#98-e02

# DEPARTMENT OF ECOLOGY

May 27, 1998

TO: Terry Jackson, Washington State Dept of Fish and Wildlife, Habitat Management

FROM: Art Johnson, Environmental Investigations and Laboratory Services

SUBJECT: **Rainbow Trout Abnormalities in Douglas Creek: Results from Chemical Analyses** (WA-44-1020)

## Introduction

In a December 1996 memo (Appendix A) you described physical abnormalities observed during a 1992 tagging study on rainbow trout in lower Douglas Creek, near McCue Spring, about 17 miles north of Quincy in Douglas County (Figure 1) The reach in question is undeveloped and provides excellent fish habitat The trout population has been doing well for many years (personal communication, Jeff Korth, WDFW). There is extensive dryland wheat farming in the upper drainage Studies by others in our program have shown this part of the creek is severely degraded due to sedimentation (Plotnikoff and Ehinger, 1997).

Abnormalities reported from 1992 included upwardly displaced pectoral fins (Figure 2), a double upper caudal lobe, and other deformities In an effort to determine if a chemical contaminant might be responsible, we analyzed a series of water, sediment, and fish tissue samples collected between April and October, 1997 Results of this work are reported here along with our own observations on abnormalities in Douglas Creek trout.

Table 1 shows what was done for the present study Samples were collected between McCue Spring and the ford one mile below the spring, the same reach as in the tagging study Although chemical analysis was limited to one or two samples each of water, sediment, and tissue, over 250 individual metals and organic compounds were specifically evaluated Atomic Emissions Detection (AED) was employed to screen for additional non-target compounds containing chlorine, bromine, nitrogen, or sulfur atoms The base/neutral/acids (BNA) analysis also provides tentative identifications for the top ten unknown peaks.

Activity of the enzyme cytochrome P4501A (CYP1A) was measured in rainbow trout liver samples as an indicator of exposure to aromatic hydrocarbons such as dioxins and planar PCBs, not analyzed directly because of the cost CYP1A breaks these compounds down into metabolites which can bind to DNA and cause damage This work was done through the generous assistance of Tracy Collier of the National Marine Fisheries Service,

Northwest Fisheries Science Center, Seattle He has extensive experience using this biomarker in evaluating effects of toxic chemicals on Puget Sound fishes (Collier and Varanassi, 1991; Collier et al , 1998).

Overall, these analyses should be adequate to detect any chronic toxic contamination that might reasonably be anticipated In addition to the chemistry, 850 fish were examined for abnormalities Fish were collected by electroshocking at the lowest possible effective voltage.

**Physical Abnormalities**

Table 2 summarizes results of our field observations on rainbow trout collected on April 21-22 and July 1, 1997 and compares them to what was reported for 1992 I understand it was not possible to get an exact count of the number of fish that appeared to be deformed in 1992 because several different teams were involved in the tagging

We also found a number of abnormal features in Douglas Creek trout but in most cases these were different from what was seen in 1992. A blunt snout and short or twisted lower jaw were the features noted most frequently and consistently by us; the jaws did not appear to have been injured by hooks We both observed one or two instances of double fins, ventral and adipose in 1997, upper caudal in 1992 As noted in Table 2, one extremely deformed fish was collected in April 1997 It had a complete second set of pelvic fins located on the middle of its underbelly, double (side-by-side) adipose fins, a short lower jaw, and a dark, raised, fleshy ridge running diagonally down its left side (Figure 3).

The size range of fish we encountered was 4 - 12 inches (Appendix B). The abnormalities tended to occur in the smaller specimens. Rainbow were the only fish species we encountered in the creek; a few crayfish were also seen.

Although I was present during both the April and July surveys, different individuals were primarily responsible for examining the fish. The results for July may be more thorough as these are observations of an experienced fisheries biologist, Jody White*, who had the further advantage of knowing what type of abnormalities were found in April

As indicated in Table 2, White noted that the fin margins, primarily the dorsal, were frayed in 15 of the 250 fish examined (6%). In his opinion, this indicted stress, although not necessarily from chemical contaminants. He also saw similar fraying in several preserved specimens from our earlier collection in April, a feature we had missed.

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## Chemical Analyses

*Methods*

Samples for chemical analysis were collected in glass jars with Teflon-lined lids, specially cleaned for analysis of metals and organic compounds at sub-parts per billion levels (EPA, 1990) Water samples were simple grabs The sediment and fish tissue samples were composites Samples were placed on ice after collection and transported to the Ecology/EPA Manchester Environmental Laboratory (MEL) for analysis

The analytical methods employed are listed in Appendix C The data reported here meet EPA QA/QC requirements for sample holding times, instrument calibration, method blanks, recover of surrogates/matrix spikes/matrix spike duplicates, precision data, and results on laboratory control samples No problems were encountered in the analyses that significantly effect the quality of the data The complete data set and case narratives by MEL staff will be kept on file at Ecology and are available for review

*Water and Sediment*

Table 3 shows general water quality conditions in Douglas Creek The creek was clear and had low concentrations of suspended solids on both occasions sampled Other parameters were within the range normally encountered in eastern Washington streams

Results on metals and other trace elements in water and sediment were unremarkable (Tables 4 and 5) With the exception of elevated magnesium, potassium, sodium, and vanadium, probably due to being spring-fed, no substantial discrepancies were apparent Concentrations of potentially toxic metals – Cr, Ni, Cu, Zn, As, Se, Ag, Cd, Sb, Tl, Pb – were within EPA (1986) water quality criteria Mercury was not analyzed in water or sediment, but a fish tissue sample (see below) showed no indication of elevated concentrations

Table 6 summarizes the results for organic compounds The complete data showing detection limits for all compounds analyzed are in Appendix D

Of the over 200 compounds analyzed, only three were detected Neither the hetero-atom screen nor the BNA tentative identifications revealed any non-target compounds of interest Trace amounts of the herbicide 2,4-D (0 003 ug/L; parts per billion) were present in the April water sample The same sample had 0 034 ug/L of 4-nitrophenol, potentially a breakdown product of the pesticides EPN, parathion, or methylparathion; and 0 02 ug/L of dibromo-anisic acid, possibly an oxidation product of the herbicide bromoxynil These herbicides/breakdown products are routinely detectable in other Washington streams (Davis et al , 1998, and references therein) The concentrations found in Douglas Creek are not associated with any known toxic effect

*Fish Tissue*

A homogenized, composite sample of seven whole rainbow trout, collected September 15, was analyzed for 45 bioaccumulative pesticides or breakdown products, seven PCB mixtures, and mercury. The fish were 199 - 258 mm in fork length and 92 - 201 grams fresh weight.

The results (Table 7) showed only DDT, its primary metabolite DDE, and mercury were detectable at 2 5, 35, and 77 ug/Kg (parts per billion), respectively This level of chemical contamination in fish tissue is minimal (Davis and Serdar, 1996; EPA, 1992; Schmitt et al , 1990; Schmitt and Brumbaugh, 1990)

The hetero-atom screen of the tissue sample showed the presence of a potentially interesting group of compounds, polybrominated diphenylethers, as described below by the analyst Norman Olson:

> "Polybrominated diphenylethers (PBDEs) were detected and confirmed present in the tissue sample, 97438000, and a duplicate sample, 97438000D The estimated concentration of the PBDEs, reported as the sum of four congeners, is 3 ug/Kg
>
> Two tissue samples from EPA's CRITFIC (Columbia River Inter-Tribal Fish Commission) Exposure Study were also examined for the presence of the PBDEs following the Douglas Creek detection Sample 97090980, steelhead tissue, contained no detectable PBDEs Sample 97130801, sturgeon tissue, showed the presence of the PBDEs at approximately 20 ug/Kg
>
> The PBDE mixture found in both the Douglas Creek and the CRITIC sample is predominantly the tetrabromo and pentabromo isomers Smaller amounts of the hexabromo isomers also appear to be present in the sturgeon This ratio of the congeners shows similarity to published descriptions of the fire retardant product Bromkal-70 At this time no CAS#s (chemical abstracts service registry number) have been located for these compounds [Olson subsequently ascribed the following CAS#s to the tetra, penta, and hexabromo isomers, respectively: 40088478, 32534819, and 36483600 ]
>
> Axys Analytical Services Ltd , Sidney B C , also detected chromatographically late eluting brominated compounds in a number of the CRITFIC project samples including sample 96284904 (mountain whitefish) The mass spectra obtained of these compounds appears to match the PBDEs; however, no confirmation has been performed in their laboratory at this time "

PBDEs are used for flame protecting synthetic polymers and textiles They are structurally similar to dioxin and PCBs and share some of the same mechanisms of toxicity (Pijnenburg et al., 1995) Because they had not previously been reported in Pacific Northwest fishes or other media, we did some further analyses to put the results in perspective Samples analyzed included a second whole rainbow trout composite

collected from Douglas Creek during the April 1997 survey, whole rainbow trout from nearby Rock Island Creek collected for CYPIA analysis, as well as whole fish and fish fillet samples from the Yakima, Spokane, Snake and Soleduck Rivers, archived frozen from 1994-1996. Polybrominated biphenyls (PBBs), a related group of fire retardant chemicals, were also analyzed.

