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SCHUBERT A L		
SETLOCK G H		
STIGER S G	X	X
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ER RB 06343

Update to Standley Lake Fish Toxics Report from Operable Unit No 3 Project Data

Sue Stiger, Associate General Manager
Environmental Restoration Management
EG&G Rocky Flats, Inc

The Colorado Department of Health (CDH) published a report that evaluated the risk from consumption of fish caught in Standley Lake Although no appreciable health risk was found, the report recommended continued monitoring Fish analysis data sampled under the Operable Unit No 3 (OU 3) project would provide current information to CDH to update this report

The 1990 CDH published report titled "Standley Lake Fish Toxics Monitoring Report" (attached), evaluated the human health risk from eating sport fish caught at Standley Lake The report concluded that " consumption of an average amount of fish from Standley Lake does not present an appreciable health risk " Additionally, the report recommends continued monitoring to confirm the assessment The OU 3 project sampled fish in Standley as part of the Interagency Agreement directed Remedial Investigation In the public interest, a report on results of the OU 3 fish tissue analysis needs to be developed now to update this risk assessment of consuming Standley Lake fish

The Department of Energy directs EG&G to provide a short report on results of the Standley Lake fish tissue analysis for transmittal to CDH Your point of contact for this report is Bob Birk at extension 5921 A scoping meeting should be scheduled within the next three weeks to begin development of the necessary scope, schedule and budget information

Jessie Roberson
Acting Assistant Manager for
Environmental Restoration

Attachment

Stiger

cc w/o Attachment
F Lockhart, ER, RFFO
B Birk, ER, RFFO
N Castaneda, ER, RFFO
M Guillaume, ER, RFFO

Broussard

ADMIN RECORD

A-OU03-000503

The Colorado Department of Health analyzed fish collected from Standley Lake in June, 1989 for a variety of pollutants to determine if these fish were safe for human consumption The species analyzed included walleyes, channel catfish, smallmouth bass and rainbow trout, which were collected by electrofishing and gillnetting Composites of raw fillets for each species were analyzed for selected metals, radioactive substances and priority organic pollutants Radioactive materials, including plutonium-239+240 and cesium-137, were subjected to exceptionally sensitive analysis and were not detected Low concentrations of cadmium, mercury, selenium, DDT, DDE, DDD and malathion were detected in some or all species Although the source of these contaminants was not determined in this study, none of them are unique to the Rocky Flats Nuclear Weapons Facility They may originate from a variety of sources in the watershed, including water diverted from Clear Creek which contributes ninety-six percent of the flow to the lake

The results of a health risk assessment indicate that consumption of a reasonable quantity of fish from Standley Lake does not present an appreciable health risk to the public, from either a toxicity or cancer-causing standpoint This type of screening survey is generally not undertaken in Colorado unless there is evidence of a known contamination source Therefore, comparative information for other lakes and reservoirs is not available Additional in-depth monitoring at Standley Lake, as well as monitoring of pollutants in fish from other Front Range lakes, should be undertaken to confirm these results and provide comparative information

The June, 1989 Agreement in Principle between the U S Department of Energy and the State of Colorado provides additional funding and resources to the Colorado Department of Health (CDH) to intensify environmental monitoring efforts around the Rocky Flats Nuclear Weapons Facility As part of this increased effort and to address public concern regarding the potential impact from Rocky Flats, CDH conducted a study of fish samples taken from Standley Lake, a water supply reservoir located 3 miles downstream from the plant The primary objective was to determine whether the fish were contaminated by chemical or radioactive pollutants from the facility and, if so, whether they were unsafe for human consumption

The screening level health risk assessment of fish considered three components 1) a hazard identification, 2) a dose-response assessment, and 3) an exposure assessment In the first two components, various chemical, toxicological and radiological data bases were reviewed In the third, the concentration of pollutants in fish tissue and average fish ingestion rates were used to estimate levels of human exposure to contaminants and the corresponding health risks

Although Great Western Reservoir also lies downstream of the Rocky Flats Plant, fish from this reservoir were not analyzed because fishing is not allowed in the reservoir and there is no public access to it

STUDY DESIGN

The primary aim of this investigation was to measure the concentrations of suspected pollutants in edible fish tissue Accordingly, fillets had to be obtained, prepared and cleaned using the same procedures normally employed by most anglers Analysis, therefore, did not include either whole fish or specific organs, such as the liver However, analysis of these tissues may be appropriate for subsequent studies

Given the initial resources available, a screening survey sampling design, patterned on Phase I of the Massachusetts Fish Toxics Monitoring Program (U S EPA 1987), was selected for an expedited assessment during the summer of 1989 That program is a three-phased approach consisting of a screening survey, confirmatory analysis, and follow-up In the Standley Lake study, at least three fish per composite were selected for each species Composite analysis was selected over analysis of individual fish because such a strategy is more cost-effective for screening when the tissue mass required for analysis is large Separate samples for organics and for inorganics (e g , metals and radionuclides) were selected for each species A combined total of eight samples, two each of four species of fish, was analyzed

