UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

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ATLANTA, GEORGIA 30365

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CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Joel G. Murphy
Environmental Engineer
Remedial Activities Branch
Environmental Division
Department of the Navy - Southern Division
Naval Facilities Engineering Command
Code 18213
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Sampling Event Report Number 17, Electrofishing, Fisheries Investigation At Selected Water Bodies

Dear Mr. Murphy:

In response to the June 24, 1993, letter from Kevin Gartland, enclosed is the Environmental Protection Agency's (EPA's) assessment of the Navy's subject report. As the risk assessment indicates, there appear to be moderately toxic and carcinogenic risks associated with the ingestion of fish from the surface waters at the Naval Air Station Jacksonville.

In the risk characterization section of EPA's assessment, attention is noted for the significant ecological hazards associated with the surface water body called the Polishing Pond. The Navy's subject report noted that it is unusual for a lagoon of this age and location to be devoid of fish. Based on the analytical data, EPA believes the lack of fish is directly related to the significant metallic contamination of sediments and surface water. The pattern of contamination indicates influence from an electroplating facility (chrome plating facility) historically discharging into this pond.

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If you have any questions, please call me at (404) 347-3016.

Sincerely,

Doyle T. Brittain

Doyle T. Brittain
Senior Remedial Project Manager

Enclosure

cc: Kevin Gartland, NASJAX
Eric Nuzie, FDER
Arthur G. Linton

ENVIRONMENTAL PROTECTION AGENCY, REGION IV, COMMENTS
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

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1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB) collected surface water, sediment and fish samples from Lake Casa Linda, Lake Scotlis and the Polishing Pond at U.S. Naval Air Station (NAS) - Jacksonville, Jacksonville, Florida. The sampling results were summarized in a sampling event report submitted to EPA Region IV on June 24, 1993. In response to this report, the U. S. Environmental Protection Agency (EPA), Region IV, has completed an evaluation of the potential risks to human health from consumption of fish from Lake Casa Linda, Lake Scotlis and the Polishing Pond.

1.1 Objective of the Fish Ingestion Risk Assessment

The objective of the Fish Ingestion Risk Assessment (FIRA) is to characterize the current and potential risks to human health that may be posed by ingestion of contaminated fish from NAS - Jacksonville. The results of the assessment may be used to determine whether onsite surface waters (i.e., Lake Casa Linda, Lake Scotlis and the Polishing Pond) pose an unacceptable risk to human health and warrant remedial action. Each surface water body is considered separately in the FIRA.

Measured fish contaminant concentrations were used to calculate risks for Lake Casa Linda and Lake Scotlis. No fish were present in the Polishing Pond. Therefore, risks from fish ingestion in the Polishing Pond are based only on measured surface water concentrations and EPA fish bioconcentration factors (BCFs). Estimates of risk based on surface water concentrations and BCFs were also calculated for Lake Casa Linda and Lake Scotlis.

1.2 Scope and Organization of the Fish Ingestion Risk Assessment

This risk assessment is based on environmental sampling data ABB collected during an electrofishing survey at NAS - Jacksonville (ABB 1993). The FIRA addressed the following issues.

1. Potential health risks have been estimated by evaluating the existing conditions at the NAS - Jacksonville site as summarized in Sampling Event Report Number 17, Electrofishing Fisheries Investigation at Selected Water Bodies, Naval Air Station, Jacksonville, Florida (ABB Environmental Services, Inc., 1993).

2. Contaminants of concern (COCs) have been identified by comparing detected concentrations with Federal Ambient Water Quality Criteria (AWQC).

3. Exposure point concentrations have been quantified separately for each water body using the upper 95% confidence limit (UCL) (EPA 1989a) on the arithmetic mean concentrations of each contaminant of concern. Exposure point concentrations have also been modelled from surface water concentrations by utilizing EPA bioconcentration factors.

4. Reasonable maximum exposure (RME) intake levels have been estimated using EPA risk assessment guidance (EPA 1989a and EPA 1991a).

5. Summaries of toxicity criteria have been prepared for the contaminants of concern.

6. Contaminant-specific carcinogenic and noncarcinogenic risks have been presented for residents ingesting recreationally caught fish.

