



PROTOCOL FOR PLACEMENT AND RETRIEVAL OF
TEMPERATURE DATA LOGGERS IN IDAHO STREAMS



Idaho Division of Environmental Quality

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TEMPERATURE DATA LOGGERS IN IDAHO STREAMS

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DISCLAIMER

The purpose of this document is to describe guidelines for the placement, retrieval, and documentation of temperature data loggers at individual stream sites and subsequent temperature data handling. Trade names are referred to or mentioned in this document solely to identify materials or instruments that have been successfully used to collect and store temperature data. Mentioning specific manufacturers or trade names does not imply endorsement by the Idaho Division of Environmental Quality or suggest superiority over comparable products.

INTRODUCTION

Background

Water temperature is a major physical factor affecting aquatic biota. Hynes (1972) described effects of water temperature on primary production, algae, higher plants, invertebrates, and fish in running waters. Heat often has a synergistic effect with other stressors on aquatic organisms (Bell 1973). Due to the foundational role that water temperature plays in the function of aquatic ecosystems and because many human activities impact temperature, water temperature criteria have been adopted into the Idaho Department of Health and Welfare Rules, Title 01, Chapter 02, "Water Quality Standards and Wastewater Treatment Requirements," also known as IDAPA 16.01.02 (Idaho Department of Health and Welfare 1999). Numeric water temperature criteria are included in the water quality standards for the protection of warm water biota (250.02.b.ii), cold water biota (250.02.c.ii), salmonid spawning (250.02.d.ii), bull trout (250.02.e), and Kootenai River white sturgeon (250.02.f). Water temperature is also used, along with pH, to define numeric criteria for un-ionized ammonia in the Idaho water quality standards (250.02.b. and c.).

A number of factors influence water temperature in streams. Stream water temperatures are influenced by water source, ground water, precipitation runoff, solar radiation (including shading), air temperature, climate, and geologic setting (Stevens et al. 1975). These factors must be considered in the design of any water temperature study, placement of temperature sensing devices, and interpretation of temperature data. Methods to help standardize surface water temperature monitoring and reduce sampling variability have been recommended (Stevens et al. 1975, Ralston and Browne 1976, Clesceri et al. 1998, Essig 1998a, Water Quality Interagency Workgroup for the Oregon Plan 1998). This protocol is intended to reduce the variability of temperature data due to sampling techniques and provide a standardized process for collection of temperature data using data loggers.

Scope

The purpose of this protocol is to describe guidelines for the placement, retrieval, and documentation of temperature data loggers at individual stream sites and subsequent temperature data handling. Even though monitoring requiring multiple data loggers is not specifically covered, this protocol may be applied to each logger used in such circumstances. This protocol does not cover lakes, reservoirs, and large non-wadeable rivers. This protocol is intended to supplement the Idaho Division of Environmental Quality (DEQ) technical procedures manual (Ralston and Browne 1976) in light of recent advances in temperature monitoring technology. It provides background information, methods, forms, and a suggested equipment list.

METHODS

Pre-placement Procedures

Develop Monitoring Plan

Prior to going to the field, a monitoring plan needs to be written for DEQ temperature monitoring activities and is highly recommended for any monitoring activity. In general, this plan needs to document: 1) the rationale for the proposed data collection, 2) what data is to be collected, 3) when, where, and for how long will the data be collected, 4) responsible personnel and their roles, and 5) approval of the data collection activity.

Why is the study being done? Monitoring objectives, such as assessments of compliance and beneficial use status, must be documented. If the monitoring is being conducted to assess fish-related beneficial uses, the investigators must also document the species of interest, most sensitive life stages, and critical time period.

Once the reasons for conducting the study have been documented and approved, data quality objectives must be established and the primary use of the data defined. The quantity and quality of the data to be collected can then be determined. A minimum of ten percent of the sites should be replicated for quality assurance purposes. The investigator needs to describe the duration and frequency (including the temperature recording interval and reported value) of the data collection and the “acceptable” loss rate of the data loggers. The study time line, milestones, products, and budget need to be documented. Lastly, the responsible personnel and their roles need to be identified. A copy of the Owyhee Mountains thermograph placement work plan (Horsburgh and Steed 1997) is included in Appendix A as an example.

Select Logger

Select a logger with a measurement range and accuracy resolution appropriate for the purposes of the study. Record manufacturer, customer support phone number, E-mail, website, mailing addresses, model, serial number(s), and date of purchase, at a minimum. Manufacturers of temperature data loggers commonly used in the Pacific Northwest are listed in Table 1. Additionally, consideration needs to be given to the transparency of the case in which the logger will reside. If not totally shaded, loggers placed in clear or translucent cases may act as heat collectors and give artificially high values due to solar radiation warming inside the case. Colored, non-translucent cases are recommended to avoid solar radiation warming.

Table 1. Name, phone number, and web site address of common temperature data logger manufacturers.