TARGET SPECIES

Target fish species were chosen to satisfy three criteria (1) that the fish are common and likely to be caught and eaten, (2) that selected species include a bottom feeder and top predator in the aquatic food chain, and (3) that the number of species be limited to four In consultation with the Colorado Division of Wildlife's Central Region fisheries personnel, CDH Water Quality Control Division selected walleye (Stizostedion vitreum), smallmouth bass (Micropterus dolomieui, rainbow trout (Oncorhynchus mykiss) and the channel catfish (Ictalurus punctatus)

Other species in the reservoir include the bluegill, carp, green sunfish, largemouth bass, sucker and yellow perch

SUSPECTED CONTAMINANTS

The list of potential contaminants (Appendix A) selected for analysis was compiled after consultation with CDH personnel from the Environmental Epidemiology, Hazardous Materials and Waste Management, Radiation Control, Laboratory and Water Quality Control Divisions The list includes a priority pollutant scan for organics and metals along with radionuclides potentially released by the Rocky Flats Plant

FISH COLLECTION

Biologists from the Colorado Division of Wildlife and the Colorado Water Quality Control Division collected fish by electrofishing along the dam between approximately 7 pm and 9 30 pm on June 28, 1989 In addition, gill nets were set at three locations on the lake (Figure 1) The Colorado Division of Wildlife personnel selected the sampling sites based on their previous work on the lake The onset of dangerous wind conditions prevented the nets from being checked after 2 to 3 hours Therefore, they were left out overnight, and retrieved between 8 and 9 the following morning

The species collected included walleye, smallmouth bass, rainbow trout, channel catfish, white suckers, carp and yellow perch The largest two walleyes, the carp and the smallmouth bass were captured along the dam by electrofisning The gillnet at site 1 captured trout, perch, carp and smaller walleyes The remaining two gillnets (site 2 and 3) captured trout, small walleyes, white suckers, carp and channel catfish

Captured fish were held temporarily in a thoroughly rinsed metal tub which contained 10 gallons of lake water Live fish were removed from the tub and killed with a sharp blow to the head before processing Subsamples of each species were randomly allocated within size groups into either organics or inorganics analysis Fish destined for organics analysis were wrapped in aluminum foil, those for the metals and radionuclide analysis were placed in