7. Uncertainties associated with the risk assessment have been discussed. Key information bearing on the level of confidence in quantitative risk estimates is presented.

2.0 DATA EVALUATION

A summary of data considered for use in the FIRA is presented in Tables 2-1 through 2-5.

2.1 Surface Water and Fish Tissue Characterization

Samples were collected from Lake Casa Linda, Lake Scotlis, and the Polishing Pond at NAS - Jacksonville. A full discussion of sampling and analysis methods is presented in ABB's sampling event report (ABB 1993).

2.1.1 Surface Water

Three surface water samples each were collected from Lake Casa Linda, Lake Scotlis and the Polishing Pond. A duplicate was also collected from Lake Scotlis.

2.1.2 Fish Tissue

Seven fish tissue samples were collected from Lake Casa Linda, and five fish tissue samples were collected from Lake Scotlis; no fish could be collected from the Polishing Pond because, as the sampling event report states, the Polishing Pond is devoid of fish of any kind. Each sample from Lake Casa Linda and Lake Scotlis consisted of several individual fish sorted by species and size group. The samples were not all handled similarly. Fillets, livers and gonads and whole fish excluding fillets were analyzed.

2.2 Evaluation of Qualified and Coded Data

A variety of organic and inorganic contaminants were detected in both surface water and fish tissues. All qualified and coded data were evaluated for potential use in the risk assessment according to EPA risk assessment guidance, as summarized below.

All data qualified to indicate uncertainties in concentration, but not in identification (i.e., data accompanied by the qualifiers B, D, J or P), were used in the risk assessment at the reported concentration. The following qualifiers were used:

- B - Reported concentration less than Contract Required Detection Limit (CRDL) but greater than or equal to Instrument Detection Limit (IDL).

- D – Identifies a compound that's reported analytical result is calculated from a greater dilution than the primary analysis.
- J – The value reported is an estimated concentration. This qualifier is used when the mass spectrograph data indicates the presence of a compound that meets identification criteria, but the result is less than the reporting limit.
- P – Indicates a pesticide analyte with a greater than 25 percent difference for detected concentrations between GC columns.

Chemicals analyzed for but not detected (those qualified by a U in every sample analysis) were eliminated from further evaluation.

TABLE 2-1
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - LAKE CASA LINDA FISH TISSUE SAMPLES

CONTAMINANT	JAXCLB001		JAXCLB002		JAXCLB003		JAXCLB004		JAXCLB00501	
	FILLET	LIVER/GONAD	FILLET	LIVER/GONAD	FILLET	LIVER/GONAD	FILLET	CARCASS	FILLET	CARCASS
Semivolatile Organic Compounds (SVOCs)										
4-Methylphenol	2,000U	82,000U	2,000U	50,000U	14,000	50,000U	2,000U	2,000U	4,000U	4,000U
Pesticides/PCBs										
alpha-Chlordane	5.1U	51U	5.1U	10U	5.1U	26U	5.1U	5.1U	6.7P	5.1U
4,4'-DDD	9.9U	99U	9.9U	20U	9.9U	30JP	9.9U	10P	9.9U	12P
4,4'-DDE	39	850D	13	150	10	230	15	72	77	120
Aroclor-1254	130U	2,800D	46J	420	43J	760	53JP	180	260	340
Concentrations presented in ug/kg										
Inorganic Compounds										
Aluminum	0.97U	1B	0.97U	2.6B	0.97U	35.2	1.2B	4B	0.97U	4.6B
Arsenic	0.03U	0.03U	0.03U	0.03U	0.03B	0.25B	0.03U	0.03U	0.03B	0.03U
Barium	0.07B	0.34B	0.11B	0.4B	0.43B	1.1B	0.72B	2B	0.91B	3B
Calcium	1,090	2,530	2,650	2,100	3,820	2,100	6,280	15,400	4,110	13,600
Chromium	0.17B	0.21B	0.15B	0.16B	0.18B	0.31B	0.33B	0.43	0.19B	0.4B
Copper	0.88B	1.4	0.33B	1.4	0.43B	1.5	0.53B	0.53B	1	1.5
Cyanide	0.14U	0.14U	0.14U	0.14U	0.14U	0.14U	0.14U	0.89B	0.14U	0.14U
Iron	3.6B	86.7	4.6	89.8	8.4	467	18.2	31.4	56.1	91.9
Lead	0.07U	0.11B	0.1B	0.09B	0.08B	0.91	0.15	0.31	0.23	0.65
Magnesium	305	223	319	258	349	212	387	518	325	388
Manganese	0.16B	1.2	0.2B	1.1	0.97	4.2	1.5	3.7	1.6	5.3
Mercury	0.08B	0.05B	0.06B	0.02U	0.06B	0.03U	0.03U	0.03U	0.03U	0.03B
Potassium	4,540	2,500	4,150	2,910	3,990	2,190	3,950	3,460	3,880	3,000
Selenium	0.07U	0.37	0.16B	0.36	0.14B	0.31	0.07U	0.13B	0.07u	0.22
Sodium	550	1,140	637	1,030	752	1,100	876	1,020	1,050	1,330
Vanadium	0.11U	0.11U	0.11U	0.11U	0.11U	0.3B	0.11U	0.11U	0.11U	0.11U
Zinc	8	22.4	9.7	23.4	12.7	20	13.4	28	12.6	25.6
Concentrations presented in mg/kg										