Manufacturer	Phone Number	Web Site Address
Onset Computer Corporation	(800) 564-4377	www.onsetcomp.com
Ryan Instruments	(425) 883-7926	www.ryaninst.com
Vemco Limited	(902) 852-3047	www.vemco.com

Calibrate Logger

To calibrate the logger(s), connect the logger to your computer and set the logger to begin storing data according to the manufacturer’s instructions. At a minimum, be sure to set the measurement interval and duration, measurement units, start date and time, and ensure the logger has a fresh battery. Be sure the clock in the computer, logger, and the clock used for the instantaneous measurements are consistent. For calibration purposes, test the logger using a short time interval to reduce calibration time. For efficiency, it is recommended to calibrate a number of loggers at the same time.

Once a batch of loggers has been launched, place them in water tight containers as necessary, and confirm a water tight seal. Prepare two water baths in a controlled temperature environment. One bath should be an ice water bath in a large cooler or other covered and insulated container. The second bath should be held at room temperature. Place the launched loggers in one of the baths long enough to equilibrate to the temperature of the bath. (Leaving the loggers in the first bath over night will assure temperature equilibration.) After the equilibration period, measure and record instantaneous water bath temperatures as close to the time the logger is recording a measurement value as possible. Use a laboratory thermometer certified accurate at a minimum of every 10EC by the National Institute of Standards and Technology (NIST) for the calibration instantaneous measurements. Concurrently, record date and time of each quality assurance measurement. Once the instantaneous water bath temperature measurements have been recorded, place the loggers in the second bath and repeat the process. An example of a logger calibration form is provided in Appendix B. Once the logger has been exposed to the range of temperatures anticipated in the field and measurements recorded, remove the loggers from the water bath, read out the data, and display the data.

Compare the logger data to the instantaneous thermometer data. **Since DEQ temperature measurements of surface waters are primarily taken to assess Idaho water quality standards, loggers are acceptable for placement only if their accuracy is within $\pm 0.7\text{EC}$ of the instantaneous measurements.** The 0.7EC accuracy tolerance level was selected since most models of temperature loggers achieve at least this level of accuracy and the surface water temperature criteria currently contained in the Idaho water quality standards are whole numbers. If the accuracy specification of the logger is less than 0.7EC, the lower limit should be used to determine the suitability of the logger for placement. Be sure to document each pair of readings and the magnitude of discrepancy. Loggers that exceed the 0.7EC tolerance limit should be returned to the manufacturer for adjustment or replacement.

Placement Procedures

Launch Logger

Launch the logger according to the manufacturer's recommendations. Program the logger to meet the specific objectives of the study. A measurement interval of no more than two hours and 24 minutes (10 readings per 24 hours) is recommended for assessments of Idaho water quality standards. To facilitate assessment of Idaho water quality standards criteria, program the logger to record temperature measurements in degrees Celsius using a date format of mm/dd/yyyy and a time format of hh/mm/ss. Record the logger serial number, period of record, interval, site description, whether triggered or delayed start, multiple or single measurement, and whether the reported value is an average, minimum, or maximum measurement. Single measurement values are the recommended values to record for assessments of Idaho water quality standards. Other temperature statistics, such as daily or weekly averages and maximums, can be determined from these data. An example of a temperature logger metadata sheet for recording pertinent locality information and instrument settings is provided in Appendix C.

Site Selection

The site selected for logger placement must be representative in terms of the goal and objectives of the monitoring activity. If the monitoring is being conducted to assess nonpoint source temperature impacts, the logger should be placed at the downstream end of a reach with relatively uniform morphology, land use, and cover. For point source temperature assessments, loggers should be placed just upstream of the discharge point and below the mixing zone. Temperature mixing zone assessments will require loggers to be placed within the mixing zone. The investigator must be aware of the spatial and temporal scale(s) at which the data is anticipated to be analyzed and select sites accordingly. For example, the data may be used to assess attainment of temperature criteria at a site, stream reach, catchment, watershed, cataloging unit, or basin scales.

Logger Placement

A list of recommended equipment for installing temperature loggers is provided in Appendix D. An example of a field form (Horsburgh and Steed 1997) is provided in Appendix E. Set the recording interval of the logger to meet study and data quality objectives if not done during pre-placement. Document the logger serial number. Lubricate the o-ring with silicone, add a form of identification inside the case (business card, etc.), be sure the logger case has a water tight seal and add desiccant as a precaution. Once in the channel, find a shaded spot (or use a shading device) where the water is adequately mixed and not influenced by localized warm or cool water sources such as ground water, point sources, or direct sunlight. The site should not be susceptible to excessive scour that may move the logger (Dunham and Vinyard 1998). Verify that the site is **well-mixed** horizontally and vertically with instantaneous temperature measurements using a calibrated hand-held thermometer. In assessments of flowing waters, well-mixed waters normally occur in the center of the thalweg. Record these findings for each temperature logger site in a field log book. Select a site that is

expected to remain wet throughout the monitoring period. Shaded sites with moderately turbulent flows, such as the tailouts of lateral scour and plunge pools, tend to make good logger placement spots.