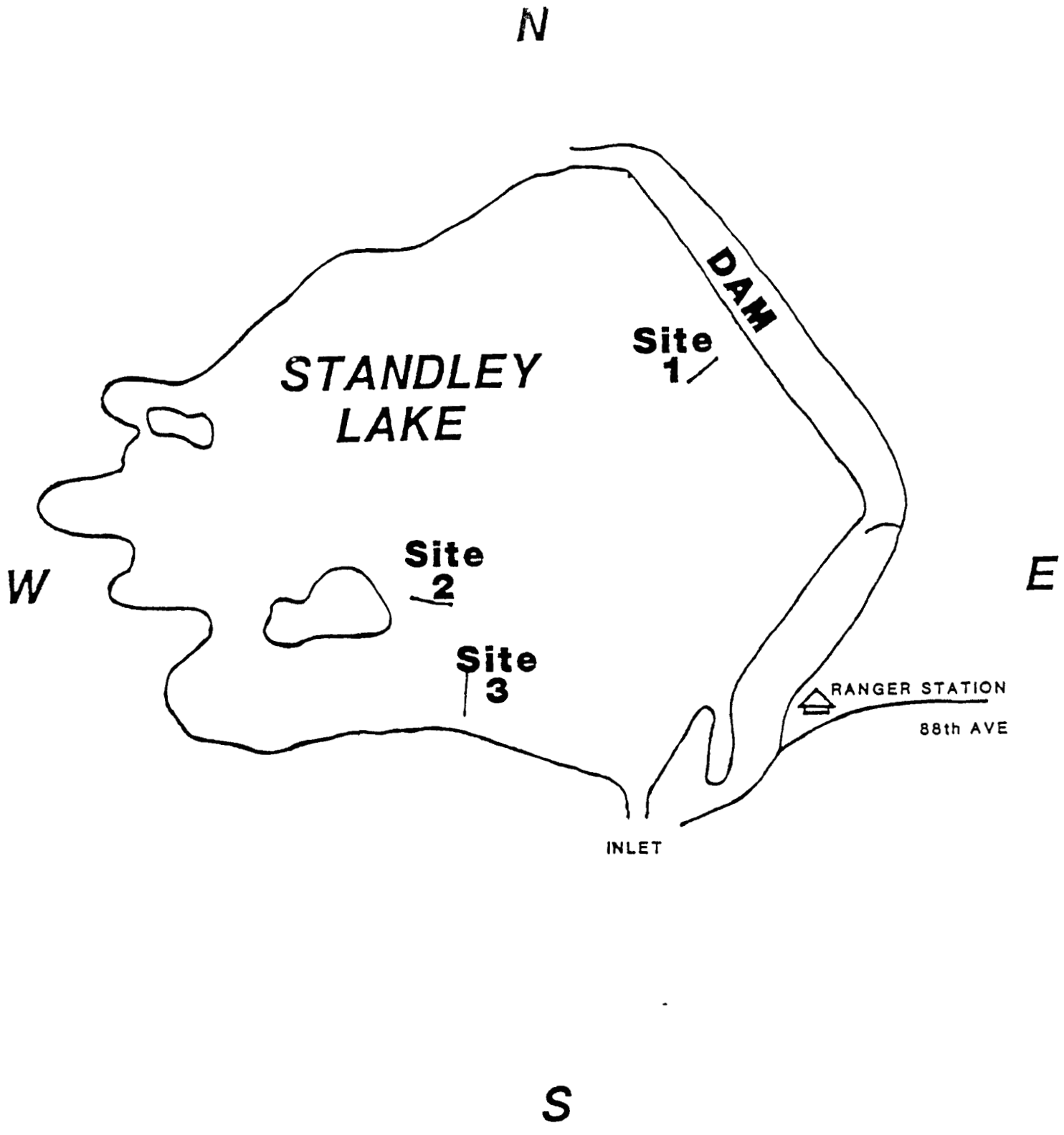

Figure 1 Fish collection locations at Standley Lake Sites 1, 2 and 3 were gillnet sets

transported back to the laboratory. These procedures are [illegible] Environmental Protection Agency (EPA) guidance (U S EPA 1989)

The whole body weights and lengths and the fillet weights of the four target species are presented in Table 1 Fillets were collected from six walleyes, six channel catfish, six smallmouth bass and ten rainbow trout Moisture in the homogenized composites ranged from 73 to 81 percent

LABORATORY PROCESSING

At the laboratory, fish were unwrapped and weigned to the nearest ounce for large fish and to the nearest 10 g for small fish, and measured to the nearest 1/4 inch (reported in cm) After wiping the slime coat from each fish with a paper towel, a skinless fillet from the left side was collected with a stainless steel fillet knife The fillets were individually weighed and then composited by species for either organics or metals analysis Because as much tissue as possible is required for analysis, the entire fillet from each fish was composited Thus composites are weighted towards larger fish Fillets came in contact only with the filleter's hands, the fillet knife and either fresh aluminum foil or fresh plastic depending on their analytical destination

Composite samples were delivered to the chemical laboratory where the fillets were blended into homogeneous composites Those composites for inorganics testing were placed in plastic containers and frozen Those composites for organics analysis were analyzed fresh

RADIOLOGICAL ANALYSIS

In addition to providing information on contaminants that could result from known historical emissions of radioactive materials from the Rocky Flats Plant, these analyses also would provide evidence of either a criticality accident or an operating nuclear reactor Each sample was analyzed for a variety of mixed fission and activation products by direct gamma spectrometric analysis This procedure is the same as that used in the routine surveillance of commercial nuclear power reactors (Colorado Department of Health 1989)

A 10-g aliquot of each composite was analyzed separately for plutonium-239+240 by actinide separation and alpha spectrometry according to CDH methods that have been used since 1970 Tissues were digested in hydrofluoric acid together with a plutonium-236 tracer, and the plutonium was eluted by ion exchange chromatography The plutonium was then electroplated on a stainless steel planchet and the plutonium-239+240 was measured by alpha spectrometry Any sample losses were corrected by measuring the recovery of the plutonium-236 tracer A duplicate analysis was conducted on the channel catfish composite as a quality assurance measure

3050 and diluted to 50 ml [illegible] method

ORGANICS ANALYSIS

Organochlorine and organophosphorus pesticide residues were extracted according to AOAC (AOAC 1984) Method 29 001 and, 29 012 - 29 015 Extracts were analyzed by gas chromatography using both electron capture detection and nitrogen-phosphorus detection Results were confirmed by gas chromatography/-mass spectrometry

METALS ANALYSIS

For chromium, beryllium, lead, cadmium and nickel, 5 0 grams of tissue was digested with nitric acid and hydrogen peroxide according to EPA method 3050 (U S EPA 1986) Digestions were diluted to 50 ml and analyzed by atomic absorption spectrophotometry (AAS) by EPA methods 218 1, 210 1, 239 1, 213 1 and 249 1 (U S EPA 1979)

For mercury 0.5 g was analyzed by cold vapor AAS according to EPA method 245 1 (U S EPA 1979) For selenium, 10 g of each sample was dried and ashed at 600C° then diluted to 50 ml with 0 15% nitric acid A 25- ml aliquot of this solution was then analyzed fluorometrically according to the CDH method

A duplicate analysis for all these metals, mentioned above, was conducted on a separate aliquot of tissue from the channel catfish composite

RISK ASSESSMENT

In performing the risk assessment, the CDH evaluated the impacts of radio-nuclides and EPA Region VIII evaluated organic chemicals and metals

