reclaimed water receive biological, coagulation, clarification, filtration treatment plus disinfection, the Department will consider treatment processes that do not utilize coagulation provided that equivalent effluent quality to that achieved with coagulation can be demonstrated. The Department shall consult with the Oregon Health Division when considering alternative treatment processes allowed for under this section;

(b) The Department may include additional permit effluent limitations and/or other permit conditions other than those required by Table 1 if it determines or has reason to believe that the reclaimed water may contain physical or chemical contaminants that would impose potential hazards to public health or the environment or cause detrimental effects on an allowed use;

(c) In cases where chlorine or chlorine compounds are used as the disinfecting agent, the Department may specify in the permit a minimum chlorine residual concentration to be met after a minimum contact time. In cases where other disinfecting agents are used, the Department may require other additional monitoring requirements that will assure adequate disinfection. The Department may consult with the Health Division before allowing disinfection agents other than chlorine or chlorine compounds;

(d) (A) The Department may reduce the buffer distances required in Table 1 if it determines that alternative controls as specified in the permit will adequately protect public health and the environment. Alternative controls may be, but are not limited to, valves that are activated by wind speed or direction, low trajectory sprinklers or remoteness of the site to incompatible uses;

(B) Buffers for uses in Table 1 for Level I effluent shall be specified in the permit and shall be based on a determination that aerosols will be adequately controlled so as to protect public health;

(C) The Department may consult with the Health Division before establishing buffer distances other than those specifically cited in Table 1.

(5) Reclaimed water from sewage treatment systems shall be considered adequately treated and disinfected if, at the end of the treatment process, the bacterial and turbidity limitations for the use of reclaimed water as specified in Table 1 are met. The sampling point for monitoring compliance with water quality limitations shall be specified in the permit.

(6) By permit, reclaimed water for a use not specified in Table 1 may be authorized. In considering such authorization, the Department may request information and shall impose such effluent limitations as deemed necessary to assure protection of public health and the environment. Before the Department shall authorize uses of reclaimed water under this section of the rule, written concurrence from the Oregon Health Division shall be obtained.

(7) A person using reclaimed water from a sewage treatment system may provide additional treatment for a more restrictive reuse as allowed under Table 1 of this Division. Under such conditions, the sewage treatment system owner providing the additional treatment is subject to the same requirements as other sewage treatment system owners releasing wastewater for reuse and its owner shall have a WPCF or NPDES permit issued by the Department.

(8) The Department may consider the effects of blending reclaimed water with other waters if proposed by the owner of a sewage treatment system. In cases where blending of reclaimed water is provided, the sewage treatment system owner shall submit to the Department, at a minimum, a plan of operation, a description of any additional treatment process, blending volumes, and a range of final quality at the point of use. Reclaimed water receiving less than secondary treatment and disinfection shall not be blended for uses requiring a higher level of treatment and disinfection.

(9) The sewage treatment system owner shall be solely responsible and liable to the Department for meeting the requirements of these rules and the sewage treatment system owner's permit for any and all water that passes through the owner's treatment plant. Any reclaimed water released for use on property not under the direct control of the sewage treatment system owner shall be allowed only if there is a legally enforceable contract between the treatment plant owner and the user. The contract shall set forth as a minimum:

(a) The quality and maximum quantity of wastewater to be released for use by the sewage treatment system;

(b) The specific use(s) for which the reclaimed water will be used by the user;

(c) The maximum quantity of reclaimed water that shall be used on an annual basis;

(d) A condition that the direct release of any reclaimed water to surface waters of the State of Oregon shall be prohibited;

(e) A statement specifying the parties in the contract responsible for compliance with these rules and the sewage treatment system permit;

(f) A provision allowing the sewage treatment system owner to cease providing reclaimed water if the Department or the owner determine that the requirements of this Division are not being met;

(g) A condition that requires the user of reclaimed water to report to the sewage treatment plant owner any and all violations of the terms of these rules or the contract.

(10) In cases where reclaimed water is transferred from one user to another, each succession of ownership of the reclaimed water shall be governed by a legally enforceable contract on file with the owner of the sewage treatment system and which notifies the succeeding reclaimed water user of the requirements of this Division and the permit for the sewage treatment system. The contract shall also require the succeeding user to so contract with any additional succeeding reclaimed water users.