U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
P - Indicates a pesticide analyte with a greater than 25% difference for detected concentrations between GC columns.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
D - Diluted Sample.

TABLE 2-1, Continued
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - LAKE CASA LINDA FISH TISSUE SAMPLES

CONTAMINANT	JAXCLB00601 FILLET	JAXCLB00601 CARCASS	JAXCLB00701 FILLET	JAXCLB00701 CARCASS	MINIMUM	MAXIMUM	FREQUENCY OF DETECTION
Semivolatile Organic Compounds (SVOCs)							
4-Methylphenol	4,000U	4,000U	4,000U	4,000U	2,000U	82,000U	1/14
Pesticides/PCBs							
alpha-Chlordane	13P	30DP	3JP	13P	3	51	5/14
4,4'-DDD	12P	23DJP	9.9U	13P	9.9U	99	6/14
4,4'-DDE	120	200D	34	100	10	850	14/14
Aroclor-1254	390	590DP	120	260	43	2,800	11/14
Concentrations presented ug/kg							
Inorganic Compounds							
Aluminum	1.4B	6.6B	1.1B	10.1	0.97U	35.2	10/14
Arsenic	0.03U	0.03B	0.05B	0.08B	0.03U	0.25	6/14
Barium	0.93B	2.2B	1.2B	2.2B	0.07	3	14/14
Calcium	4,240	12,400	4,470	11,100	1,090	15,400	14/14
Chromium	0.21B	0.38B	0.21B	0.35B	0.15	0.43	14/14
Copper	1	1.1	1.4	1.5	0.33	1.5	14/14
Cyanide	0.14U	0.14U	0.14U	0.14U	0.14U	0.89	1/14
Iron	30.6	86.6	31.3	68.4	3.6	467	14/14
Lead	0.27	0.73	0.16	0.45	0.07U	0.91	13/14
Magnesium	296	332	302	431	212	518	14/14
Manganese	2.2	5	2	4.4	0.16	5.3	14/14
Mercury	0.03U	0.04B	0.03U	0.04B	0.02U	0.08	7/14
Potassium	3,770	2,980	3,020	3,350	2,190	4,540	14/14
Selenium	0.07U	0.2B	0.22	0.18B	0.07U	0.37	10/14
Sodium	979	1,270	830	1,080	550	1,330	14/14
Vanadium	0.11U	0.11U	0.11U	0.12B	0.11U	0.3	2/14
Zinc	13.6	27.6	17.7	31.8	8	31.8	14/14
Concentrations presented in mg/kg							

U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
P - Indicates a pesticide analyte with a greater than 25% difference for detected concentrations between GC columns.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
D - Diluted Sample.