The dose response assessment for radiation was based on the U S Department of Energy's dose conversion factors (U S DOE 1988) For metals and organic chemicals, it was consistent with EPA guidelines (U S EPA 1989)

Because there were no detectable quantities of radionuclides in the fish samples, the typical case was calculated at the lower limit of detection for each of 22 radionuclides for which analyses were performed, to provide a very conservative estimate of potential risk This effective whole body radiation dose (based on individual organ radiation sensitivities) assumes that four ounces of fish would be consumed per week for 70 years This consumption rate is more than twice as conservative as that assumed by the majority of states in establishing fish and water ingestion criteria (U S EPA August, 1989) The human health risk for this typical case dose was determined by summation of the doses for all radionuclides analyzed The collective dose in millirems was equated to health risk at a rate of 0 0002 cases (somatic and genetic) per rem (ICRP 1977)

National Council on Radia[illegible]

(NCRP 1987) of 0 001 rem per year (or 0 070 rem per 70 years) with an associated health risk (somatic only) of 1 in 10,000,000 per year (or 7 0 in a 1,000,000 per 70 years) Details of these assessments are presented in Appendix B

The risk assessment for metals and organic chemicals was conducted by EPA The assumptions used to calculate exposures listed in Appendix C are consistent with those used in the risk assessment for radionuclides For non-carcinogenic compounds, the exposures were compared with the reference doses, found in the EPA Integrated Risk Information System (IRIS), which are the amounts of a chemical which can be ingested without an appreciable risk of deleterious effects during a lifetime In the case of carcinogenic compounds, the exposure was multiplied by the carcinogenic potency factor obtained from IRIS to estimate the upper limit of lifetime cancer risk

RESULTS AND DISCUSSION

In the following sections, findings of chemical and radiological analysis of the fillet composites and the calculated risk assessment are presented As described above, this initial screening project was restricted to composite sampling Because individual fillets were not analyzed, there are no estimates of the range or variance of the underlying population and thus no uncertainty analysis However, compositing unequal weights of fillets from individual fish provides an average weighted towards the larger fish This provides a worst-case analysis because the pollutants tend to accumulate in higher concentration in the larger fish

In addition, because of available time and resources for this initial screening effort, the study did not include a comparison of metals/pesticide residues in fish from other lakes in the region Monitoring of fish for contaminants is not routinely performed in Colorado Therefore, little comparative data were available Had such data been available, it would have been possible to determine whether the concentrations were normal or were atypical

RADIONUCLIDES

Concentrations of radionuclides, including uranium (all isotopes in natural abundance), plutonium-239+240, cesium-137 and 18 other gamma emitters (fission byproducts), were not present in detectable quantities in any of the species of fish that were analyzed (Table 2 and Appendix B) As previously mentioned, although no radionuclides were detected, the lower limits of detection, rather than zeros, were used in the risk evaluation The resulting estimate of risk

fish consumptio[illegible]
detection levels were low enough to identify any health impact if it existed

Analysis for tritium and radiostrontium was not performed However, the failure of other radionuclides to appear in detectable quantities provides sufficient reason to conclude that they would not be present in detectable quantities

The measurement sensitivity for gamma-emitting radionuclides in walleye, catfish and trout was superior to the surveillance requirements of the U S Nuclear Regulatory Commission for fish collected near commercial power reactors Because the amount of tissue in the smallmouth bass sample was small, the sensitivity of the measurements for that sample did not meet these same requirements Sensitivity for the plutonium analysis was considered to be very good for all species

The maximum 70-year committed effective dose equivalent (CEDE) for all radionuclides combined was estimated to be much less than 0 004 rem (CEDE rem) This is much less than the Negligible Individual Risk Level (NIRL) equivalent dose of 0 070 CEDE rem established by the National Council for Radiological Protection and Measuremerts The associated maximum 70-year (somatic and genetic) risk was estimated to be much less than 0 8 in 1,000,000 This estimate was less thar the somatic risk level of 7 0 in 1,000,000 in 70 years calculated from the NIRL

ORGANIC CHEMICALS

Table 2 presents the results of only those organic chemicals found at detectable levels All of the priority pollutant organics with the exception of DDT (Dichloro-diphenyl-trichloroethane) and its metabolites DDE and DDD and malathion were not present in any detectable quantity Concentrations of DDT, DDE, and DDD in the trout, smallmouth bass and walleye ranged from 0 002 to 0 006 ug/g (wet weight basis) and ranged from 0 02 ug/g to 0 03 ug/g in the channel catfish These concentrations are below the FDA allowable tolerance levels which existed at the time that DDT was registered for use A trace of malathion was found only in the smallmouth bass composite, at a non-quantifiable level below 0 1 ug/g, but above the minimum detectable level of 0 01 ug/g