(11) The use of reclaimed water from a sewage treatment system for direct human consumption, regardless of the level of treatment, is prohibited unless, after public hearing and with the written concurrence of the Oregon Health Division, it is so authorized by the Environmental Quality Commission.

(12) The monitoring requirements specified in any permit that authorizes use of reclaimed water shall, at a minimum, meet the requirements listed in Table 1 of this Division. Effluent and other data required by a permit authorizing use of reclaimed water from sewage treatment plants shall be submitted to the Department each month.

(13) A permit authorizing use of reclaimed water from sewage treatment plants shall require reporting of noncompliance with this Division and the sewage treatment system owner's permit within 24 hours of when the permittee becomes aware of an incident of noncompliance. If the permittee becomes aware of the incident of noncompliance when the Department is not open, the incident shall be reported to Oregon Emergency Response System (Telephone Number 1-800-452-3011).

Stat. Auth.: ORS Ch. 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-015 TABLE 1 (OAR 340-55-015)

TREATMENT AND MONITORING REQUIREMENTS FOR USE OF RECLAIMED WATER

NOTE: This table specifies the allowable beneficial purposes for various levels of quality of reclaimed water. If reclaimed water is to be applied to a specific beneficial purpose, all requirements--except advisory notices, but including footnotes, listed for

that level of reclaimed water and use must be met.

CATEGORY	Level I	Level II	Level III	Level IV
Biological Treatment	X	X	X	X
Disinfection		X	X	X
Clarification				X
Coagulation				X
Filtration				X
Total Coliform (organisms/100 ml): Two Consecutive Samples	N/L	240	N/L	N/L
7-Day Median	N/L	23	2.2	2.2
Maximum	N/L	N/L	23	23
Sampling Frequency	N/R	1 per week	3 per week	1 per day
Turbidity (NTU):				
24-Hour Mean	N/L	N/L	N/L	2
5% of Time During a 24-Hour Period	N/L	N/L	N/L	5
Sampling Frequency	Hourly			

GENERAL

Public Access	Prevented (signs, gates, locks)	Controlled (signs, rural or nonpublic lands)	Controlled public rural or nonpublic lands)	No direct (fences contact irrigation cycle

(Numbers in the Table Refer to Footnotes)

Buffers for Irrigation:	Surface: 10 ft. Spray: site specific	Surface: 10 ft. Spray: 70 ft.	10 ft.	None required
Agricultural:				
Food Crops	N/A	N/A	N/A	Unrestricted
Processed Food Crops	N/A	1	1	Unrestricted
Orchards and Vineyards	N/A	2	2	Unrestricted
Fodder, Fiber, and Seed Crops not for Human Ingestion	3	1	1	Unrestricted
Pasture for Animals	N/A	4	4	Unrestricted
Sod	N/A	1	1	Unrestricted
Ornamental Nursery	N/A	1	1	Unrestricted
Stock Christmas Trees	N/A	1	1	Unrestricted
Firewood	N/A	1	1	Unrestricted
Commercial Timber	3	1	1	Unrestricted
Parks, Playgrounds, Schoolyards, Golf Courses with Contiguous Residences	N/A	N/A	N/A	5, 6
Golf Courses without Contiguous Residences	N/A	5, 7	5, 7	5, 6
Cemeteries, Highway Medians, Land-				

scapes without Frequent Public Access	N/A	5, 7,	5, 7	5, 6
Industrial or Commercial Use	N/A	9, 10 11, 12	9 9, 10 10, 11, 12 12	
Construction Use	N/A	9, 10, 11, 12, 13	9, 9, 10, 10, 11, 12, 12, 13 13	
Impoundments:				
Unrestricted	N/A	N/A	N/A	8,10
Restricted	N/A	N/A	8, 8, 10, 10 14	
Landscape Impoundments	N/A	8, 10, 14	8, 8, 10, 10 14	

FOOTNOTES:

1 Advisory Notice Only: The Oregon State Health Division recommends that there should be no irrigation of this level of effluent for 3 days prior to harvesting.