Results showed the PBDE levels in Douglas Creek trout, 1.4 - 3 ug/Kg, to be low compared to samples from other Washington rivers (Table 8). The highest concentrations were found in whole fish samples from the Yakima and Spokane, 64 - 105 ug/Kg. No PBDEs could be detected in Rock Island Creek or Soleduck River fish. PBBs were not detected in any of these samples at or below about 2 ug/Kg.

Review of the available literature on PBDEs indicates that, although infrequently analyzed, these are probably ubiquitous environmental contaminants. Jansson et al. (1993) detected PBDEs in 10 of 11 biological samples from a variety of terrestrial and aquatic environments in Sweden. Muscle tissue from carp in New York's Buffalo River had total PBDE concentrations ranging from 13 - 23 ug/Kg (Loganathan et al., 1995). Much higher concentrations approaching 1,000 ug/Kg have been detected in Lake Michigan steelhead (personal communication, Michael Hornung, Univ. Wisconsin). Tetra isomers appear to be the most common.

It is unlikely that PBDEs are the cause of the deformities seen in Douglas Creek rainbow trout. In the first place, concentrations appear to be low. Secondly, laboratory exposure of rainbow trout to substantial doses of these compounds has not produced toxicity. Hornung et al. (1996) injected rainbow trout eggs with PBDEs and saw no dioxin-like effects, including craniofacial malformations, the type of abnormality most commonly seen in Douglas Creek:

> "The PBDEs were inactive as well when injected into newly fertilized rainbow trout eggs to doses of 12 ug/g (parts per million). The 2,2',3,3'-TBDE is an environmentally relevant congener that was found to comprise 70% of the PBDEs in fish samples from the North Sea, with various pentabrominated diphenylethers making up much of the remaining portion of the total PBDEs. Studies using commercial mixtures of PBDEs have also produced little or no TCDD-like effects as measured by effects on cytochrome P450 activity, liver morphology, and reproduction. "

*CYP1A*

CYPIA enzyme activities were measured in three composite liver samples each from Douglas Creek, collected September 25, and a nearby reference area Rock Island Creek, collected October 7. This watershed does not have the extensive acreage devoted to wheat farming, as found in the upper Douglas Creek watershed. The Rock Island fish were collected near Luehm Spring which is 9.5 miles due west of McCue Spring on Douglas Creek.

Results are shown in Table 9 Mean CYPIA activities in the Douglas Creek samples (analyzed in triplicate) ranged from 64 -147 pmoles/mg/min and 90 - 128 pmoles/mg/min in Rock Island Creek samples NMFS' Tracy Collier evaluates these findings as follows:

> "The levels of activity appear to be slightly elevated from both areas, at least compared to levels in salmon from reference estuaries, which run around 50-80 pmoles/mg/min But, without a lot of data on trout in freshwater systems, I would not say there is anything here as far as induction In my opinion, if there is a contaminant etiology to the deformities, the signature is not detectable in the older fish by assay of CYPIA induction This means there is little evidence for ongoing exposure of this population to aromatic contaminants."

## Conclusions

A fairly extensive series of chemical and biochemical analyses failed to identify a toxicant as being the cause of abnormalities in Douglas Creek rainbow trout The level of chemical contamination in the creek appears very low In light of this finding and the reported long-term stability of the trout population, further chemical investigation is not recommended at this time

## Acknowledgments

The generous assistance of Tracy Collier and his colleague Mark Meyers at the NMFS Northwest Fisheries Science Center in conducting the CYPIA analyses is very much appreciated Thanks are due Norman Olson, Ecology Manchester Laboratory for his initiative in analyzing fish tissue samples for PBDEs, and to Bob Reick, EPA Manchester staff for his contributions toward identifying these compounds Field work for this study was done with the welcome assistance of Dale Davis, Dave Serdar, Jody White, and Bill Yake

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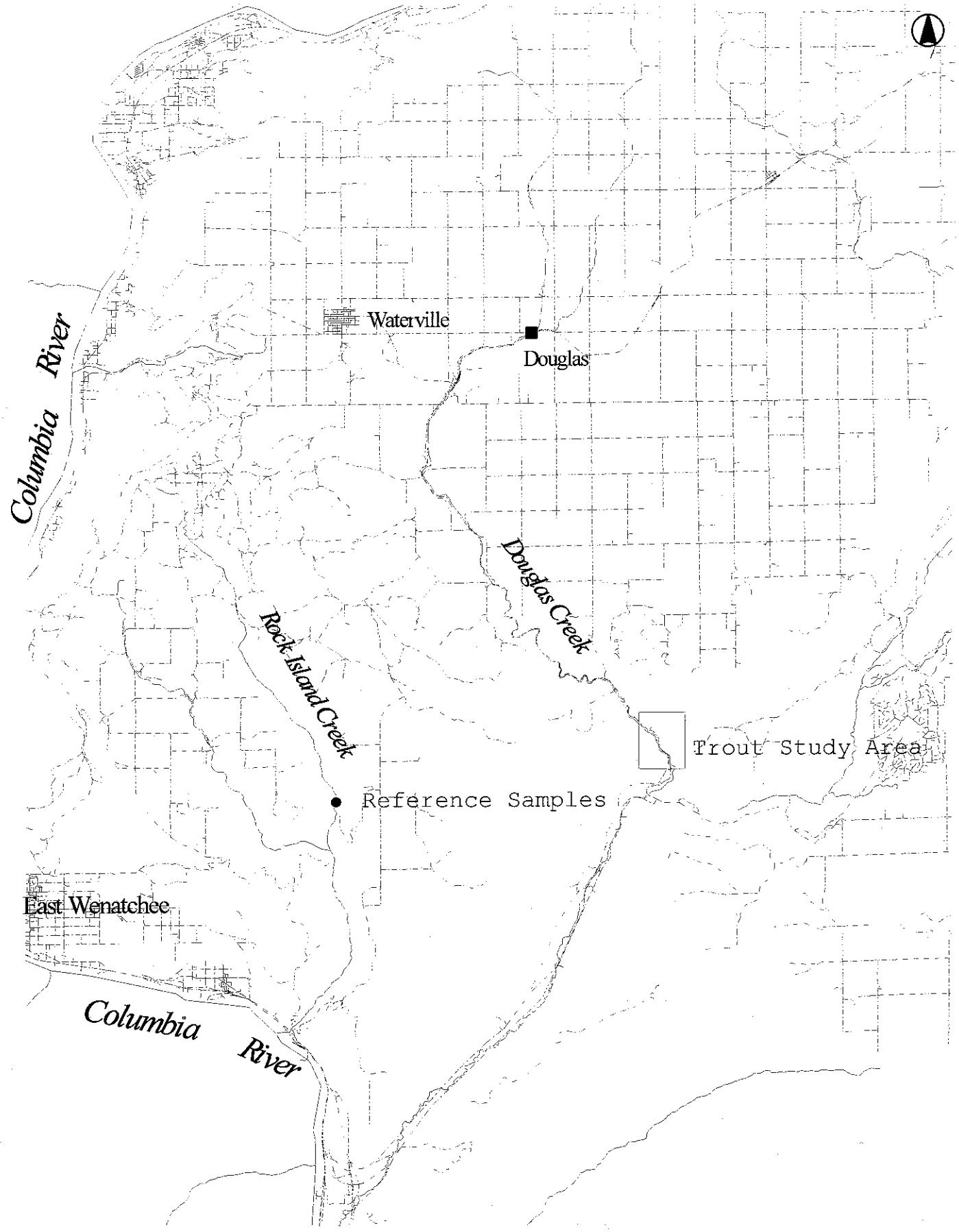


Figure 1. Douglas Creek and Vicinity

The following two pages are:

Figure 2. Douglas Creek rainbow trout with displaced pectorals (WDFW, 1992)