Because of its widespread historical use as a pesticide and its persistence in the environment, DDT and its metabolites DDE and DDD are ubiquitous and are detected in many foods in small amounts, including fish Based on levels found in the channel catfish, average weekly consumption of four ounces of catfish would result in a dose of 0 017 ug/kg/day which is well under the non-cancer

assuming a weekly meal of catfish, would be 6 in 1,000,000 (Appendix C) To put this in perspective, in a group of 1,000 people who ate a weekly meal of channel catfish over a lifetime, an additional 006 cases of cancer would occur in those 1,000 people over what would be expected

The exposure to malathion, an organophosphate insecticide, from a weekly meal of four ounces of smallmouth bass would be 0 01 ug/kg/day, which is well below the acceptable reference dose of 20 ug/kg/day (Appendix C)

METALS

Table 2 lists the concentrations of metals found in the fish fillets expressed on a wet weight basis Only cadmium, mercury and selenium were detected

Cadmium concentrations were 0 48 ug/g in rainbow trout, 0 40 ug/g in the smallmouth bass, 0 26 ug/g in the walleye and less than 0 23 ug/g in the channel catfish The exposure to cadmium from an average weekly consumption of four ounces of rainbow trout would be 0 12 ug/kg/day, which is less than the reference dose of 1 ug/kg/day

Mercury was detected in all species and concentrations ranged from 0 06 ug/g in the rainbow trout to 0 21 ug/g in the smallmouth bass Assuming this mercury to be all methyl mercury, the specified routine consumption of smallmouth bass would result in an exposure of 0 05 ug/kg/day, which is below the reference dose of 0 3 ug/kg/day for methyl mercury

Selenium was found only in the smallmouth bass, at a concentration of 0 02 ug/g This would result in an exposure of 0 005 ug/kg/day, which is less than the reference dose of 3 ug/kg/day

The duplicate analysis of the channel catfish revealed only a difference in the mercury concentrations which were 0 09 ug/g and 0 14 ug/g Other metals were below the detection limit in both samples

POTENTIAL SOURCES OF CONTAMINANTS

This study did not attempt to determine the source of the pollutants detected in the fish However, based on water quality monitoring in the basin, likely sources are the immediate lake environment, and the watershed In addition, the majority of the trout in the lake were stocked, and this study did not include any separate examination that distinguished between recently stocked fish and other fish in the reservoir In the lake, fish accumulate pollutants through a combination of chemical-specific contaminants in food, water and sediment

of which comes from other drainage basins. This is water diverted from Clear Creek through the Farmers' Highline Canal and the Croke Canal. Clear Creek contains pollutants from a variety of sources. For example, in the past five years, it has received pollutants from municipal dischargers, industrial dischargers, mining activities and non-point sources. These sources may have contributed pollutants to the water and sediment.

To a lesser extent, the immediate watershed, including the Rocky Flats area, may be contributing pollutants. However, of the contaminants found in the fish, none are unique to operations at the Rocky Flats Plant.

CONCLUSION

Based on the results of the risk analysis of the fish fillets, using a conservative (i.e., health protective) estimate of lifetime weekly consumption, consumption of an average amount of fish from Standley Lake does not present an appreciable health risk. No non-cancer toxicological impacts were predicted. With regard to DDT, DDE and DDD, there is an extremely small increased lifetime risk of cancer for people eating channel catfish from the lake. However, because DDT and its metabolites are ubiquitous in the environment, the increased risk is not unique to Standley Lake.

This initial screening study did not include the collection and analysis of fish samples from other Colorado lakes and reservoirs. Therefore, no comparisons could be made. As part of follow-up monitoring, multiple composites or individual fish samples from a variety of lakes should be analyzed so that statistical comparisons can be made.

In addition, monitoring should be conducted at Standley Lake to verify the concentrations of mercury and cadmium in fish. These two metals were at concentrations that, although not posing a significant risk, are near the reference doses and therefore warrant further assessment. With this additional monitoring, the data and conclusions in this report could be confirmed.

Acknowledgements

Several people from state and federal agencies contributed to this study Robert McConnell of the CDH Water Quality Control Division was responsible for the sampling design, collection and preparation of the fish for analysis, as well as preparation of a first draft of this report The CDH Laboratory Division, supervised by Dr Elizabeth Sexton and Howard Olson, and the Radiation Control Division performed the chemical analysis of the fish Albert Hazle of the CDH Rocky Flats Program Unit prepared the risk assessment for radionuclides and Dr Robert Benson of EPA Region VIII prepared the risk assessment for metals and organic compounds James Satterfield and Spencer Dumont of the Colorado Division of Wildlife participated in designing the study and collecting the fish Kathleen Bogert provided valuable assistance in the final preparation of this report Critical review and comment were provided by the following persons Paul Frohardt, Kay Kishline, Judy Bruch and Dr Norma Morin of the CDH Rocky Flats Program Unit, by Dr Karen Gottlieb and Judy Becher of the CDH Disease Control and Environmental Epidemiology Division, and by Robert Terry of the CDH Radiation Control Division

Annals of ICRP 1977 ICRP Publication 26 Recommendations of the International Commission on Radiological Protection, p 12