2 Surface irrigation where edible portion of crop does not contact the ground, and fruit or nuts shall not be harvested off the ground.

3 The Department may permit spraying if it can be demonstrated that public health and the environment will be adequately protected from aerosols. Advisory Notice Only: The Oregon State Health Division recommends that there should be no irrigation of this level of effluent for 30 days prior to harvesting.

4 Surface or spray irrigation: No animals shall be on the pasture during irrigation.

5 Signs shall be posted around the perimeter of the facility's perimeter and other locations indicating that reclaimed water is used for irrigation and is not safe for drinking, and in the case of effluent quality Levels II and III for body contact (e.g., for Level IV, ATTENTION: RECLAIMED WATER USED FOR IRRIGATION--DO NOT DRINK • ATENCION: RECLAMADO DESPERDICIO DE AGUA USADO PARA LA IRRIGACION. NO BEBA EL AGUA; for Levels II and III, ATTENTION; RECLAIMED WATER USED FOR IRRIGATION--AVOID CONTACT--DO NOT DRINK • ATENCION: RECLAMADO DESPERDICIO DE AGUA USADO PARA LA IRRIGACION--EVITE EL CONTACTO--NO BEBA EL AGUA).

6 Reclaimed water shall be applied in a manner so that it is not sprayed onto areas where food is prepared or served or onto drinking fountains.

7 Reclaimed water shall be applied in a manner so that it is not sprayed within 100 feet

from areas where food is prepared or served or where drinking fountains are located.

8 Signs shall be posted around the perimeter and other locations indicating that reclaimed water is used and is not safe for drinking, and in the case of effluent quality Levels II and III for body contact (e.g., for Level IV, ATTENTION: RECLAIMED WATER--DO NOT DRINK • ATENCION: RECLAMADO DESPERIDICIO DE AGUA--NO BEBA EL AGUA; for Levels II and III, ATTENTION: RECLAIMED WATER--AVOID CONTACT--DO NOT DRINK • ATENCION: RECLAMADO DESPERDICIO DE AGUA--EVITE EL CONTACTO--NO BEBA EL AGUA).

9 The Department may impose more stringent limits on the use of reclaimed water if it believes it is necessary to protect public health and the environment.

10 There shall be no disposal of reclaimed waters into surface or groundwaters without authorization by an NPDES or WPCF permit.

11 Use of reclaimed water in evaporative cooling systems shall be approved only if the user can demonstrate that aerosols will not present a hazard to public health.

12 Members of the public and employed personnel at the site of the use or reclaimed water shall be notified that the water is reclaimed water. Provisions for how this notification will be provided shall be specified in the reclaimed water use plan.

13 Unless decontaminated in a manner approved in writing by the Oregon Health Division, tanker trucks or trailers that transport and/or use reclaimed water shall not be used to transport potable water intended for use as domestic water. A tanker truck or trailer used to transport and/or use reclaimed water shall have the words "NONPOTABLE WATER" written in 6-inch high letters on each side and the rear of the truck. The words "NONPOTABLE WATER" shall not be removed until decontamination as approved by the Health Division has occurred.

14 Aerators or decorative fixtures which may generate aerosols shall not be used unless approved in writing by the Department. Approval will be considered if it can be demonstrated that aerosols will be confined to the area of the impoundment or a restricted area around the impoundment.

DEFINITIONS:

Surface: Surface irrigation where application of reclaimed water is by means other than spraying such that contact between the edible portion of any food crop and reclaimed water is prevented.

Spray: Spray irrigation where application of reclaimed water to crops is by spraying it from orifices in piping.

Processed Food Crops: Those which undergo thermoprocessing sufficient to ki ll

spores of Clostridium botulinum. Washing, pickling, fermenting, milling or chemical treatments are not sufficient.

N/A: This level of reclaimed water not allowed for this use.

N/L: No limit

X: Required treatment for this treatment level.

N/R: Not required. ADVISORY NOTICE ONLY:

The Oregon State Health Division recommends that persons who who must handle irrigation or other equipment for reclaimed wastewater or who are exposed to reclaimed water should be fully advised of any hazards associated with such exposure and should be provided with necessary protective clothing.