Securely attach the logger (cable is recommended) to structure(s) that will not move in the event of a large runoff event. Figure 1 shows a drawing of a three-inch inside diameter by six-inch long metal pipe Hobo[®] holder used by the Nez Perce Tribe for logger attachment. The Hobo[®] case fits inside the pipe and is held in place with two 3/8-inch by four inch bolts. Devices such as this are very simple to make, inexpensive, provide total shade for the logger, protect the logger from moving debris, and provide for secure attachment with a cable. It is highly recommended to let this or similar devices and attachment cable rust to reduce their visibility.

Locality Documentation

A thorough and complete description of the locality for each site must be completed to help ensure the logger may be relocated and to account for factors that influence surface water temperature. This description should, at a minimum, include water body name, DEQ water body index number, U.S. Geological Survey cataloging unit, latitude and longitude, public land survey, elevation in meters, a site map, photographs of the site, instantaneous water temperature, date, and time of the actual placement. Locality information needed to assess aquatic life temperature criteria contained in the Idaho water quality standards is listed on the temperature logger metadata sheet in Appendix C. An identification number should be assigned to each site and associated with the logger serial number. Directions to the site from relatively permanent landmarks should be recorded.

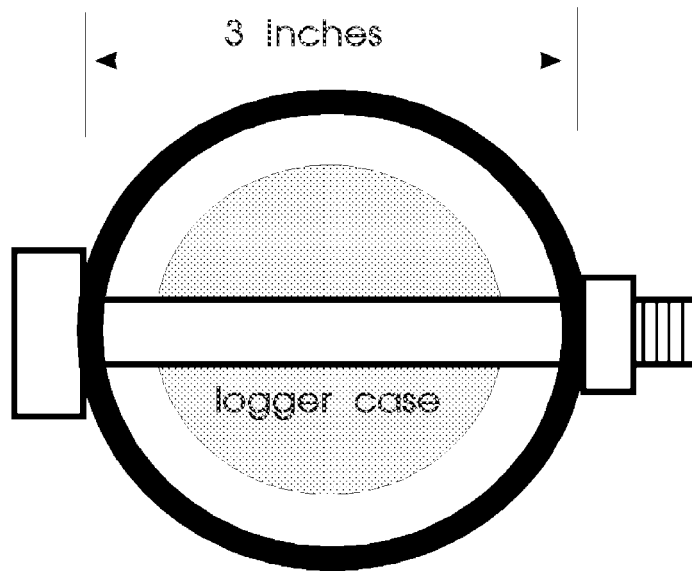
Depending on the purposes of the monitoring activity, additional measurements or observations may be useful in interpreting the temperature data. Parameters that can influence temperature measurements include, but are not limited to, water depth, water velocity, stream discharge, habitat type, channel width, solar input, distance from the stream bank, overhead cover, and air temperature. These parameters should be considered for measurement in each surface water temperature monitoring activity.

Retrieval Procedures

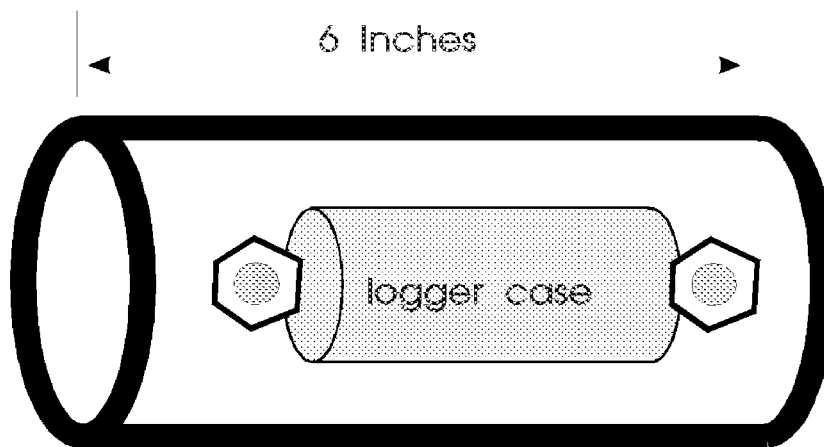
Whenever feasible, it is recommended to make an interim visit to the site to make any needed adjustment to the logger. An interim visit is especially important for spring high flow placements. When an interim visit is made, record the date, time, and instantaneous water temperature.

Upon arrival at the site to retrieve the logger, document the condition of the site and the logger. At a minimum, record such things as whether the logger is still in the water, any signs of vandalism or disturbance, and the integrity of the logger. Also, record the date, time, and instantaneous water temperature. Follow manufacturers' procedures for downloading of the data. Guidelines for temperature data handling are provided in Appendix F.

Figure 1. End view (View a) and plan view (View b) of the Nez Perce Tribe Hobo[®] holder.



View a.



View b.