Association of Official Analytical Chemists 1984 Official Methods of Analysis Fourteenth Edition

Colorado Department of Health 1989 Memorandum from R W Terry to R McConnell Fish tissue - fission product analysis

National Council on Radiation Protection and Measurements 1987 Recommendations on Limits for Exposure to Ionizing Radiation Report No 91, Section 20, pp 43-45

U S Department of Energy 1988 Internal Dose Conversion Factors for Calculation of Dose to the Public Washington, DC

U S Environmental Protection Agency 1979 Methods for Chemical Analysis of Water and Wastes EPA-600/4-79-020 (1983 revision) Environmental Monitoring and Support Laboratory, Cincinnati, OH

U S Environmental Protection Agency 1986 Test Methods for Evaluating Solid Waste SW-846 Third Edition Volume 1A Laboratory Manual Physical/Chemical Methods Office of Solid Waste and Emergency Response, Washington, DC

U S Environmental Protection Agency 1987 The Massachusetts Fish Toxics Monitoring Program Water Quality Program Highlights Monitoring and Data Support Division Office of Water, Washington, DC January

U S Environmental Protection Agency 1989 Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish A Guidance Manual EPA-503/8-89-002 Office of Marine and Estuarine Protection and Office of Water Regulations and Standards, Washington, DC

U S Environmental Protection Agency August, 1989 Status Report State Numerical Water Quality Criteria for Toxics

Species	Type of Analysis	Whole fish Length (cm)	Whole fish Weight	Fillet weight (g)
Walleye	I	59	102 oz	450
	I	40	19 oz	66
	I	37	1b oz	82
	O	61	94 oz	390
	O	48	36 oz	180
	O	37	16 oz	73
Channel catfish	I	41	20 oz	70
	I	48	41 oz	145
	I	53	66 oz	290
	O	48	39 oz	79
	O	43	24 oz	41
	O	33	12 oz	22
Smallmouth bass	I	29	10 oz	44
	I	25	5 oz	24
	I	22	102 g	19
	O	29	350 g	49
	O	22	165 g	23
	O	21	135 g	22
Rainbow trout	I	31	8 oz	35
	I	27	6 oz	35
	I	27	185 g	36
	I	34	250 g	40
	I	30	230 g	45
	I	30	310 g	82
	O	31	220 g	35
	O	30	190 g	30
	O	28	230 g	39
	O	26	190 g	35

Type of analysis I = inorganic (wrapped in plastic)
O = organic (wrapped in aluminum foil)

Table 2 Concentration of pollutants in fish fillet (left side without skin) composites collected from Standley Lake on June 18 and 29 1989 Concentrations are on a wet weight basis

Pollutant	Rainbow Trout (Composite)	Channel Catfish (Composite)	Channel Catfish (Duplicate Analysis)	Smallmouth Bass (Composite)	Walleye (Composite)
RADIONUCLIDES pCi/g					
plutonium 239+240	< 0 0002	< 0 0001	< 0 0003	< 0 0003	< 0 0002
cesium 137[A]	< 0 02	< 0 010	---	< 0 282	< 0 009
uranium (all isotopes)	< 0 01	< 0 01	< 0 01	< 0 01	< 0 0.
ORGANIC CHEMICALS[B] - ug/g					
DDT	0 006	0 030	---	0 005	0 004
DDE	0 003	0 020	---	0 002	0 002
DDD	0 004	0 020	---	0 003	0 004
malathion [C]	< 0 01	< 0 01	---	0 040	< 0 0.
fat extract (g)	0 12	0 24	---	0 09	0 2.
METALS - ug/g					
beryllium	< 0 50	< 0 50	< 0 50	< 0 50	< 0 50
cadmium	0 48	< 0 23	< 0 23	0 40	0 26
chromium	< 0 99	< 0 99	< 0 99	< 0 99	< 0 99
lead	< 2 5	< 2 5	< 2 5	< 2 5	< 2 5
mercury	0 06	0 09	0 .4	0 21	0 18
nickel	< 0 99	< 0 99	< 0 99	< 0 99	< 0 99
selenium	< 0 01	< 0 01	< 0 01	0 02	< 0 01
NO FISH PER COMPOSITE					
organics	4	3	---	3	3
metals & radionuclides	6	3	---	3	3

A All other fission byproducts are also less then detectable and are tabulated separately in Appendix B

B Only those organics found at detectable levels are tabulated

C The minimum detectable level is 0 01 ug/g the practical quantitation limit is 0 1 ug/g

Suspected Contaminants for Analysis

Radionuclides

Plutonium - 239 and 240

Uranium

Cesium 137 (and 20 other gamma-emitting fission products)

Americium (not analyzed - may be calculated on the basis of maximum ingrowth in Rocky Flats grade plutonium)

Metals

Chromium

Selenium

Beryllium

Lead

Mercury (total)

Cadmium

Nickel

Organic Chemicals

Priority pollutants analysis including

Volatile organic chemicals

- Chloroform
- Acetone
- Methylene chloride
- Benzene

Semi-volatile organic chemicals

- Phthalates
- Pesticides
- PCB

SOURCE = STANDLEY LAKE (86/29/89)