340-55-020 Groundwater Protection Requirements

No reclaimed water shall be authorized for use unless all requirements for groundwater protection established in OAR Chapter 340, Division 40 are satisfied. OAR Chapter 340, Division 40 shall be considered satisfied by the Department if the sewage treatment system owner demonstrates that reclaimed water will not be used in a manner or applied at rates that cause contaminants to be leached into the groundwater in quantities that will adversely affect groundwater quality.

Stat. Auth.: ORS Ch. 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-025 Reclaimed Water Use Plan

Reclaimed water use plans shall demonstrate how the sewage treatment system owner will comply with these rules and shall meet the following minimum requirements:

(1) The plan shall contain a description of the design of the proposed reclamation system and shall clearly indicate the means for compliance with these regulations.

(2) No reclaimed water use plan submittal shall be deemed complete for review by the Department unless the submittal includes three complete copies of the proposed plan.

Stat. Auth.: ORS Ch. 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

340-55-030 Other Requirements for Use of Reclaimed Water

(1) No bypassing shall be allowed of untreated or inadequately treated water from the sewage treatment system or from any intermediate unit processes to the point of use.

(2) Alarm devices shall be provided as necessary to provide warning of loss of power and/or failure of process equipment essential to the proper operation of the sewage treatment system and to compliance with this Division.

(3) Unless otherwise approved in writing by the Department, sewage treatment systems providing reclaimed water for use shall have standby power facilities of sufficient capacity to fully operate all essential treatment processes. The Department may grant an exception to this section only if the sewage treatment system owner demonstrates that power failure will not result in inadequately treated water being released for use and will not result in any violation of an NPDES or WPCF permit limit or condition or Oregon Administrative Rule.

(4) Sewage treatment systems that provide reclaimed water for use shall contain sufficient level of redundant treatment facilities and monitoring equipment to effectively prevent inadequately treated water from being used or discharged to public waters.

(5) Unless otherwise approved in writing by the Department, all piping, valves, and other portions of the reclaimed water use system shall be constructed and marked in a manner to prevent cross-connection with potable water systems. Unless otherwise approved in writing by the Department, construction and marking shall be consistent with sections (2), (3), (4), and (5) of the Final Draft of the "Guidelines for Distribution of Nonpotable Water" of the California-Nevada Section of the American Water Works Association, as revised September 14,

1983. The Department may allow exceptions for existing systems in rural areas where it can be demonstrated that both private and public domestic water systems are more than 100 feet from any component of the system using reclaimed water.

(6) There shall be no connection between any potable water supply system and the distribution system carrying reclaimed water unless the connection is through either an unrestricted air gap at least twice as wide as the diameter of the potable water discharge, or a reduced pressure principle back flow preventor (RPP) which is tested and serviced professionally at least once per year.

(7) Every NPDES or WPCF permit that authorizes use of reclaimed water shall include a requirement that the sewage treatment system operator submit at least an annual report to the Department describing the effectiveness of the system to comply with the approved reclaimed water use plan, the rules of this Division, and permit limits and conditions.

(8) No reclaimed water shall be made available to a person proposing to use reclaimed water unless that person certifies in writing that they have read and understand the provisions in these rules. This written certification shall be kept on file by the sewage treatment system owner and be made available to the Department for inspection upon request.

(9) Compliance with these rules shall not create a water right under ORS Chapters 536, 537, 539 or 540.

[Publications: The publication(s) referred to or incorporated by reference in this rule are available from the Department of Environmental Quality.]

Stat. Auth.: ORS Ch. 468.020, 468.705 & 468.710
Hist.: DEQ 32-1990, f. & cert. ef. 8-15-90

Appendix L: Temperature Management Plan Template

Temperature Management Plan

{NOTE TO PLAN PREPARER:
This template can be used for preparing a temperature management plan for approval from Oregon Department of Environmental Quality. The Plan Preparer should fill in appropriate information at_____.