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GLOSSARY

Calibration - the process of comparing the values recorded by a temperature logger to temperature measurements from a National Institute of Standards and Technology certified thermometer.

Downloading - the process of transferring stored data from a logger to a computer for assessment.

Launch - the process of setting the type of start, measurement type, measurement interval, or other programmable functions of a particular logger prior to placement in a body of water.

Logger - a battery powered electronic device typically comprised of a microprocessor, data storage capability, and a temperature sensor. Temperature data is recorded at programmed intervals and stored for subsequent downloading to a personal computer.

Placement - the process of putting a logger into a body of water once an appropriate site has been determined.

Retrieval - the process of removing a logger from a body of water.

APPENDICES

Appendices:

- A: Owyhee Mountains thermograph placement work plan
 - B: Temperature logger calibration form
 - C: Temperature logger metadata sheet
 - D: Field equipment list
 - E: Temperature logger field form
 - F: Temperature data handling
-

APPENDIX A

Owyhee Mountains Thermograph Placement Work Plan

Owyhee Mountains Thermograph Placement Work Plan

Prepared by: Bryan Horsburgh and Robert Steed

April 1997

Rationale

Nine streams in the Catalog Unit Numbers 17050105 and 17050107 are listed on the 1996 '303(d) list as a result of suspected temperature criteria violations. Based on the eight year TMDL schedule developed by the Division of Environmental Quality, these streams are scheduled for TMDL development by the year 1999.

Invaluable data with regards to the analysis of thermally modified surface waters are those data generated by the placement of thermographs. Thermographs are programmable to collect up to eighteen hundred data points over a time period specified by the investigator. We anticipate placing at least one thermograph in each of the nine streams in the above-mentioned HUCs. This project will require three days time for two individuals. The details of the project are outlined below.

Methods

Thermographs will be placed in the following water bodies:

Water Body	Boundaries	HUC
SF Owyhee River	Nevada Line to Owyhee River	17050105
Cabin Creek	Headwaters to NF Owyhee River	17050107
Corral Creek	Headwaters to NF Owyhee River	17050107
Noon Creek	Headwaters to NF Owyhee River	17050107
Juniper Creek	Headwaters to NF Owyhee River	17050107
Pleasant Valley Creek	Headwaters to NF Owyhee River	17050107
NF Owyhee River	Headwaters to Oregon Line	17050107
MF Owyhee River	Headwaters to Oregon Line	17050107
Squaw Creek	Headwaters to Oregon Line	17050107

Thermograph Placement

Each thermograph will be programmed to collect the maximum number of data points between June and October 1997. After locating a suitable site on each water body, placing the thermographs takes approximately 30 minutes. At least one site will be within one mile of the most downstream confluence for each water body. Due to the locality of these water bodies and the conditions of the roads used to get to them, most of the time spent on this project will be driving time. However, the water bodies are situated in a manner that the two-person team can place thermographs in all but the SF Owyhee River in a matter of two days. The SF Owyhee River thermograph will be placed during the third day.

After locating a suitable site for placement the crew will record discharge, take a GPS reading, record the location on a map, and take an instantaneous temperature measurement. After launching, the thermograph's exact location in the water will be documented with photos, metal tags, hand drawn sketches, and by recording the azimuth to a permanent landmark. Each site will be given a site ID using the following method: 97BOITHERM01, 97BOITHERM02 . . . , etc.

Quality Control

At a minimum of one site, two thermographs will be launched simultaneously. The thermographs will be placed as close to each other as possible, making sure they are in similar instream habitat types, at the same depth, and that they will receive similar sunlight influences.

1997 Thermograph Retrieval

Each thermograph will be relocated and downloaded via a laptop computer in October 1997. The batteries will be replaced and the thermograph will again be launched to collect the maximum number of data points through June 1998. Prior to taking the thermograph out of the water the crew will take an instantaneous temperature measurement and record discharge.

1998 Thermograph Retrieval

Each thermograph will be relocated and permanently retrieved in June 1998. Prior to taking the thermograph out of the water the crew will take an instantaneous temperature measurement and record discharge.

Equipment List

15 thermographs
Laptop computer with launching software
Tape measure
Calibrated thermometer
Fence post driver
Camouflage gauze
Bricks with holes
Metal tags

15 thermograph cases
Flow meter and rod
GPS Receiver
Fence posts
Cable/sleeves/crimping tool
Zipties
Camera with film
Flagging

Approval

This work plan has been examined and approved by:

Authorizing Agent

APPENDIX B

Temperature Logger Calibration Form

Temperature Logger Calibration Form

Logger:

serial number _____ calibration date _____

conducted by _____

NIST certified thermometer:

manufacturer _____

model _____ serial number _____

Time	Bath Temperature (EC)	Logger Temperature (EC)	Discrepancy (EC)