	DOE REM/uCi CEDE *	picoCurie/gram tissue: WALLEYE PIKE	CATFISH	TROUT	BASS	TYPICAL CASE	70 YR DOSE (REM)	70 YR RISK
Pu-239+240	5 7	< 2e-4	< 2e-4	< 2e-4	< 3e-4	< 2e-4	< 0004706	< 0000001
URANIUM	25	< 01	< 01	< 01	< 01	< 01	< 0010319	< 0000002
GAMMA ANALYSIS								
COUNT TIME (seconds)		75,000	75,000	75,000	175,000			
MASS COUNTED (grams)		536	459.	246.	65 2			
MN-54	.0027	< .009	< .011	< 021	< .29	< .009	< .0000100	< 2.006e-9
CO-58	.0035	< .009	< .011	< 021	< .297	< .009	< 0000130	< 2.600e-9
FE-59	.0066	< .024	< .026	< .051	< .715	< .024	< .0000654	< 1 300e-8
CO-60	.026	< 009	< .01	< 019	< .264	< 009	< .0000966	< 1.932e-8
ZN-65	.014	< 022	< .025	< 049	< .609	< .022	< 0001271	< 2 543e-8
ZR-95	0034	< .007	< .019	< .036	< .536	< .007	< 0000090	< 1 965e-9
NB-95	.0022	< 006	< .011	< .021	< .300	< .006	< .0000054	< 1 090e-9
MO-99	.0044	< 007	< 009	< .02	< .446	< .007	< .0000127	< 2.543e-9
RU-103	.0027	< 006	< 007	< 013	< 266	< 006	< .0000067	< 1 337e-9
RU-106	021	< 072	< 08	< .153	< 2 41	< .072	< .0006241	< 0000001
SB-125	.0026	< 014	< .016	< .03	< 706	< .014	< .0000150	< 3 005e-9
I-131	053	< .005	< .009	< 014	< 309	< .005	< .0001094	< 2 100e-8
TE-132	0074	< .017	< 024	< .055	< 1 12	< 017	< .0000519	< 1.039e-8
CS-134	074	< 011	< 012	< 023	< 332	< 011	< .0003360	< .0000001
CS-136	.011	< 014	< 017	< .033	< .491	< 014	< .0000636	< 1 271e-8
CS-137	05	< .009	< 01	< 02	< .282	< .009	< .0001057	< 3 715e-8
BA-140	0004	< 018	< .022	< 045	< .063	< .018	< 0000624	< 1 240e-8
LA-140	0077	< .01	< 012	< 025	< .306	< 01	< 0000310	< 6 357e-9
CE-144	02	< .003	< .009	< .057	< 2 33	< 003	< .0007677	< 0000002
						'' MAXIMUM TOTAL '' =	<< .0040970	<\ 0000000

CEDE * = Reference Internal Dose Conversion Factors for Calculation of Dose to the Public
U S Department of Energy, Washington, DC, July 1988 (NTIS)
[CEDE = Committed Effective Dose Equivalent (all organs considered)]

NOTE: For equal tissue masses (gms) and counting times, the lower limits of detection will be the same, i.e., Walleye Pike (the most sensitive analysis) used as the TYPICAL CASE

70 YEAR DOSE(REM) = Conc X REM/uCi X 1e-6 uCi/pCi X 1/4 #/meal X 1 meal/week X 52 weeks/year X 70 years
[70 year consumption using acute exposure ingestion equations and 50 year dose acquisition period]

70 YEAR RISK = (70 YEAR DOSE (CEDE REM)) X (0 0002 risk/CEDE REM)

0 0002 risk/CEDE REM = Ref.. International Commission on Radiological Protection #26, p12, para (60)
[includes both somatic (0.0001 risk/REM) and genetic risk (0 0001 risk/REM)]

The Negligible Individual Risk Level of the National Council on Radiation Protection and Measurements is equal to or less than, 0 070 CEDE REM in 70 years and a somatic risk level of 0 000007 in 70 years
[NCRP Report No 91, Section 20, pp 43-45, June 1, 1987]

NOTE: Nothing in this data indicates an impact from the Rocky Flats Plant

09/01/89 AJH

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202 2405

Ref 8WM-DW

MEMORANDUM

Date November 29, 1989

To: Bob McConnell, Water Quality Division
Colorado Department of Health

From Bob Benson, Toxicologist RB
Drinking Water Branch

Subject. Contaminants in fish from Standley Lake

I have reviewed the data on the fish collected from Standley Lake. Only the concentrations of DDT, DDE, DDD, malathion, cadmium, mercury, and selenium exceed the minimum detection levels. Malathion and selenium were detected in only one fish sample. In all cases consumption of a reasonable quantity of fish from Standley Lake results in exposure to the chemical < EPA's reference dose (RfD) for non-cancer toxicological effect for the chemical Because EPA classifies DDT, DDE, and DDD as probable human carcinogens, consumers of fish from Standley Lake will have an increased lifetime risk of cancer A quantitative risk assessment for DDT, DDE, and DDD shows that the upper limit of the lifetime risk of cancer is 6 in 1,000,000

My conclusion is that consumption of a reasonable quantity of fish from Standley Lake does not present a significant health risk to the public. Because cadmium and mercury bioaccumulate in fish tissue, and because the exposures to these chemicals are close to the RfD's, additional monitoring of fish, water, and sediment for these chemicals is prudent. Additional monitoring would be especially prudent if contamination of the lake with cadmium and mercury is likely to continue.