Figure 3. Douglas Creek rainbow trout with multiple abnormalities, including extra pelvic fins, double adipose fin, short lower jaw, and raised fleshy ridge on left side. April 1997 (Photo credit: Bill Yake)

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**Table 1. Chemical Analyses Conducted by Ecology on Samples from Douglas Creek**
(number of chemicals or chemical mixtures analyzed shown in parenthesis)

| Media | Date Collected | General Chemistry | Metals (24) | BNAs[1] (75) | PCBs (7) | Pesticides (146) | Hetero-atom Screen | CYP1A[2] |
|---|---|---|---|---|---|---|---|---|
| Water | 4/21/97 | x | x | x | x | x | x | |
| " | 7/1/97 | x | | | x | x | x | |
| Sediment | 4/21/97 | | x | | x | x | | |
| Fish Tissue | 9/25/97 | | x[3] | | x | x | x | x |

[1]base/neutral/acid compounds

[2]analyzed by National Marine Fisheries Service, Seattle

[3]mercury only

**Table 2. Physical Abnormalities Observed in Douglas Creek Rainbow Trout, 1992 and 1997**

| Agency:<br>Date: | Fish & Wildlife<br>4/92-10/92 | Ecology<br>4/21-22/97 | Ecology<br>7/1/97 |
|---|---|---|---|
| Number of Fish Examined | > 5000 | 600 | 250 |
| Number of Abnormal Fish | > 18 | 9 | 30 |
| Percent with Abnormalities | ? | 2% | 12% |
| Head: | | | |
| Blunt snout | | 1 | 18[b] |
| Short lower jaw | | 2[a] | 13[b] |
| Twisted lower jaw | | 3 | 3 |
| Deformed lower jaw | 1 | | |
| "Unicorn" growth on snout | 3 | | |
| Fins: | | | |
| Pectorals displaced upward | 9 | | |
| Double adipose fin | 5 | 2[a] | 1 |
| Double pelvic fins | | 1[a] | |
| Double upper caudal lobe | 1 | | |
| Ventral caudal lobe deformed | | | 3 |
| Frayed fin margins[c] | | | 15 |
| Body: | | | |
| Hump-backed | 1 | | |
| Raised fleshy ridge on side | | 1[a] | |

[a]One of each of these abnormalities was seen in the same fish

[b]Eight fish had both short lower jaws and blunt snouts

[c]Not included in tally of percent abnormal

**Table 3. General Water Quality Conditions in Douglas Creek**

| Date Collected: | 4/12/97 | 7/1/97 |
|---|---|---|
| Sample Number: | 178010 | 278020 |
| pH (S.U.) | - - | 8.4 |
| Conductivity (umhos/cm) | 302 | 316 |
| Hardness (mg/L) | 126 | 126 |
| Total Alkalinity (mg/L) | - - | 120 |
| Turbidity (NTU) | - - | 1.2 |
| Total Suspended Solids (mg/L) | 4 | 3 |
| Total Dissolved Solids (mg/L) | - - | 218 |
| Nitrite+Nitrate (mg/L) | - - | 2.3 |
| Total Organic Carbon (mg/L) | - - | 2.2 |

**Table 4. Metals and Other Trace Elements in Douglas Creek Water (ug/L, total recoverable; ppb)**

| Location: | Douglas Creek @ Ford | Columbia River @ Wenatchee |
|---|---|---|
| Date Collected: | 4/21/97 | 4/22/97 |
| Sample Number: | 178010 | 178011 |
| Calcium | **26500** | **19500** |
| Sodium | **17300** | **2980** |
| Magnesium | **12400** | **4950** |
| Potassium | **4100** | **1600** |
| Strontium | **130** | **92** |
| Iron | **50** | **87** |
| Aluminum | **33** | **80** |
| Vanadium | **16** | **0.58** |
| Manganese | **4.2** | **10** |
| Zinc | **2.5** | **0.2** |
| Nickel | **2.4** | **1.0** |
| Arsenic | **0.95** | **0.75** |
| Selenium | **0.92** | <0.4 |
| Copper | **0.91** | **1.5** |
| Cobalt | **0.14** | **0.11** |
| Lead | **0.12** | **0.62** |
| Thallium | **0.09** | **0.08** |
| Titanium | <10 | <10 |
| Molybdenum | <5 | <5 |
| Chromium | <0.2 | **0.22** |
| Antimony | <0.1 | **0.32** |
| Beryllium | <0.1 | <0.1 |
| Cadmium | <0.05 | **0.09** |
| Silver | <0.05 | <0.05 |

**Table 5. Metals and Trace Elements in Douglas Creek Sediment (mg/Kg; ppm)**

| Location: | Douglas Creek @ Ford | Background Concentrations in Washington State Soils[1] |
|---|---|---|
| Date: | 4/21/97 | |
| Sample No: | 178012 | |
| Iron | **16900** | **43100** |
| Aluminum | **8280** | **37200** |
| Calcium | **3410** | -- |
| Magnesium | **2660** | -- |
| Potassium | **1470** | -- |
| Titanium | **1390** | -- |
| Manganese | **424** | -- |
| Sodium | **234** | -- |
| Vanadium | **55** | -- |
| Zinc | **34** | **86** |
| Strontium | **25** | -- |
| Copper | **11** | **36** |
| Cobalt | **9.9** | -- |
| Chromium | **9.3** | **42** |
| Nickel | **7.2** | **38** |
| Lead | **6.3** | **17** |
| Arsenic | **4.3** | **7** |
| Silver | **0.4** | -- |
| Beryllium | **0.4** | **1.6** |
| Cadmium | **0.3** | **1.0** |
| Selenium | < 4 | -- |
| Antimony | < 4 | -- |
| Thallium | < 4 | -- |
| Molybdenum | < 0.5 | -- |

[1] 90th percentile values reported in San Juan (1994)

**Table 6. Summary of Organics Analyses on Douglas Creek Water and Sediment (ppb)**

| | Water Samples | | Sediment Sample |
|---|---|---|---|
| Date Collected: | 4/21/97 | 7/1/97 | 4/21/97 |
| Sample Number: | 178010 | 278020 | 178012 |
| Base/Neutral/Acids | none detected | -- | -- |
| Polychlorinated Biphenyls | none detected | none detected | none detected |
| Carbamate Pesticides | none detected | -- | -- |
| Organochlorine Insecticides | none detected | none detected | none detected |
| N-containing Pesticides | none detected | none detected | -- |
| Organophosphorous Insecticides | none detected | none detected | -- |
| Herbicides: | | none detected | -- |
| 2,4-D | **0.003** ug/L | | |
| 4-nitrophenol | **0.034** ug/L | | |
| dibromo-anisic acid | **0.02** ug/L | | |

-- = not analyzed

**Table 7. Pesticides, PCBs, and Mercury Analysis of Douglas Creek Rainbow Trout (ug/Kg, wet)**
(sample number 438000; whole fish composite)

| | |
|---|---|
| DDT & Analogs | |
| 4,4'-DDT | 2.5 |
| 4,4'-DDE | 35 |
| 4,4'-DDD | < 19 |
| 4,4'-DDMU | < 19 |
| 2,4'-DDT | < 19 |
| 2,4'-DDE | < 19 |
| 2,4'-DDD | < 19 |
| 4,4'-dichlorobenzophenone | < 38 |
| dicofol | < 76 |
| methoxychlor | < 19 |
| Cyclodienes | |
| aldrin | < 19 |
| dieldrin | < 19 |
| endrin | < 19 |
| endrin aldehyde | < 19 |
| endrin ketone | < 19 |
| endosulfan I | < 19 |
| endosulfan II | < 19 |
| endosulfan sulfate | < 19 |
| cis-chlordane | < 19 |
| trans-chlordane | < 19 |
| cis-chlordene | < 19 |
| trans-chlordene | < 19 |
| cis-nonachlor | < 19 |
| trans-nonachlor | < 19 |
| oxychlordane | < 19 |
| heptachlor | < 19 |
| heptachlor epoxide | < 19 |
| Mercury | 77 |

| | |
|---|---|
| Benzene Hexachloride | |
| alpha BHC | < 19 |
| beta BHC | < 19 |
| delta BHC | < 19 |
| gamma BHC (Lindane) | < 19 |
| Misc. Chlorinated Pesticides | |
| hexachlorobenzene | < 9.5 |
| DCPA (dacthal) | < 19 |
| oxadiazon | < 19 |
| tetradifon | < 38 |
| mirex | < 19 |
| toxaphene | < 570 |
| captan | < 57 |
| captafol | < 95 |
| Organophosphates | |
| diazinon | < 66 |
| chlorpyrifos | < 66 |
| ethion | < 57 |
| parathion | < 66 |
| methylparathion | < 57 |
| Phenols | |
| pentachloroanisole* | < 9.5 |
| Polychlorinated Biphenyls | |
| PCB-1016 | < 19 |
| PCB-1221 | < 19 |
| PCB-1232 | < 38 |
| PCB-1242 | < 19 |
| PCB-1248 | < 19 |
| PCB-1254 | < 19 |
| PCB-1260 | < 19 |