Instructions for filling in the information will be located in { } s throughout the template. These sections should be deleted as you fill in the document. }

I. Introduction

This Temperature Management Plan is prepared In accordance with the 1996 Oregon Temperature Standard. This plan will become part of our National Pollutant Discharge Elimination System (NPDES) permit once approved. This plan is required for the following reasons:

{Check all that apply}

- ☐ Discharge is to a stream that is water quality-limited
- ☐ Heat is contributed to the stream above a water quality-limited stream segment
- ☐ The discharge has a measurable impact outside of the assigned mixing zone
- ☐ There are endangered fish present
- ☐ Discharge is to a lake
- ☐ Receiving stream violates standard for dissolved oxygen
- ☐ Mixing zone impairs a cold-water refugia for fish

Included in this plan is background information on the POTW and receiving water, temperature monitoring data, results of modeling/mixing zone analysis, information on BMPs evaluated, and descriptions of temperature management activities to be undertaken.

II. Treatment Plant General Information

The following section contains general information on the POTW.

{This information can be found on the front page of the NPDES Permit}

Applicant Name _____

Treatment Plant Name and Location _____

Permit Number _____

File Number

Treatment Plant Type _____

Street Address _____

City _____ Zip Code _____ County _____

Phone Number _____

Map of Treatment Plant location included? Yes ____ No ____

III. Treatment Plant Description

Flow

Design Average Dry Weather Flow,(mgd) _____

Population Served, (1000s people) _____

Liquid Stream Processes

{Check all that apply}

Preliminary/Primary Treatment

- Influent Pumping ☐
- Grit Basins ☐
- Degritted Primary Sludge ☐
- Mechanical Bar Screens ☐
- Barminutors ☐
- Comminutors ☐
- Primary Clarifiers ☐
- Other _____, ☐

Secondary Treatment

- Activated Sludge ☐
- Trickling Filters ☐
- Trickling Filter Solids Contact ☐
- Trickling Filter/Activated Sludge ☐
- Facultative Lagoons ☐
- Aerated Lagoons ☐
- Secondary Clarifiers ☐
- Other _____, ☐

Tertiary Treatment & Nutrient Removal

- Effluent Filters ☐
- Tertiary Clarification or Flocculation ☐
- Nitrification ☐
- Nitrogen Removal ☐
- Phosphorus Removal
  - Biological Removal ☐
  - Chemical Addition ☐
- Other _____, ☐

Disinfection

- Chlorine/Hypochlorite Contact ☐
- Ultraviolet (UV) ☐

Outfall

- Submerged ☐
- Submerged with Diffuser ☐
- Streambank ☐

Schematic of Treatment Plant Included? Yes ____ No ____

IV. Receiving Water and Outfall Information

{Much of this information can be found on the first page of the NPDES permit, latitude and longitude can be taken from maps or using GPS.}

Basin: _____

Sub-Basin: _____

Receiving Stream: _____

Hydro Code: _____

Outfall Location & Description _____

Coordinates (latitude, longitude): _____

V. Potentially Impacted Beneficial Uses

I. Are Threatened or Endangered salmonid species found in the receiving water?

Yes _____ No _____

List Threatened or Endangered Salmonid Species Present
1. _____
2. _____
3. _____
4. _____

II. Are Bull Trout found in the receiving water? Yes _____ No _____

III. The following salmonid spawning, egg incubation, fry emergence, and rearing activities occur in the receiving water:

Salmonid Species	Spawning		Incubation		Fry Emerge		Rearing		Location
	Start	End	Start	End	Start	End	Start	End	

VI. Applicable Receiving Water Criteria

{If a TMDL for temperature has been developed for the receiving water, DEQ may have established site specific temperature criteria as part of the TMDL development. In the absence of site specific temperature criteria, the following criteria would apply. The suitability of these criteria should be confirmed with DEQ prior to finalization of the plan.}

Fish Activity	Applicable Temperature Standard		Time Period
In a basin for which salmonid fish rearing is a designated beneficial use	64°F	□	
In waters and during periods of the year to support native salmonid spawning, egg incubation, and fry emergence	55°F	□	
In waters that are habitat to native Oregon Bull Trout	50°F	□	
In the lower reaches of the mainstem of the Willamette and Columbia Rivers *	68°F	□	

* This criterion has not been approved by EPA and may become more stringent.