Assumptions

I made the following assumptions:

1. a sportsfisherman and his family consume one meal of fish from Standley Lake per week,
2. the average serving size is 120 grams (about four ounces),
3. exposure continues for a lifetime,
4. the most highly contaminated species is consumed, and
5. the average body weight is 70 kg.

DDT, DDE, and DDD

DDT was previously one of the most widely used pesticides DDE and DDD are degradation products of DDT EPA has cancelled the uses of DDT However, because of persistence in the environment, DDT, DDE, and DDD are often detected in food samples. The average concentration of these chemicals in meat, fish, and poultry in 1982 was 0.003 ug/gram The Food and Drug Administration (FDA) has established an action level for fish in interstate commerce of 5 ug/gram FDA's action level is based on the concept of an unavoidable contamination, rather than a quantitative risk assessment.

The total concentration of DDT, DDE, and DDD in catfish from Standley Lake is 0.07 ug/gram. The RfD for non-cancer effects is 0.5 ug/kg/day. The exposure to DDT, DDE, and DDD from a weekly meal of catfish is 0.017 ug/kg/day.

(120 g fish/meal x 1 meal/week x 1 week/7 days x 1/70 kg x 0.07 ug DDT, DDE, DDD/g fish)

DDT is known to cause liver tumors in experimental animals. On this basis EPA classifies DDT, DDE, and DDD as probable human carcinogens with a cancer slope factor of 0 34 $(mg/kg/day)^{-1}$ The upper limit of the lifetime cancer risk is 6 in 1,000,000.

$[0.34\ (mg/kg/day)^{-1} \times 0.017 \times 10^{-3}\ mg/kg/day]$

Malathion

Malathion is an organophosphate insecticide. The toxicity associated with the ingestion of malathion is inhibition of acetylcholinesterase, an enzyme involved in the transmission of nerve impulses. The concentration of malathion in the smallmouth bass is 0.04 ug/gram. The RfD for malathion is 20 ug/kg/day. The exposure to malathion from a weekly meal of smallmouth bass is 0.01 ug/kg/day.

(120 g fish/meal x 1 meal/week x 1 week/7 days x 1/70 kg x 0.04ug malathion/g fish)

Cadmium

Cadmium is a naturally occurring heavy metal. The toxicity associated with the ingestion of cadmium is kidney damage. Cadmium accumulates in the kidney and causes renal damage when the concentration of cadmium in the kidney exceeds 200 ug/g. Cadmium accumulates in aquatic and terrestrial organisms. Typical concentrations of cadmium in fish from non-polluted areas range from 0.001 to 0.1 ug/gram. The concentration of cadmium in

rainbow trout from Standley Lake is 0 48 ug/gram The RfD for cadmium from food is 1 ug/kg/day The exposure to cadmium from a weekly meal of rainbow trout is 0 12 ug/kg/day.

(120 g fish/meal x 1 meal/week x 1 week/7 days x 1/70 kg x 0.48 ug cadmium/g fish)

Mercury

Mercury is a naturally occurring heavy metal which bioaccumulates in fish as methyl mercury. The major exposure of people to methyl mercury is from fish. The toxicity associated with the ingestion of methyl mercury is damage to the nervous system. The average concentration of methyl mercury in most fish is less than 0.2 ug/gram. The concentration of mercury in smallmouth bass from Standley Lake is 0.21 ug/gram. The RfD for methyl mercury is 0 3 ug/kg/day The exposure to mercury from a weekly meal of smallmouth bass is 0.05 ug/kg/day

(120 g fish/meal x 1 meal/week x 1 week/7 days x 1/70 kg x 0.21 ug mercury/g fish)

Selenium

Selenium is a naturally occurring heavy metal which is an essential nutrient, but which is also toxic when excessive quantities are consumed The amount necessary to maintain good nutritional status is 50-200 ug/day. The average diet contains 75-150 ug/day. Selenosis is observed when ingestion exceeds 3200 ug/day. The concentration of selenium in the smallmouth bass from Standley Lake is 0 02 ug/gram. The RfD for selenium is 3 ug/kg/day. The exposure to selenium from a weekly meal of smallmouth bass is 0.005 ug/kg/day.

(120 g fish/meal x 1 meal/week x 1 week/7 days x 1/70 kg x 0.02 ug selenium/g fish)