*metabolite of pentachlorophenol

**Table 8. Results on Fish Tissue Samples Analyzed for Polybrominated Diphenylethers (ug/Kg, wet weight; ppb)**

| Sample Type | Location | Date Collected | Sample Number | Tetrabromo-diphenylether | Pentabromo-diphenylether | Hexabromo-diphenylether | Total PBDEs | Percent Lipid |
|---|---|---|---|---|---|---|---|---|
| **Initial Results:** | | | | | | | | |
| Rainbow Trout - Whole | Douglas Creek | 9/25/97 | 438000 | - - | - - | - - | **3** | na |
| White Sturgeon - Whole* | Lower Columbia R. | 3/21/97 | 130801 | - - | - - | - - | **20** | na |
| Mountain Whitefish -Whole* | Umatilla River | 7/11/96 | 284904 | - - | - - | - - | tentative match | na |
| Steelhead - Fillet* | Clearwater River | 2/25/97 | 90980 | - - | - - | - - | not detected | na |
| **Follow-up Analyses:** | | | | | | | | |
| Rainbow Trout - Whole | Douglas Creek | 4/21/97 | 118070 | **0.66** | **0.69** | <2.2 | **1.4** | 4.8 |
| " | " | " | 118070 dup. | **0.71** | **0.74** | <2.2 | **1.5** | 3.8 |
| " | " | " | 118070 dup. | **0.65** | **0.71** | <2.2 | **1.4** | na |
| Rainbow Trout - Whole** | Rock Island Creek | 7/10/97 | 118071 | <2.2 | <2.2 | <2.2 | not detected | 5.2 |
| " | " | " | 118071 dup. | <2.2 | <2.2 | <2.2 | not detected | 4.9 |
| Largescale Sucker - Whole | Spokane River | 8/96 | 118072 | **95** | <2.1 | **10** | **105** | 4.4 |
| Rainbow Trout - Fillet | " | 8/96 | 118073 | **11** | **7.9** | **1.4** | **20** | 1.3 |
| Largescale Sucker - Whole | Yakima River | 8/95 | 118076 | **61** | <2.1 | **2.9** | **64** | 4.2 |
| Carp - Fillet | " | 8/95 | 118075 | **21** | <2.0 | **0.84** | **22** | 2.3 |
| Channel Catfish - Fillet | Snake River | 9/14/95 | 118074 | **4.3** | **3.0** | **0.72** | **8.0** | 4.3 |
| Mountain Whitefish - Fillet | Soleduck River | 9/7/94 | 118077 | <2.1 | <2.1 | <2.1 | not detected | 5.7 |

*EPA CRITFIC samples
**less liver
na = not analyzed

**Table 9. Hepatic CYP1A Activities (pmoles/mg/min) in Rainbow Trout from Douglas and Rock Island Creeks**

**(analyzed by T. Collier, NMFS, Seattle)**

| AHH# | Usome # | Comp # | Specimen # | Species | Site Name | Fork Length (mm) | Weight (gm) | Gender | CYPIA Activity mean | CYPIA Activity s.d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 2/10/98 #1 | 98060201 | DOE970925-C1 | Doug 1 | Rainbow Trout | Douglas Creek | 195 | 81 | ? | 147 | 21 |
| | | | Doug 2 | Rainbow Trout | Douglas Creek | 189 | 79 | ? | | |
| | | | Doug 4 | Rainbow Trout | Douglas Creek | 217 | 115 | ? | | |
| | | | Doug 5 | Rainbow Trout | Douglas Creek | 228 | 124 | ? | | |
| 2 | 98060202 | DOE970925-C2 | Doug 3 | Rainbow Trout | Douglas Creek | 210 | 106 | F | 64 | 22 |
| | | | Doug 9 | Rainbow Trout | Douglas Creek | 210 | 93 | F | | |
| | | | Doug 13 | Rainbow Trout | Douglas Creek | 225 | 135 | F | | |
| | | | Doug 14 | Rainbow Trout | Douglas Creek | 210 | 114 | F | | |
| | | | Doug 15 | Rainbow Trout | Douglas Creek | 207 | 108 | F | | |
| 3 | 98060203 | DOE070925-C3 | Doug 6 | Rainbow Trout | Douglas Creek | 209 | 118 | M | 111 | 0 |
| | | | Doug 7 | Rainbow Trout | Douglas Creek | 210 | 106 | M | | |
| | | | Doug 8 | Rainbow Trout | Douglas Creek | 245 | 171 | M | | |
| | | | Doug 10 | Rainbow Trout | Douglas Creek | 228 | 147 | M | | |
| | | | Doug 11 | Rainbow Trout | Douglas Creek | 232 | 147 | M | | |
| | | | Doug 12 | Rainbow Trout | Douglas Creek | 254 | 199 | M | | |
| 4 | 98060204 | DOE971007-C1 | RI 9 | Rainbow Trout | Rock Island Cr. | 164 | 48 | ? | 128 | 28 |
| | | | RI 12 | Rainbow Trout | Rock Island Cr. | 152 | 36 | ? | | |
| | | | RI 14 | Rainbow Trout | Rock Island Cr. | 151 | 38 | ? | | |
| 5 | 98060205 | DOE971007-C2 | RI 2 | Rainbow Trout | Rock Island Cr. | 198 | 83 | F | 90 | 17 |
| | | | RI 5 | Rainbow Trout | Rock Island Cr. | 200 | 86 | F | | |
| | | | RI 10 | Rainbow Trout | Rock Island Cr. | 164 | 54 | F | | |
| 6 | 98060206 | DOE971007-C3 | RI 1 | Rainbow Trout | Rock Island Cr. | 197 | 73 | M | 99 | 14 |
| | | | RI 3 | Rainbow Trout | Rock Island Cr. | 200 | 86 | M | | |
| | | | RI 4 | Rainbow Trout | Rock Island Cr. | 198 | 80 | M | | |
| | | | RI 6 | Rainbow Trout | Rock Island Cr. | 195 | 79 | M | | |
| | | | RI 7 | Rainbow Trout | Rock Island Cr. | 185 | 70 | M | | |
| | | | RI 8 | Rainbow Trout | Rock Island Cr. | 168 | 47 | M | | |
| | | | RI 11 | Rainbow Trout | Rock Island Cr. | 169 | 48 | M | | |
| | | | RI 13 | Rainbow Trout | Rock Island Cr. | 154 | 47 | M | | |
| | | | RI 15 | Rainbow Trout | Rock Island Cr. | 160 | 43 | M | | |

**Appendix A.**

State of Washington
**DEPARTMENT OF FISH AND WILDLIFE**

Mailing Address: 600 Capitol Way N, Olympia, WA 98501-1091 - (206) 902-2200; TDD (206) 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

December 13, 1996

TO: Art Johnson
Department of Ecology

FROM: Terry Jackson Jerry
Department of Fish and Wildlife, Habitat Management

**SUBJECT: Background information pertaining to anomalies seen in Douglas Creek rainbow trout**

Several months ago, I sent you a copy of a photo of a so-called "mutated" rainbow trout from Douglas Creek in Douglas County, Washington, along with a map showing the specific location. This memo is in response to your most recent request for a brief description of the specific study being conducted at the time these fish were found.

In the summer of 1992 (April through October), the Department of Wildlife resident trout research team conducted a comparative tagging study of two size groups of wild rainbow trout in a stream environment. The objectives were: 1) to compare rainbow trout loss from the sample population over time by tag type; 2) to compare retention of four tag types (2 tag types in rainbow trout <= 152 mm and two tag types in rainbow trout > 152 mm); and 3) compare effects of tags on growth and condition of rainbow trout. As part of objective 1, movement of trout within the study sections was also analyzed. The study site consisted of eight continuous 100 meter sections. In April, a total of 1200 fish were electroshocked and tagged (which included fish for each tag group, size category, and control groups). The eight sections were again electroshocked in May, June, July, and October in order to determine loss from the sample population, tag retention, and movement. In order to reduce injury in fish while electroshocking, direct current (DC) was used.