APPENDIX C

Temperature Logger Metadata Sheet

Temperature Logger Metadata Sheet

water body			
HUC/WBID	HUC:	WBID:	
SiteID/description			
1/4, sec., twn., rng.			
7.5' quad map			
lat/long			
differential correction?	G yes	G no,	from a: G map G GPS G GIS
elev. (m or ft.* 0.3048)			
logger serial no.			
.dtf/txt file name			
thermal scale	G Celsius	G Fahrenheit	
start	G triggered	G delayed	
period of record			
interval			
measurement	G single	G multiple	
reported value	G average	G minimum	G maximum
agency/collector/contact			
phone, fax, or E-mail			
salmonid species	bull trout key watershed (Batt 1996)?	G yes	G no
species of concern			
comments	anomalous graph?	G yes	G no

APPENDIX D

Field Equipment List

Field Equipment List

G	calibrated loggers ($\pm 0.7\text{EC}$)	G	backup loggers
G	calibrated thermometer ($\pm 0.7\text{EC}$)	G	cable clamps
G	cable	G	steel fence posts
G	GPS unit	G	pliers
G	sledge hammer	G	post driver
G	camera/film	G	waders
G	lap top computer (if field launch/download)	G	interface cable
G	submersible cases (don't use clear cases)	G	silicone grease
G	silicone rings	G	field book
G	time piece	G	desiccant
G	backup batteries	G	surveyor's flagging tape
G	metadata sheets	G	field forms
G	wrenches	G	locks
G	wire cutters	G	wire
G	pocket knife	G	brush cutting tools
G	first aid kit	G	maps/aerial photos
G	camouflage gauze	G	bricks with holes
G	tape measure	G	metal tags
G	cable ties	G	thermocouple
G	compression fittings	G	crimping tool

APPENDIX E

Temperature Logger Field Form

TEMPERATURE LOGGER FIELD FORM

Logger Placement

Water body name _____ Date _____

Site ID _____ Boundaries _____

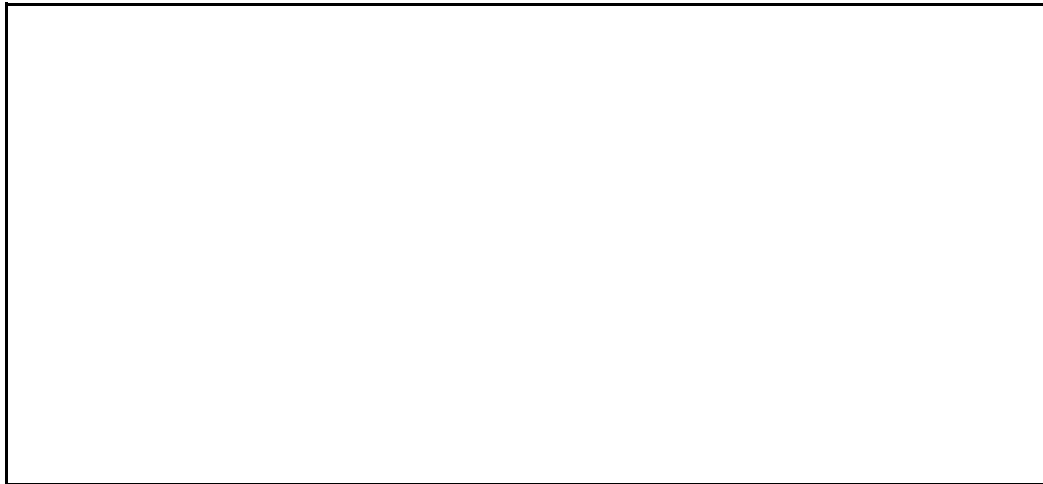
_____ 1/4, Sec. _____, T _____, R _____ Elevation _____ m

Latitude _____ Longitude _____

Instantaneous temperature _____ EC Time _____ hours

Permanent landmark _____

Site Sketch



Logger Retrieval

Date _____ Instantaneous temperature _____ EC Time _____ hours

Condition of site/logger _____

APPENDIX F

Temperature Data Handling

TEMPERATURE DATA HANDLING

Download Data

Follow the manufacturer's procedures to download the data from the logger. Display the data graphically and print the graph as a reference in data handling.

Data Handling

Export the raw data (in degrees Celsius) to a text file and fill out the metadata sheet (Appendix C) to the extent possible. Examine the printed temperature graph for anomalous data. Common anomalies in temperature logger data include air temperature values (extreme spikes on the graph) recorded prior to placement in the water and after removal from the water and sudden changes in the magnitude of the daily temperature ranges. All values that represent anything but representative water temperatures must be edited out of the text file prior to any analysis. Retain the original raw data file in its unaltered state for future reference. Instructions for the use of two Lotus 123® v.5.0 macros written to facilitate data analyses are presented below.