TABLE 2-2
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - LAKE SCOTLIS FISH TISSUE SAMPLES

CONTAMINANT	JAXLSB001		JAXLSB002		JAXLSB003		JAXLSB004	
	FILLET	CARCASS	FILLET	CARCASS	FILLET	CARCASS	FILLET	CARCASS
Semivolatile Organic Compounds (SVOCs)								
Bis(2-ethylhexyl)phthalate	4,000U	4,000U	990U	4,000U	990U	4,000U	990U	4,000U
Di-n-butylphthalate	4,000U	4,000U	250J	4,000U	990U	4,000U	990U	4,000U
4-Methylphenol	690J	4,000U	990U	4,000U	990U	4,000U	990U	4,000U
Pesticides/PCBs								
alpha-Chlordane	5.1U	5.1U	5.1U	5.1U	5.1U	5.1U	5.1U	5.1U
4,4'-DDE	15	54	9.1J	19	12	27	7.2J	69
Aroclor-1254	110	250	59J	140	99U	130	99U	130
Concentrations presented in ug/kg								
Inorganic Compounds								
Aluminum	0.97U	3.1B	0.97U	9.1	11.8	12.5	8.8	15
Arsenic	0.03U	0.03U	0.03U	0.03B	0.03U	0.03U	0.03U	0.03U
Barium	0.1B	0.63B	0.11B	0.56B	0.61B	1.8B	0.78B	1.3B
Calcium	2,010	20,300	2,640	13,200	4,010	10,800	3,670	16,100
Chromium	0.21B	0.52	0.18B	0.39B	0.22B	0.33B	0.14B	0.48
Cobalt	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U
Copper	0.33B	1	0.33B	1.1	0.6B	0.24B	0.55B	0.12B
Cyanide	0.14U	0.14U	0.14U	0.14U	0.14U	0.14U	0.14U	0.14U
Iron	4.8	13.6	4.9	18.5	9.5	20.3	8.5	32.5
Lead	0.12	0.99	0.17	2	0.42	1.4	0.42	2.1
Magnesium	306	585	308	486	312	407	284	529
Manganese	0.16B	0.95	0.2B	0.86	0.99	2.8	1.3	2.6
Mercury	0.21	0.06B	0.07B	0.05B	0.03U	0.04B	0.06B	0.07B
Potassium	4,060	3,420	3,770	3,200	3,340	3,110	3,800	3,040
Selenium	0.26	0.19B	0.29	0.22	0.28	0.28	0.2	0.14B
Sodium	779	1,210	799	1,070	845	932	869	1,090
Vanadium	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11B
Zinc	7.3	18.5	9.3	29.5	16.3	34.2	11.1	26.9
Concentrations presented in mg/kg								

U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
P - Indicates a pesticide analyte with a greater than 25% difference for detected concentrations between GC columns.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
D - Diluted Sample.

TABLE 2-2, Continued
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - LAKE SCOTLIS FISH TISSUE SAMPLES

CONTAMINANT	JAXLSB005 FILLET	CARCASS	MINIMUM	MAXIMUM	FREQUENCY OF DETECTION
Semivolatile Organic Compounds (SVOCs)					
Bis(2-ethylhexyl)phthalate	1,500J	4,000U	990	4,000U	1/10
Di-n-butylphthalate	4,000U	4,000U	250	4,000U	1/10
4-Methylphenol	4,000U	4,000U	690	4,000U	1/10
Pesticides/PCBs					
alpha-Chlordane	160DP	150DP	5.1U	160	2/10
4,4'-DDE	520D	420DP	7.2	520	10/10
Aroclor-1254	3,500D	3200D	59	3500	10/10
Concentrations presented in ug/kg					
Inorganic Compounds					
Aluminum	12.8	4.1B	0.97U	15	10/10
Arsenic	0.06B	0.04B	0.03U	0.06	3/10
Barium	0.78B	0.45B	0.1	1.8	10/10
Calcium	8,580	2,890	2,010	20,300	10/10
Chromium	0.33B	0.19B	0.14	0.52	10/10
Cobalt	0.11U	0.15B	0.11U	0.15	1/10
Copper	1.3	1	0.12	1.3	10/10
Cyanide	0.28B	0.14U	0.14U	0.28	1/10
Iron	36.4	19.4	4.8	36.4	10/10
Lead	1.5	0.52	0.12	2.1	10/10
Magnesium	304	282	282	585	10/10
Manganese	1.2	0.66	0.16	2.8	10/10
Mercury	0.06B	0.03U	0.03U	0.21	8/10
Potassium	2,790	3,400	2,790	4,060	10/10
Selenium	0.44	0.33	0.14	0.44	10/10
Sodium	999	737	737	1,210	10/10
Vanadium	0.11B	0.11U	0.11U	0.11	1/10
Zinc	16.3	7.5	7.3	34.2	10/10
Concentrations presented in mg/kg					