During this study, a variety of anomalies were observed. Unfortunately, only one of the two teams recorded these observations on the data forms. Therefore, the number of observations listed below is possibly half that actually observed. It is also possible that some of the observations might be the same fish seen again on a different sample date. Caution should be used therefore in using the following information in a quantitative manner. It should merely be interpreted that a variety of different anomalies were observed repetitively within the population of resident trout in Douglas Creek.

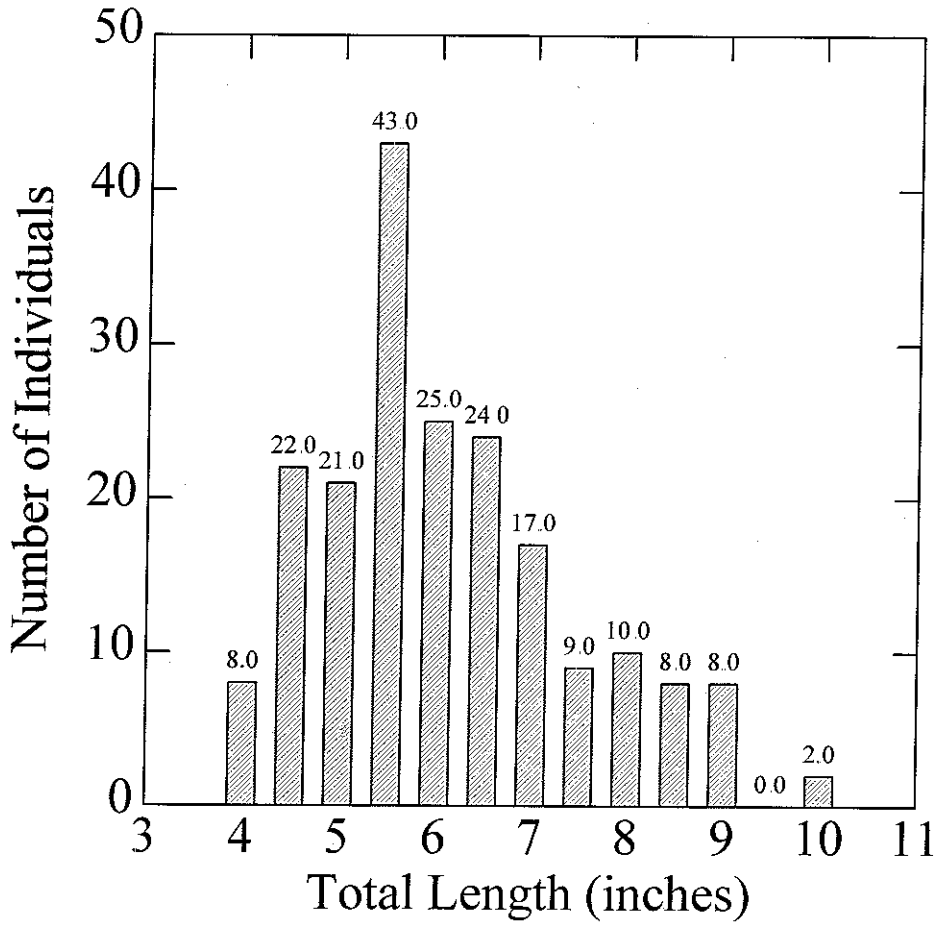
Anomalies Observed (1 Sample Team Only):

1) dorso-lateral displacement of pectoral fins (as seen in the photograph) - 9 observations over five different sample dates.
2) growth on head somewhat similar to a unicorn - 3 observations over 3 sample dates.
3) deformed mandible - 1 observation.
4) deformed back hump - 1 observation.
5) double adipose fins - 5 observations over 3 sample dates.
6) double upper caudal fins - 1 observation.

I hope this information is helpful. I'm sorry that more efforts weren't made at the time to carefully quantify these anomalies, but the field data collected at the time was already very time consuming and laborious. Please feel free to contact me (902-2609) if you have any further questions. I will be very interested to hear of any future efforts the Department of Ecology might be able to focus on this issue.

/tbj

**Appendix B. Length Data from April 21, 1997**



**Appendix C. Analytical Methods for 1997 Douglas Creek Trout Abnormality Study**

| Matrix | Analysis | Method |
|---|---|---|
| Water | Metals | ICP/MS EPA Methods 200.7; 200.8 |
| " | Base/Neural/Acids | GC/MS EPA Method 8270 |
| " | PCBs | GC/ECD EPA Method 8080 |
| " | OC,OP,N Pesticides | GC/AED, GC/ITD EPA Method 1618 |
| " | Herbicides | GC/AED, GC/ITD EPA Method 8150 |
| " | Carbamates | HPLC EPA Method 531.1 |
| Sediment | Metals | ICP EPA Method 200.7 |
| " | Pesticides/PCBs | GC/ECD EPA Method 8080 |
| Fish Tissue | Pesticides/PCBs | GC/AED, GC/ITD EPA Method 8080 |
| " | Mercury | CVAA EPA Method 245.5 |
| " | Hetero-atom Screen | GC/AED, GC/MS EPA 8085-proposed |

Appendix D

Results for Organic Compounds Analyzed in Douglas Creek Water and Sediment Samples, 1997

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Base/Neutral/Acids + all TIC's

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 05/16/97

**Method:** SW8270
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier | Analyte | Result | Qualifier |
|---|---|---|---|---|---|
| N-Nitrosodimethylamine | .27 | U | 2,4-Dinitrophenol | 5.3 | U |
| Pyridine | .27 | U | 4-Nitrophenol | 1.3 | U |
| **Aniline** | | **REJ** | Dibenzofuran | .27 | U |
| Phenol | .27 | U | 2,4-Dinitrotoluene | .53 | U |
| Bis(2-Chloroethyl)Ether | .27 | U | Diethylphthalate | .27 | UJ |
| 2-Chlorophenol | .27 | U | Fluorene | .27 | U |
| 1,3-Dichlorobenzene | .27 | U | 4-Chlorophenyl-Phenylether | .27 | U |
| 1,4-Dichlorobenzene | .27 | U | **4-Nitroaniline** | | **REJ** |
| 1,2-Dichlorobenzene | .27 | U | 4,6-Dinitro-2-Methylphenol | 2.7 | U |
| Benzyl Alcohol | .27 | UJ | N-Nitrosodiphenylamine | .27 | UJ |
| 2-Methylphenol | .27 | U | 1,2-Diphenylhydrazine | .27 | U |
| 2,2'-Oxybis[1-chloropropane] | .27 | U | 4-Bromophenyl-Phenylether | .27 | U |
| N-Nitroso-Di-N-Propylamine | .53 | U | Hexachlorobenzene | .27 | U |
| 4-Methylphenol | .27 | U | Pentachlorophenol | 2.7 | U |
| Hexachloroethane | .27 | UJ | Phenanthrene | .27 | U |
| Nitrobenzene | .27 | U | Anthracene | .27 | U |
| Isophorone | .27 | U | Caffeine | .27 | U |
| 2-Nitrophenol | 1.3 | U | Carbazole | 2.7 | U |
| 2,4-Dimethylphenol | .27 | U | Di-N-Butylphthalate | .27 | UJ |
| Bis(2-Chloroethoxy)Methane | .27 | UJ | Fluoranthene | .27 | U |
| Benzoic Acid | 5.3 | U | Benzidine | 5.3 | U |
| 2,4-Dichlorophenol | .27 | U | Pyrene | .27 | U |
| 1,2,4-Trichlorobenzene | .27 | U | Retene | .27 | U |
| Naphthalene | .27 | U | Butylbenzylphthalate | .27 | U |
| **4-Chloroaniline** | | **REJ** | Benzo(a)anthracene | .27 | U |
| Hexachlorobutadiene | .27 | U | 3,3'-Dichlorobenzidine | 5.3 | U |
| 4-Chloro-3-Methylphenol | .27 | U | Chrysene | .27 | U |
| 2-Methylnaphthalene | .27 | U | Bis(2-Ethylhexyl) Phthalate | .27 | UJ |
| Hexachlorocyclopentadiene | 1.3 | UJ | Di-N-Octyl Phthalate | 2.7 | U |
| 2,4,6-Trichlorophenol | .27 | U | Benzo(b)fluoranthene | .27 | U |
| 2,4,5-Trichlorophenol | 1.3 | U | Benzo(k)fluoranthene | .27 | U |
| 2-Chloronaphthalene | .27 | U | Benzo(a)pyrene | .27 | U |
| 2-Nitroaniline | .53 | UJ | Indeno(1,2,3-cd)pyrene | .27 | U |
| Dimethylphthalate | .53 | U | 3B-Coprostanol | 5.3 | U |
| 2,6-Dinitrotoluene | 1.3 | U | Dibenzo(a,h)anthracene | .27 | U |
| Acenaphthylene | .27 | UJ | Benzo(ghi)perylene | .27 | U |
| 3-Nitroaniline | .27 | UJ | 1-Methylnaphthalene | 27 | U |
| Acenaphthene | .27 | U | | | |