Lotus 123® v.5.0 Macros

The Lotus 123® spreadsheet macro for reducing water temperature data was written by Douglas Miley (1998) in the DEQ State Fiscal Office. This data reduction macro is contained in the file: tempdata.wk4 which is available on the DEQ server at: J:\xfer\tempdata. A companion macro for formatting logger data files so they can be read by the data reduction macro was written by Don Essig (1998b) of the DEQ State Water Quality Program Office. The formatting macro is contained in the file: tempget2.wk4 and is also available on the DEQ server at: J:\xfer\tempdata.

Data Handling Macro Instructions

This section is an excerpt from the first sheet of the data reduction macro (Miley 1998) and may be viewed while using the program. This text contains some editing to update the instructions in light of the recent DEQ reorganization.

Instruction Sheet

This sheet explains how the file and its automated programs function. If you have questions about the operation of the file and its programs please call Doug Miley at 208-373-0199 in the State Fiscal Office at DEQ.

Issue Date and Time of this Version of the TEMPDATA.WK4 file.

Issue Date	Issue Time
11/05/98	09:09 AM

Save File to Your Work Area

When you retrieve this file from the J-Drive use the "File, Save-as" command to create a file in your personal work area such as drive C, H, or wherever you like. If you load the file from the network only you will have access to the file until you close it. For this reason copy the file to your own work area and use it from there.

When you save the TEMPDATA.WK4 file to your work area do not change the file name. Some of the macros perform work based on the name TEMPDATA.WK4 and if the name gets changed those programs will not work correctly.

Create a Backup

Make a backup copy of the TEMPDATA.WK4 file in case something happens to the file you work with. The TEMPDATA.WK4 file has no protections that prevent changes to the formulas or macro instructions so if you accidentally change something and the file stops working properly you will have a backup copy.

Explanation of the Sheets in This File

The various sheets in this file perform different functions and the following descriptions tell what each sheet does. For you to use the file, you only need to use the CRITERIA, HIGHLOW and HUC4 sheets. All operations originate from the HIGHLOW sheet so its explanation appears first followed by CRITERIA and HUC4. The remaining sheets all have parts in how the programs operate but you will not need to make any changes on them and their explanations follow the three mentioned above.

Highlow Sheet

The HIGHLOW sheet presents the high, low and average data summarized from the DATABASE sheet. It also gives a report of the number of times the summarized data exceeds the criteria shown on the CRITERIA sheet. The HIGHLOW sheet has buttons that aid you in processing data from a source file and producing a summarized report. Below you will find a description of the buttons - IMPORT, EXCEEDANCES, PRINT and SUMMARY.

IMPORT - Pressing this button starts the process of importing a source file into the database sheet. The program asks for information that appears in the title section of the HIGHLOW sheet. As it asks for the information please enter the data. When you have entered the requested data, the program retrieves the source file, completes the DATABASE sheet and places the summarized daily data on the HIGHLOW sheet for your review. Also, a "DATA REVIEW" note appears at cell HIGHLOW:J8 upon completion of the importing process. Please read the note and follow the instructions.

Import Process - When you press the IMPORT button the program asks for the following:

- 1 File Name - At this point the program takes you to the MACRO sheet where it has instructions on how to change the file path and name. Follow the instructions and press the ENTER key.
- 2 Data Source Name - Enter the name of the organization that provided the data file you want to import. For example, if the data came from the U.S. Forest Service, enter that name.
- 3 HUC4 Number - Enter the HUC4 number that goes with the data you want to import. The number must match one of the numbers on the HUC4 table. If you enter a number that does not match the table the program will ask you to enter a valid number. Upon entering a valid HUC4 number the program will automatically complete the HUC4 Name and write the North/South of the Salmon Clearwater Divide indicator.
- 4 Water body Name - Enter the name of the Water body from where the data comes.
- 5 Idaho Bull Trout Elevation - If you know the elevation of the Water body then enter it now. Or you may accept the default settings by pressing the ENTER key. The water quality standards for bull trout bring into effect elevation criteria that say whether or not to apply the temperature criteria depending upon the elevation of the water body. These criteria vary according to the north/south indicator described below.

Water body locations south of the Salmon Clearwater Divide must have an elevation exceeding 1400 meters before the temperature criteria come into play. For places north of the Salmon Clearwater Divide, the elevation must exceed 600 meters for the temperature criteria to take effect. If the water body elevation does not exceed 1400 meters in the south or 600 meters in the north, the temperature standards do not apply and the program will not test for any temperature exceedances in regards to Idaho bull trout. The elevation criteria have no effect on the EPA bull trout counts.

- 6 Water body ID Number - Enter a number that has three or fewer characters. DEQ has assigned the numbers but the numbers do not appear in a table so you can enter any characters you wish as long as the length does not exceed three characters.
- 7 Data Collection Site - Enter the name of the site within a Water body from where the data comes.
- 8 Upon entering the above data the program completes the import process by determining on a daily basis the High, Low, Average and 7-Day Average temperature. Once it has written these figures it sounds a "beep" and writes a message on the screen about reviewing the data on the HIGHLOW sheet and deleting incomplete data. Please review the note and press enter. Now review the data.