U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
P - Indicates a pesticide analyte with a greater than 25% difference for detected concentrations between GC columns.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
D - Diluted Sample.

TABLE 2-3
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - LAKE CASA LINDA SURFACE WATER CONCENTRATIONS

CONTAMINANT	JAXCLSW01	JAXCLSW02	JAXCLSW03	MINIMUM	MAXIMUM	FREQUENCY OF DETECTION
Semivolatile Organics Compounds (SVOCs)						
Bis(2-ethylhexyl)phthalate	2BJ	10U	10U	2	10U	1/3
Carbazole	2BJ	10U	10U	2	10U	1/3
Di-n-butylphthalate	2BJ	10U	10U	2	10U	1/3
Pyrene	1BJ	10U	10U	1	10U	1/3
Inorganic Compounds						
Aluminum	35.2B	45.4B	39.7B	35.2	45.4	3/3
Arsenic	1.7U	1.4U	2U	ND	ND	ND
Barium	42.6B	49.6B	43.2B	42.6	49.6	3/3
Cadmium	2.8U	2.8U	2.8U	ND	ND	ND
Calcium	23,200	24,300	23,500	23,200	24,300	3/3
Chromium	2.8U	2.8U	2.8U	ND	ND	ND
Copper	1.2U	1.2U	3.2B	1.2U	3.2	1/3
Cyanide	3.7B	1.4U	1.4U	1.4U	3.7	1/3
Iron	3,340	7,910	2,920	292	791	3/3
Lead	1.7U	3.30	1.7U	1.7U	3.3	1/3
Magnesium	6,500	6,590	6,530	6,500	6,590	3/3
Manganese	6.7B	9.2B	6.8B	6.7	9.2	3/3
Mercury	0.07U	0.08B	0.07U	0.07U	0.08	1/3
Nickel	9.4U	9.4U	9.4U	ND	ND	ND
Potassium	3,230B	3,180B	3,340B	3,180	3,340	3/3
Selenium	1.8U	1.8U	1.9B	1.8U	1.9	1/3
Sodium	6,440	6,750	6,690	6440	6,750	3/3
Zinc	9U	9U	9.8B	9U	9.8	1/3

Concentrations presented in ug/l
U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
D - Diluted sample.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
ND - Not detected.

TABLE 2-4
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - LAKE SCOTLIS SURFACE WATER CONCENTRATIONS

CONTAMINANT	JAXLSSW01	JAXLSSW02	JAXLSSW03	MINIMUM	MAXIMUM	FREQUENCY OF DETECTION
Semivolatile Organics Compounds (SVOCs)						
Bis(2-ethylhexyl)phthalate	10U	2J	10U	2	10U	1/4
Carbazole	10U	10U	10U	ND	ND	ND
Di-n-butylphthalate	10U	1J	10U	1	10U	1/4
Pyrene	10U	10U	10U	ND	ND	ND
Inorganic Compounds						
Aluminum	51.1B	51.9B	41.4B	38.9	51.9	4/4
Arsenic	1.7U	1.8U	1.4U	ND	ND	ND
Barium	37.2B	36.3B	36.9B	36.3	37.4	4/4
Cadmium	2.8U	2.8U	2.8U	ND	ND	ND
Calcium	23,200	23,000	23,200	23,000	23,500	4/4
Chromium	2.8U	2.8U	2.8U	ND	ND	ND
Copper	4B	3.5B	3.5B	2.9	4	4/4
Cyanide	1.4U	1.4U	1.4U	ND	ND	ND
Iron	243	214	275	214	275	4/4
Lead	4.7	5.4	4.2	4.2	5.4	4/4
Magnesium	11,700	11,500	11,700	11,500	11,700	4/4
Manganese	3.8B	3.3B	3.9B	3.3	3.9	4/4
Mercury	0.07U	0.07U	0.07U	ND	ND	ND
Nickel	9.4U	9.4U	9.4U	ND	ND	ND
Potassium	1,520B	1,420B	1,500B	1,170	1,520	4/4
Selenium	1.8U	1.8U	1.8U	ND	ND	ND
Sodium	8,290	8,200	8,300	8,200	8,320	4/4
Zinc	14.6B	12.3B	9U	9U	14.6	3/4