VII. Monitoring Data

{Temperature data spreadsheets and summary charts are to be included in Appendix A. Summary charts should include graphs of the seven day moving mean of daily maximum temperatures.}

The following temperature monitoring data are included in Appendix A:

Treatment Plant		Station Description	Data Period
Influent	☐		
Effluent	☐		
Other	☐		
Receiving Water			
Station #1	☐		
Station #2	☐		
Station #3	☐		
Collection System	☐		

Other temperature data included in Appendix A:

_____

_____

DEQ data reporting forms are included in the appendix. The seven-day moving mean of daily maximum temperatures is graphed for the in-stream and treatment plant data and included in Appendix A.

VIII. Modeling/Mixing Zone Analysis

{Describe the existing mixing zone and any analysis completed to ascertain the actual mixing that occurs within the existing mixing zone. All data and model input/output from the mixing zone analysis should be presented within Appendix B.}

Existing Mixing Zone

Description of Existing Mixing Zone as Defined within NPDES Permit.

Evaluation of Mixing Within Existing Mixing Zone

Dilution Obtained by Existing Mixing Zone: _____ to 1.

Method or Model Used to Determine Mixing: _____.

☐ This mixing zone does not overlap salmonid spawning, egg incubation, or fry emergence areas within the receiving water.

☐ This mixing zone overlaps salmonid spawning, egg incubation, or fry emergence areas within the receiving water.

Proposed Alternative Mixing Zone for Temperature

{An alternative mixing zone for temperature may be warranted if it can be shown that it is protective of fish activities. This should be discussed with DEQ's permit writer prior to finalization of the plan. Data and input/output from computer model should be included in Appendix B. If no alternative mixing zone is proposed, this section should be marked as "Not Applicable".}

Description of Alternative Mixing Zone for Temperature

Evaluation of Mixing Within Proposed Alternative Mixing Zone

_____

_____

_____

_____

_____

_____

Dilution Obtained by Existing Mixing Zone: _____ to 1.

Method or Model Used to Determine Mixing: _____.

☐ This mixing zone does not overlap salmonid spawning, egg incubation, or fry emergence areas within the receiving water.

☐ This mixing zone overlaps salmonid spawning, egg incubation, or fry emergence areas within the receiving water.

IX. Effect of Discharge on Receiving Water

(Note to Plan Preparer: Once the dilution is known, it should be used to determine the temperature increase at the edge of the mixing zone that results from the POTW discharge. If the upstream receiving water temperature is already higher than the criteria temperature, current DEQ policy is to use the criteria temperature as the upstream receiving water temperature.)

$$T_{mz} = \frac{T_e + DT_s}{1 + D}$$ where:

T_{mz} = temperature of the stream at the edge of the regulatory mixing zone, °F
D = dilution obtained within the mixing zone
T_s = upstream receiving water temperature, °F
T_e = effluent temperature, °F

The temperature increase at the edge of the mixing zone (ΔT) or ($T_{mz} - T_s$) is equal to:

_____ .

{Note to Plan Preparer: Mixing zone dilution is typically determined at "worst case" conditions of seven day, 10 year, low flow, and high effluent temperatures. As outlined in the guidance manual, it may be appropriate to more carefully evaluate conditions during critical time periods when fish activities are most sensitive to temperature impacts. These conditions and the resulting impact on receiving water temperatures may be different than "worst case" and should be described and summarized within this section.}

Case 1

Case 2

Case 3

The following table summarizes the results of the mass balance analysis

Parameter	Case I	Case II	Case III
Q_s, mgd			
T_s, °F			
Q_e, mgd			
T_e, °F			
D			
T_{mz}, °F			
ΔT, °F			

X. BMPs Evaluated

The following temperature management BMPs were evaluated:

{Note to Plan Preparer: Check all of the BMPs that were evaluated during development of the plan. If a BMP was not evaluated, provide an explanation of why it is not applicable to your POTW in the space provided below.}

Collection System

- Pretreatment of Identified Heat Loads ☐
- Public Awareness/Education ☐
- Limiting Discharge to the Collection System ☐

Treatment Process Modifications

- Covering Basins ☐
- Disinfection Alternatives Evaluation ☐
- Recycling and/or Eliminating the Discharge ☐
- Energy Conservation ☐