EXCEEDANCES - Pressing this button causes the program to count the number of times that a temperature exceeds the criteria set out on the CRITERIA sheet. It also highlights the cells that exceed the criteria by drawing a bolded outline and a bolded temperature number within the cell. Please review the bolded areas to verify that they have exceeded the criteria as stated in the law. Many of the criteria apply only at certain times of the year, for certain species, at various elevations, longitudes and other specific parameters.

Highlighting - the data that exceeds the figures on the CRITERIA sheet get highlighted as follows:

- Bolded outline with shading - Idaho cold water biota
- Bolded outline - Idaho salmonid spawning and EPA bull trout
- J or S - Idaho bull trout for juvenile rearing or for spawning.

PRINT - Press the button to print the data on the HIGHLOW sheet and the graph on the CHART sheet.

SUMMARY FILE - Clicking this button exports the daily data and the criteria summaries on the HIGHLOW and CHART sheets to a file with the same name as the source file name entered during the

IMPORT process except that this button saves the new export file with an extension of "SUM" to indicate "Summary" data. If the file name you entered already exists with an extension of "sum" then the program will say the file already exists and asks if you want to replace it or cancel the save process. The program does not offer a way to change the file extension so you will need to rename the previously existing file that has the "sum" extension if you want to save the file just produced.

NOTES - Just below the Criteria Exceedance Summaries in cell L49 you find a text box where you can put notes relative to the data you have processed. To access the notes box use the mouse and move the pointer inside of the box and double click. Enter your notes. When done, move the mouse pointer outside of the text box and click. When deleting rows of data, if you find the notes box has moved into the area where the exceedance boxes appear just push the EXCEEDANCE button and it will reposition the notes box.

If the notes you enter into the box remain basically the same for every group of data you analyze you may edit the notes box on the CRITERIA sheet and write the standard wording in the box. When the program copies the box to the HIGHLOW sheet it will have your notes in it.

When deleting rows of data on the HIGHLOW sheet make sure that you do not completely delete the notes box. If the data you want to delete covers the entire range of the notes box then move the notes box prior to deleting the rows. If your deletions cover only a portion of the notes box you may delete the rows and if needed you can edit the size of the notes box to make it bigger. If you accidentally delete the entire notes box you will need to run the import process again to setup the notes box.

Criteria Sheet

The CRITERIA sheet contains the criteria established by Idaho and Federal law. The exceedance summaries that appear on the HIGHLOW sheet use the numbers on the CRITERIA sheet as a basis for counting the number of temperature data that exceed the laws. You may change the criteria at any time but remember that the "Criteria Exceedance Summary" does its testing based on the figures in the CRITERIA sheet so make your changes accurately. To change the criteria go to the sheet named criteria and change the numbers that appear in the "Criteria" column and in the color blue.

The criteria tests performed by the button named EXCEEDANCES on the HIGHLOW sheet make their comparisons to the temperature data based on a "Greater-Than" formula. For example, if the criteria shows a 22 degree requirement the program will interpret any temperatures greater than 22 degrees as exceeding the criteria and will add that exceedance to the "Exceedance Counts - Nmbr and Prcnt". The program will not count anything equal to or less than the criteria.

The criteria tests also have some dates that give ranges when the temperature criteria apply. Please enter the date ranges as shown below. For example, if a temperature criteria applies from June 1 through August 15 then you need to enter the dates as "1-JUN" and "15-AUG". The cold water biota dates run year round so the criteria sheet does not collect dates for cold water. The salmonid spawning covers several ranges during a year and the program allows for a "spring" and a "fall" period. You may use these ranges to enter data on two species that spawn at different times of the year within the same Water body. The Idaho bull trout has two date ranges that cover the juvenile rearing and the spawning. The EPA bull trout has only one date range.

If you want to analyze some temperatures and date ranges for species other than those named you could change the criteria to fit your analysis. However, the names and descriptions in the Exceedance areas would not change. You would need to manually write names and changes but the counts would be accurate so long as you entered accurate criteria.

The criteria sheet also contains a text block named TEXT 3. TEXT 3 copies to the HIGHLOW sheet during the IMPORT process. If you find yourself entering the same data time after time into the "Notes" box on the HIGHLOW sheet you may want to enter your data into the text block TEXT 3 on the CRITERIA sheet. When the import process copies the text block to the HIGHLOW sheet you will already have your default data entered. However, whatever appears in the box will always copy to the "Notes" box on the HIGHLOW sheet.

HUC4 Sheet

HUC4 provides a table used to track HUC4 numbers, names, and to show whether the water body lies north or south of the Salmon/Clearwater divide. The HUC4 table gets used in the middle of the import process when the program asks for a HUC4 number. The number you enter must appear on the HUC4 table or the program will not proceed with the import function. The number you enter also causes the program to automatically write the Water body name assigned to the number and write the north/south indicator.

For more details on the operation of the HUC4 table go to the HUC4 sheet and read the information at the top. It explains how to add more data to the table.