Authorized By: _____ Release Date: 5/21/97 Page: 1

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Base/Neutral/Acids + all TIC's

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 05/16/97

**Method:** SW8270
**Matrix:** Water
**Units:** ug/L

**Surrogate Recoveries**

| | | |
|---|---|---|
| 2-Fluorophenol | 60 | % |
| D5-Phenol | 49 | % |
| D4-2-Chlorophenol | 90 | % |
| 1,2-Dichlorobenzene-D4 | 65 | % |
| D5-Nitrobenzene | 86 | % |
| 2-Fluorobiphenyl | 70 | % |
| D10-Pyrene | 91 | % |
| D14-Terphenyl | 93 | % |

Authorized By: _____ Release Date: 6/2/97

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Base/Neutral/Acids + all TIC's

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 05/16/97

**Method:** SW8270
**Matrix:** Water
**Units:** ug/L

*Tentatively Identified Compounds*

| CAS Number | Analyte Description | Result | Qualifier |
|---|---|---|---|
| *3008006 | *Unknown 06* | .2 | NJ |
| *3008001 | *Unknown 01* | .19 | NJ |
| 4376185 | *1,2-Benzenedicarboxylic acid, monomethyl* | .16 | NJ |
| *3008002 | *Unknown 02* | .2 | NJ |
| *3008003 | *Unknown 03* | .16 | NJ |
| 473552 | *Bicyclo[3.1.1]heptane, 2,6,6-trimethyl-* | .27 | NJ |
| *3008004 | *Unknown 04* | .39 | NJ |
| *3008005 | *Unknown 05* | .22 | NJ |

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Polychlorinated Biphenyls

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 05/09/97

**Method:** SW8080
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| PCB - 1016 | 0.067 | U |
| PCB - 1221 | 0.067 | U |
| PCB - 1232 | 0.067 | U |
| PCB - 1242 | 0.067 | U |
| PCB - 1248 | 0.067 | U |
| PCB - 1254 | 0.067 | U |
| PCB - 1260 | 0.067 | U |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **4,4-Dibromooctafluorobiphenyl** | **86** | % |
| **Dibutylchlorendate** | **67** | % |
| **Decachlorobiphenyl (PCB congen** | **99** | % |
| **Tetrachloro-m-xylene** | **83** | % |

Authorized By: _____ Release Date: 6/19/97

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Chlorinated Pesticides (GC/AED)

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 04/28/97

**Method:** EPA1618
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| Alpha-BHC | 0.012 | UJ |
| Beta-BHC | 0.012 | UJ |
| Gamma-BHC (Lindane) | 0.012 | UJ |
| Delta-BHC | 0.012 | UJ |
| Heptachlor | 0.012 | UJ |
| Aldrin | 0.012 | UJ |
| Heptachlor Epoxide | 0.012 | UJ |
| Trans-Chlordane (Gamma) | 0.012 | UJ |
| Endosulfan I | 0.012 | UJ |
| Dieldrin | 0.012 | UJ |
| 4,4'-DDE | 0.012 | UJ |
| Endrin | 0.012 | UJ |
| Endosulfan II | 0.012 | UJ |
| 4,4'-DDD | 0.012 | UJ |
| Endrin Aldehyde | 0.012 | UJ |
| Endosulfan Sulfate | 0.012 | UJ |
| 4,4'-DDT | 0.012 | UJ |
| Endrin Ketone | 0.012 | UJ |
| Methoxychlor | 0.012 | UJ |
| Alpha-Chlordene | 0.012 | UJ |
| Gamma-Chlordene | 0.012 | UJ |
| Oxychlordane | 0.012 | UJ |
| DDMU | 0.012 | UJ |
| Cis-Chlordane (Alpha-Chlordane | 0.012 | UJ |
| Cis-Nonachlor | 0.012 | UJ |
| Kelthane | 0.047 | UJ |
| Captan | 0.035 | UJ |
| 2,4'-DDE | 0.012 | UJ |
| Trans-Nonachlor | 0.012 | UJ |
| 2,4'-DDD | 0.012 | UJ |
| 2,4'-DDT | 0.012 | UJ |
| Captafol | 0.059 | UJ |
| Mirex | 0.012 | UJ |
| Toxaphene | 0.23 | UJ |
| Hexachlorobenzene | 0.012 | UJ |
| Pentachloroanisole | 0.012 | UJ |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **Decachlorobiphenyl** | **72** | % |

Authorized By: _____ Release Date: 5/16/97 Page: 1

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Organophosphorous Pesticides (GC/AED)

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 04/28/97

**Method:** EPA1618
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| Demeton-O | 0.014 | UJ |
| Sulfotepp | 0.012 | UJ |
| Demeton-S | 0.014 | UJ |
| Fonofos | 0.012 | UJ |
| Disulfoton (Di-Syston) | 0.012 | UJ |
| Methyl Chlorpyrifos | 0.016 | UJ |
| Fenitrothion | 0.014 | UJ |
| Malathion | 0.016 | UJ |
| Chlorpyriphos | 0.016 | UJ |
| Merphos (1 & 2) | 0.023 | UJ |
| Ethion | 0.014 | UJ |
| Carbophenothion | 0.020 | UJ |
| EPN | 0.020 | UJ |
| Azinphos Ethyl | 0.031 | UJ |
| Ethoprop | 0.016 | UJ |
| Phorate | 0.014 | UJ |
| Dimethoate | 0.016 | UJ |
| Diazinon | 0.016 | UJ |
| Methyl Parathion | 0.014 | UJ |
| Ronnel | 0.014 | UJ |
| Fenthion | 0.014 | UJ |
| Parathion | 0.016 | UJ |
| Fensulfothion | 0.020 | UJ |
| Bolstar (Sulprofos) | 0.014 | UJ |
| Imidan | 0.022 | UJ |
| Azinphos (Guthion) | 0.031 | UJ |
| Coumaphos | 0.023 | UJ |
| Dichlorvos (DDVP) | 0.016 | UJ |
| Mevinphos | 0.020 | UJ |
| Dioxathion | 0.033 | UJ |
| Propetamphos | 0.039 | UJ |
| Methyl Paraoxon | 0.035 | UJ |
| Phosphamidan | 0.047 | UJ |
| Tetrachlorvinphos (Gardona) | 0.039 | UJ |
| Fenamiphos | 0.029 | UJ |
| Butifos (DEF) | 0.027 | UJ |
| Abate (Temephos) | 0.18 | UJ |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **Triphenyl Phosphate** | **146** | **%** |

Authorized By: _____ Release Date: 5/16/97 Page: 1

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Nitrogen Containing Pesticides

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97 **Method:** EPA1618
**Date Prepared:** 04/25/97 **Matrix:** Water
**Date Analyzed:** 04/28/97 **Units:** ug/L