Discharge Alternatives

- Move Discharge Location ☐
- Alter Diffuser ☐
- Storing Heated Effluent ☐
- Land Application During Critical Time Periods ☐
- Rapid Infiltration ☐

Direct Effluent Treatment

- Cooling Towers ☐
- Spray Ponds ☐
- Cooling Ponds ☐
- Chillers

Other _____

XI. Watershed Alternatives

{Note to Plan Preparer: It is not required in the 1996 temperature standard to investigate watershed alternatives, but this may be a very effective way of reducing temperature in your receiving water. DEQ must be consulted prior to any actions to verify that the POTW can receive credit for any watershed improvements.}

Is there a Watershed Council for the Receiving Water? Yes ____ No ____

If yes, was the Watershed Council Contacted? ? Yes ____ No ____

Was a HeatSource Model Evaluation Performed? Yes ____ No ____

If a model evaluation was performed, a copy of the results is included with this plan in Appendix C.

The following watershed alternatives were investigated to reduce the temperature of the receiving water:

Flow Augmentation ☐

Riparian Restoration ☐

Other Watershed Alternative ☐

{Note to Plan Preparer: Insert a description of watershed alternatives evaluated. Include information on type and location of restoration, method of flow augmentation or details on other watershed alternatives. Include results from modeling exercise if performed and if results were used in determining location of river restoration work.}

XII.Evaluation Criteria

{Note to Plan Preparer: Evaluation criteria should be selected at the outset of development of the temperature management plan. The following list is a sample of criteria that can be used. The final criteria selected should be based on your individual community values. Of the criteria listed, check the ones that will be factored into your evaluation}

The following evaluation criteria were used to evaluate the management practices and to develop those BMPs that should be implemented as part of this temperature management plan:

		Weighting
Capital cost	☐	
Present worth cost	☐	
Implementation feasibility	☐	
Temperature reduction effectiveness	☐	
Cost effectiveness	☐	
Public acceptance	☐	
Environmental benefits	☐	
Other:		

{Note to Plan Preparer: This is a sample matrix. Edit the following table to match the BMPs evaluated at your POTW and the criteria being used. Rank each alternative in terms of the criteria with a score of 1 through 5, with 5 being best and 1 being worst. Once all BMPs are scored for each criteria total the score for each BMP. Use this matrix to determine a course of action for temperature reduction.}

The following table ranks the BMPs selected in terms of the above criteria:

Best Management Practice	Capital cost	Present worth cost	Implementation feasibility	Effectiveness	Cost effectiveness	Public acceptance	Environmental benefits	Other	Total Score
Weighting									
Collection System									
Pretreatment of Identified Heat Loads									
Public Awareness/Education									
Limiting Discharge to the Collection System									
Treatment Process Modifications									
Covering Basins									
Disinfection Alternatives Evaluation									
Recycling and/or Eliminating the Discharge									
Energy Conservation									
Discharge Alternatives									
Move Discharge Location									
Alter Diffuser									
Storing Heated Effluent									
Land Application During Critical Time Periods									
Rapid Infiltration									
Direct Effluent Treatment									
Cooling Towers									
Spray Ponds									
Cooling Ponds									
Chillers									

{Note to Plan Preparer: Provide an explanation based on the above scoring matrix as to which BMPs will be implemented. Also in this section provide a discussion of watershed alternatives and actual POTW BMPs. Provide a rational as to why one was chosen. In this section describe which combination of activities will be performed to meet the temperature standard. Provide reasons why certain BMPs have been eliminated.}

Discussion of BMPS:

XIII. Implementation

Budget

{Note to Plan Preparer: Include with this plan a budget breakdown of the costs to implement the BMPs discussed above. This budget should include equipment and installation costs costs for required manhours, and operation and maintenance costs. Also in this section include information on available funding and procedures for attaining funding.}

Schedule

{Note to Plan Preparer: Provide a realistic schedule for implementation of temperature monitoring and BMPs. Schedule should be broken down by months and include information on key tasks, necessary permits, regulatory meetings and any other information relevant to the implementation of the above mentioned BMPs.}

Check Appendices included with the Plan.

- ☐ A – Temperature Monitoring Data
- ☐ B – Mixing Zone Analysis