Instruction Sheet

The INSTRUCTIONS sheet gives instructions on how to use the file and whom to contact if you have questions about how the file and its programs function. It also shows a version indicator referred to as Issue Date and Issue Time of the TEMPDATA.WK4 file.

Database Sheet

The DATABASE sheet contains the data that comes from the source file which has the dates, times and temperature measurements. When you press the IMPORT button on the sheet named HIGHLOW the program retrieves the file you indicate and puts the data on the DATABASE sheet. The program then sorts the data chronologically and inserts a blank row between date changes.

At a minimum the text file you import must have the "date/time" number as explained below and the "degrees Celsius". With these two columns the IMPORT program will function properly and the DEQ Summary of Temperature Data will correctly calculate. However, the DATABASE sheet will not have the Fahrenheit and Kelvin measurements as it is designed to display.

To display and calculate complete data the source file must have data in the following order: 1st column must have a "date/time" number; 2nd column must display degrees Celsius; 3rd column shows degrees Fahrenheit; and the 4th column gives degrees Kelvin. Data appearing in any other order will cause errors in the DEQ Summary of Temperature Data and on the DATABASE sheet.

The "date/time" number must appear as a number like 35912.5003009259259. The first five digits represent the date and the digits behind the decimal point represent the time. If the text file you want to import does not show the "time/date" number as explained above you will need to convert the dates to "date/time" numbers. For example, dates formatted like "04/27/98", "27-APR-98", "27/04/98", or some other format require conversion to a five digit date number followed by the time number found behind the decimal. The IMPORT program bases its sorting on the "date/time" number shown on the DATABASE sheet. Without valid "date/time" numbers the sorts that determine different dates would not work and you would get unreliable high and low temperatures by date that would affect the "Summary of Temperatures".

Chart Sheet

The CHART sheet presents a graph of the high, average and diurnal temperatures of the data shown on the CHARTDATA sheet. Each time you press the EXCEEDANCES button the chart recalculates and presents the temperature data along with the titles as displayed on the HIGHLOW sheet.

Chartdata Sheet

The CHARTDATA sheet receives temperature data from the HIGHLOW sheet and it stores and calculates based on that data. CHARTDATA then serves as the source for the data displayed in graphic form on the CHART sheet.

Macros Sheet

The MACROS sheet contains the program instructions that make the file perform its functions. Please do not delete, insert, or change in any way the macros sheet. It may cause the programs to function improperly. The only exception to changing the macro sheet comes when you must edit the import file path and name but it is part of the program process so it will guide you through that part.

Scratchpad Sheet

The SCRATCHPAD sheet provides a location for you to perform calculations, keep notes, etc. Use the scratchpad to do anything you need.

You may also add new sheets to this file if you need them. Please add them to the right of the SCRATCHPAD sheet. And if you make range names make sure they differ from the names already defined in the file.

On every sheet you will find a "PRINT" button and a "CLEAR" button. The print button automatically makes printing choices and prints the sheet. The clear button deletes entries from the sheet and makes it ready for new entry. You do not have to use the print or clear buttons to use the sheets. You may manually print and clear the sheets if desired.

You may either enter data directly into the sheets and print or choose to print cleared forms and complete the forms by hand or some other method.

Signature Fields

The signature fields remain unlocked because many of the people using the forms enter the person's name who will sign the form and the person then signs or initials next to their name. In all cases you may enter the name on the signature line and in some cases you may enter the name on the row below the signature line. Not all of the forms allow for entry below the line however.

Duplexing

The Training form needs two pages and the instruction portion of the form explains how to duplex that form.

Sheet Instructions

At the right side of each sheet beginning at row 1 appears a brief description of each form's purpose and how it works. All of the forms come from the original FISCAL designs and you complete them according to FISCAL procedures.

Protected Cells

To maintain consistency throughout DEQ we have protected the format of the sheets and certain cells within the sheet. When trying to enter data, if you get a message declaring the cell as protected, you will need to move to another area to enter your data. To see whether or not a cell is protected, look at the bottom of the screen in the Lotus Edit Line. In the fourth box from the right side you will see a capital "U" if the cell is unprotected. You may enter data into any unprotected cell. If the box shows a "Pr" it means the cell is protected and you cannot enter data in it. If your version of Lotus does not show an edit line, you may activate the Edit Line by selecting from the menu View, Set View Preferences and clicking on the Edit Line box. When the box contains an "X" the Edit Line is activated.

Data Quality Control

- C fill in header information
- C trim any false values

Setting of Criteria

- C confirm appropriate aquatic life criteria
- C identify an appropriate salmonid species/life stage (document on metadata sheet) and set appropriate time period-if possible pick a spring and a fall spawner
- C identify if water body is a bull trout key watershed-if so, confirm appropriate criteria for spawning and juvenile rearing
- C confirm EPA bull trout criteria
- C run tempdata.wk4, print file, create summary file