| Analyte | Result | Qualifier | Analyte | Result | Qualifier |
|---|---|---|---|---|---|
| Dichlobenil | 0.039 | UJ | Butachlor | 0.12 | UJ |
| Tebuthiuron | 0.029 | UJ | Fenarimol | 0.059 | UJ |
| Propachlor (Ramrod) | 0.047 | UJ | Diuron | 0.12 | UJ |
| Ethalfluralin (Sonalan) | 0.029 | UJ | Di-allate (Avadex) | 0.14 | UJ |
| Treflan (Trifluralin) | 0.029 | UJ | Profluralin | 0.047 | UJ |
| Simazine | 0.020 | UJ | Metalaxyl | 0.12 | UJ |
| Atrazine | 0.020 | UJ | Cyanazine | 0.029 | UJ |
| Pronamide (Kerb) | 0.078 | UJ | | | |
| Terbacil | 0.059 | UJ | **Surrogate Recoveries** | | |
| Metribuzin | 0.020 | UJ | | | |
| Alachlor | 0.070 | UJ | **1,3-Dimethyl-2-nitrobenzene** | **53** | % |
| Prometryn | 0.020 | UJ | | | |
| Bromacil | 0.078 | UJ | | | |
| Metolachlor | 0.078 | UJ | | | |
| Diphenamid | 0.059 | UJ | | | |
| Pendimethalin | 0.029 | UJ | | | |
| Napropamide | 0.059 | UJ | | | |
| Oxyfluorfen | 0.078 | UJ | | | |
| Norflurazon | 0.039 | UJ | | | |
| Fluridone | 0.12 | UJ | | | |
| Eptam | 0.039 | UJ | | | |
| Butylate | 0.039 | UJ | | | |
| Vernolate | 0.039 | UJ | | | |
| Cycloate | 0.039 | UJ | | | |
| Benefin | 0.029 | UJ | | | |
| Prometon (Pramitol 5p) | 0.020 | UJ | | | |
| Propazine | 0.020 | UJ | | | |
| Chlorothalonil (Daconil) | 0.047 | UJ | | | |
| Triallate | 0.059 | UJ | | | |
| Ametryn | 0.020 | UJ | | | |
| Terbutryn (Igran) | 0.020 | UJ | | | |
| Hexazinone | 0.029 | UJ | | | |
| Pebulate | 0.039 | UJ | | | |
| Molinate | 0.039 | UJ | | | |
| Chlorpropham | 0.078 | UJ | | | |
| Atraton | 0.029 | UJ | | | |
| Triadimefon | 0.050 | UJ | | | |
| MGK264 | 0.16 | UJ | | | |

Authorized By: _____ Release Date: 5/16/97 Page: 1

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Chlorophenoxy Herbicides

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 05/08/97

**Method:** SW8150
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| 2,4,6-Trichlorophenol | 0.024 | U |
| 3,5-Dichlorobenzoic Acid | 0.039 | U |
| **4-Nitrophenol** | **0.034** | **J** |
| 2,4,5-Trichlorophenol | 0.024 | U |
| Dicamba I | 0.039 | U |
| 2,3,4,6-Tetrachlorophenol | 0.022 | U |
| MCPP (Mecoprop) | 0.078 | U |
| MCPA | 0.078 | U |
| Dichlorprop | 0.043 | U |
| Bromoxynil | 0.039 | U |
| **2,4-D** | **0.0026** | **NJ** |
| 2,3,4,5-Tetrachlorophenol | 0.022 | U |
| Trichlopyr | 0.033 | U |
| Pentachlorophenol | 0.020 | U |
| 2,4,5-TP (Silvex) | 0.031 | U |
| 2,4,5-T | 0.031 | U |
| 2,4-DB | 0.047 | U |
| Dinoseb | 0.059 | UJ |
| Bentazon | 0.059 | U |
| Ioxynil | 0.039 | U |
| Picloram | 0.039 | UJ |
| Dacthal (DCPA) | 0.031 | U |
| 2,4,5-TB | 0.035 | U |
| Acifluorfen (Blazer) | 0.16 | U |
| Diclofop-Methyl | 0.059 | U |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **2,4,6-Tribromophenol** | **147** | **%** |

Authorized By: _____ Release Date: 5/16/97 Page: 1

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Chlorophenoxy Herbicides

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/25/97
**Date Analyzed:** 05/08/97

**Method:** SW8150
**Matrix:** Water
**Units:** ug/L

***Tentatively Identified Compounds***

| CAS Number | Analyte Description | Result | Qualifier |
|---|---|---|---|
| 50840 | *2,4-Dichlorobenzoic Acid* | 0.0022 | NJ |

Authorized By: _____ Release Date: 5/16/97

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Carbamate Pesticides

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178010 **Date Received:** 04/23/97 **Method:** EPA531.1
**Field ID:** DOUGLAS CR **Matrix:** Water
**Project Officer:** Art Johnson **Date Analyzed:** 05/07/97 **Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| Aldicarb Sulfone | 0.5 | U |
| Aldicarb Sulfoxide | 0.5 | U |
| Oxamyl (Vydate) | 0.5 | U |
| Methomyl | 0.5 | U |
| 3-Hydroxycarbofuran | 0.5 | U |
| Aldicarb | 1 | U |
| Baygon (Propoxur) | 0.5 | U |
| Carbofuran | 0.5 | U |
| Carbaryl | 0.5 | U |
| 1-Naphthol | 1 | U |
| Methiocarb | 5 | U |

Authorized By: _____ Release Date: 9/16/97 Page: 1

# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Chlorinated Pesticides (GC/AED)

**Project Name:** Douglus Creek **LIMS Project ID:** 1380-97

**Sample:** 97278020
**Field ID:** @FORD
**Project Officer:** Art Johnson

**Date Received:** 07/02/97
**Date Prepared:** 07/03/97
**Date Analyzed:** 07/11/97

**Method:** EPA1618
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| Alpha-BHC | 0.012 | UJ |
| Beta-BHC | 0.012 | UJ |
| Gamma-BHC (Lindane) | 0.012 | UJ |
| Delta-BHC | 0.012 | UJ |
| Heptachlor | 0.012 | UJ |
| Aldrin | 0.012 | UJ |
| Heptachlor Epoxide | 0.012 | UJ |
| Trans-Chlordane (Gamma) | 0.012 | UJ |
| Endosulfan I | 0.012 | UJ |
| Dieldrin | 0.012 | UJ |
| 4,4'-DDE | 0.012 | UJ |
| Endrin | 0.012 | UJ |
| Endosulfan II | 0.012 | UJ |
| 4,4'-DDD | 0.012 | UJ |
| Endrin Aldehyde | 0.012 | UJ |
| Endosulfan Sulfate | 0.012 | UJ |
| 4,4'-DDT | 0.012 | UJ |
| Endrin Ketone | 0.012 | UJ |
| Methoxychlor | 0.012 | UJ |
| Alpha-Chlordene | 0.012 | UJ |
| Gamma-Chlordene | 0.012 | UJ |
| Oxychlordane | 0.012 | UJ |
| DDMU | 0.012 | UJ |
| Cis-Chlordane (Alpha-Chlordane | 0.012 | UJ |
| Cis-Nonachlor | 0.012 | UJ |
| Kelthane | 0.049 | UJ |
| Captan | 0.037 | UJ |
| 2,4'-DDE | 0.012 | UJ |
| Trans-Nonachlor | 0.012 | UJ |
| 2,4'-DDD | 0.012 | UJ |
| 2,4'-DDT | 0.012 | UJ |
| Captafol | 0.061 | UJ |
| Mirex | 0.012 | UJ |
| Toxaphene | 0.25 | UJ |
| Hexachlorobenzene | 0.012 | UJ |
| Pentachloroanisole | 0.012 | UJ |
| PCB - 1242 | 0.082 | UJ |
| PCB - 1248 | 0.082 | UJ |
| PCB - 1254 | 0.082 | UJ |
| PCB - 1260 | 0.082 | UJ |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **Decachlorobiphenyl (PCB congen** | **102** | % |

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# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Organophosphorous Pesticides (GC/AED)

**Project Name:** Douglus Creek **LIMS Project ID:** 1380-97

**Sample:** 97278020
**Field ID:** @FORD
**Project Officer:** Art Johnson

**Date Received:** 07/02/97
**Date Prepared:** 07/03/97
**Date Analyzed:** 07/11/97

**Method:** EPA1618
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| Demeton-O | 0.014 | UJ |
| Sulfotepp | 0.012 | UJ |
| Demeton-S | 0.014 | UJ |
| Fonofos | 0.012 | UJ |
| Disulfoton (Di-Syston) | 0.012 | UJ |
| Methyl Chlorpyrifos | 0.016 | UJ |
| Fenitrothion | 0.014 | UJ |
| Malathion | 0.016 | UJ |
| Chlorpyriphos | 0.016 | UJ |
| Merphos (1 & 2) | 0.025 | UJ |
| Ethion | 0.014 | UJ |
| Carbophenothion | 0.020 | UJ |
| EPN | 0.020 | UJ |
| Azinphos Ethyl | 0.033 | UJ |
| Ethoprop | 0.016 | UJ |
| Phorate | 0.014 | UJ |
| Dimethoate | 0.016 | UJ |
| Diazinon | 0.016 | UJ |
| Methyl Parathion | 0.014 | UJ |
| Ronnel | 0.014 | UJ |
| Fenthion | 0.014 | UJ |
| Parathion | 0.016 | UJ |
| Fensulfothion | 0.020 | UJ |
| Bolstar (Sulprofos) | 0.014 | UJ |
| Imidan | 0.023 | UJ |
| Azinphos (Guthion) | 0.033 | UJ |
| Coumaphos | 0.025 | UJ |
| Dichlorvos (DDVP) | 0.016 | UJ |
| Mevinphos | 0.020 | UJ |
| Dioxathion | 0.035 | UJ |
| Propetamphos | 0.041 | UJ |
| Methyl Paraoxon | 0.037 | UJ |
| Phosphamidan | 0.049 | UJ |
| Tetrachlorvinphos (Gardona) | 0.041 | UJ |
| Fenamiphos | 0.031 | UJ |
| Butifos (DEF) | 0.029 | UJ |
| Abate (Temephos) | 0.19 | UJ |

**Surrogate Recoveries**

| | | |
|---|---|---|
| Triphenyl Phosphate | 102 | % |

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# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Nitrogen Containing Pesticides

**Project Name:** Douglus Creek **LIMS Project ID:** 1380-97

**Sample:** 97278020 **Date Received:** 07/02/97 **Method:** EPA1618
**Field ID:** @FORD **Date Prepared:** 07/03/97 **Matrix:** Water
**Project Officer:** Art Johnson **Date Analyzed:** 07/11/97 **Units:** ug/L

| Analyte | Result | Qualifier | Analyte | Result | Qualifier |
|---|---|---|---|---|---|
| Dichlobenil | 0.041 | UJ | Butachlor | 0.12 | UJ |
| Tebuthiuron | 0.031 | UJ | Carboxin | 0.12 | UJ |
| Propachlor (Ramrod) | 0.049 | UJ | Fenarimol | 0.061 | UJ |
| Ethalfluralin (Sonalan) | 0.031 | UJ | Diuron | 0.12 | UJ |
| Treflan (Trifluralin) | 0.031 | UJ | Di-allate (Avadex) | 0.14 | UJ |
| Simazine | 0.020 | UJ | Profluralin | 0.049 | UJ |
| Atrazine | 0.020 | UJ | Metalaxyl | 0.12 | UJ |
| Pronamide (Kerb) | 0.082 | UJ | Cyanazine | 0.031 | UJ |
| Terbacil | 0.061 | UJ | | | |
| Metribuzin | 0.020 | UJ | **Surrogate Recoveries** | | |
| Alachlor | 0.074 | UJ | | | |
| Prometryn | 0.020 | UJ | **1,3-Dimethyl-2-nitrobenzene** | **85** | **%** |
| Bromacil | 0.082 | UJ | | | |
| Metolachlor | 0.082 | UJ | | | |
| Diphenamid | 0.061 | UJ | | | |
| Pendimethalin | 0.031 | UJ | | | |
| Napropamide | 0.061 | UJ | | | |
| Oxyfluorfen | 0.082 | UJ | | | |
| Norflurazon | 0.041 | UJ | | | |
| Fluridone | 0.12 | UJ | | | |
| Eptam | 0.041 | UJ | | | |
| Butylate | 0.041 | UJ | | | |
| Vernolate | 0.041 | UJ | | | |
| Cycloate | 0.041 | UJ | | | |
| Benefin | 0.031 | UJ | | | |
| Prometon (Pramitol 5p) | 0.020 | UJ | | | |
| Propazine | 0.020 | UJ | | | |
| Chlorothalonil (Daconil) | 0.049 | UJ | | | |
| Triallate | 0.061 | UJ | | | |
| Ametryn | 0.020 | UJ | | | |
| Terbutryn (Igran) | 0.020 | UJ | | | |
| Hexazinone | 0.031 | UJ | | | |
| Pebulate | 0.041 | UJ | | | |
| Molinate | 0.041 | UJ | | | |
| Chlorpropham | 0.082 | UJ | | | |
| Atraton | 0.031 | UJ | | | |
| Triadimefon | 0.052 | UJ | | | |
| MGK264 | 0.16 | UJ | | | |

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# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Chlorophenoxy Herbicides

**Project Name:** Douglus Creek **LIMS Project ID:** 1380-97

**Sample:** 97278020
**Field ID:** @FORD
**Project Officer:** Art Johnson

**Date Received:** 07/02/97
**Date Prepared:** 07/03/97
**Date Analyzed:** 07/17/97

**Method:** SW8150
**Matrix:** Water
**Units:** ug/L

| Analyte | Result | Qualifier |
|---|---|---|
| 2,4,6-Trichlorophenol | 0.025 | U |
| 3,5-Dichlorobenzoic Acid | 0.042 | U |
| 4-Nitrophenol | 0.073 | U |
| 2,4,5-Trichlorophenol | 0.025 | U |
| Dicamba I | 0.042 | U |
| 2,3,4,6-Tetrachlorophenol | 0.023 | U |
| MCPP (Mecoprop) | 0.083 | U |
| MCPA | 0.083 | U |
| Dichlorprop | 0.046 | U |
| Bromoxynil | 0.042 | U |
| 2,4-D | 0.042 | U |
| 2,3,4,5-Tetrachlorophenol | 0.023 | U |
| Trichlopyr | 0.035 | U |
| Pentachlorophenol | 0.021 | U |
| 2,4,5-TP (Silvex) | 0.033 | U |
| 2,4,5-T | 0.033 | U |
| 2,4-DB | 0.050 | U |
| Dinoseb | 0.063 | UJ |
| Bentazon | 0.063 | U |
| Ioxynil | 0.042 | U |
| Picloram | 0.042 | UJ |
| Dacthal (DCPA) | 0.033 | U |
| 2,4,5-TB | 0.038 | U |
| Acifluorfen (Blazer) | 0.17 | U |
| Diclofop-Methyl | 0.063 | U |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **2,4,6-Tribromophenol** | **108** | **%** |

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# Manchester Environmental Laboratory

## Department of Ecology

## Analysis Report for

## Organochlorine Pesticides and Polychlorinated Biphenyls

**Project Name:** Douglas Creek **LIMS Project ID:** 1193-97

**Sample:** 97178012
**Field ID:** DOUGLAS CR
**Project Officer:** Art Johnson

**Date Received:** 04/23/97
**Date Prepared:** 04/28/97
**Date Analyzed:** 05/09/97

**Method:** SW8080
**Matrix:** Sediment/Soil
**Units:** ug/Kg Dry Wt.

| Analyte | Result | Qualifier |
|---|---|---|
| Alpha-BHC | 2.6 | U |
| Beta-BHC | 2.6 | U |
| Gamma-BHC (Lindane) | 2.6 | U |
| Delta-BHC | 2.6 | U |
| Heptachlor | 2.6 | U |
| Aldrin | 2.6 | U |
| Heptachlor Epoxide | 2.6 | U |
| Endosulfan I | 2.6 | U |
| 4,4'-DDE | 2.6 | U |
| Dieldrin | 2.6 | U |
| Endrin | 2.6 | U |
| Endosulfan II | 2.6 | U |
| 4,4'-DDD | 2.6 | U |
| Endrin Aldehyde | 2.6 | U |
| 4,4'-DDT | 2.6 | U |
| Endosulfan Sulfate | 2.6 | U |
| Endrin Ketone | 2.6 | U |
| Methoxychlor | 2.6 | U |
| Chlordane (Tech) | 52 | U |
| Toxaphene | 160 | U |
| PCB - 1016 | 52 | U |
| PCB - 1221 | 52 | U |
| PCB - 1232 | 52 | U |
| PCB - 1242 | 52 | U |
| PCB - 1248 | 52 | U |
| PCB - 1254 | 52 | U |
| PCB - 1260 | 52 | U |

**Surrogate Recoveries**

| | | |
|---|---|---|
| **Tetrachloro-m-xylene** | **58** | **%** |
| **Dibutylchlorendate** | **73** | **%** |
| **Decachlorobiphenyl (PCB congen** | **70** | **%** |
| **4,4-Dibromooctafluorobiphenyl** | **55** | **%** |

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## *DATA QUALIFIER CODES*

| | | |
|---|---|---|
| U | - | The analyte was not detected at or above the reported result. |
| J | - | The analyte was positively identified. The associated numerical result is an estimate. |
| UJ | - | The analyte was not detected at or above the reported estimated result. |
| REJ | - | The data are unusable for all purposes. |
| NAF | - | Not analyzed for. |
| N | - | For organic analytes there is evidence the analyte is present in this sample. |
| NJ | - | There is evidence that the analyte is present. The associated numerical result is an estimate. |
| NC | - | Not Calculated |
| E | - | This qualifier is used when the concentration of the associated value exceeds the known calibration range. |