Concentrations presented in ug/l
U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
ND - Not detected.

TABLE 2-5
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

SUMMARY OF ANALYTICAL RESULTS - POLISHING POND SURFACE WATER CONCENTRATIONS

CONTAMINANT	JAXPPSW01	JAXPPSW02	JAXPPSW03	MINIMUM	MAXIMUM	FREQUENCY OF DETECTION
Semivolatile Organics Compounds (SVOCs)						
Bis(2-ethylhexyl)phthalate	1U	10U	10U	ND	ND	ND
Carbazole	10U	2J	10U	2	10U	1/3
Di-n-butylphthalate	1J	10U	1J	1	10U	1/3
Pyrene	10U	10U	10U	ND	ND	ND
Inorganic Compounds						
Aluminum	63.9B	270	264	63.9	270	3/3
Arsenic	1.4B	1.5B	1B	1	1.5	3/3
Barium	10.4B	12.9B	12.9B	10.4	12.9	3/3
Cadmium	3.1B	2.8U	5.4	2.8U	5.4	2/3
Calcium	34,300	33,600	33,500	33,500	34,300	3/3
Chromium	29.4	28.9	39.2	28.9	39.2	3/3
Copper	4.3B	5.3B	8.3B	4.3	8.3	3/3
Cyanide	3B	7.5B	12.7	3	12.7	3/3
Iron	373	404	425	373	425	3/3
Lead	3.1	2.8B	2.2B	2.2	3.1	3/3
Magnesium	13,700	13,500	13,500	13,500	13,700	3/3
Manganese	54	51.5	51.5	51.5	54	3/3
Mercury	0.07U	0.07U	0.07U	ND	ND	ND
Nickel	43	49.2	48.9	43	49.2	3/3
Potassium	7,240	7,320	7,250	7,240	7,320	3/3
Selenium	1.8U	1.8U	1.8U	ND	ND	ND
Sodium	19,600	20,300	20,200	19,600	20,300	3/3
Zinc	12B	26.2	20.6	12	26.2	3/3

Concentrations presented in ug/l
U - Compound not identified above detection limit (detection limit is listed).
J - Estimated concentration.
B - Reported concentration less than contract required detection limit (CRDL), but greater than or equal to instrument detection limit (IDL).
ND - Not detected.

3.0 SELECTION OF CONTAMINANTS OF CONCERN

3.1 The Selection Process

The rationale for selection of contaminants of concern used in this assessment are based on EPA risk assessment guidance (EPA 1989a, EPA 1991b and EPA 1992). Contaminants of concern in each medium (surface water and biota) are listed in Table 3-1.

Maximum concentrations in surface water were compared to Federal AWQC for the Ingestion of Organisms (see Table 3-2). Any surface water contaminants present at concentrations less than the AWQC were not evaluated in the risk assessment.

Contaminants detected in at least one fish tissue sample were retained for evaluation in the risk assessment.

Aluminum, calcium, iron, magnesium, potassium, sodium and zinc were eliminated from the list of contaminants of concern because of their inherently low toxicity and nutritive value.

TABLE 3-1
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTAMINANTS OF CONCERN

LAKE CASA LINDA	LAKE SCOTLIS	POLISHING POND
Fish Fillets	Fish Fillets	
4-Methylphenol	Bis(2-ethylhexyl)phthalate	
alpha-Chlordane	Di-n-butylphthalate	
4,4'-DDD	4-Methylphenol	
4,4'-DDE	alpha-Chlordane	
Aroclor-1254	4,4'-DDE	
Arsenic	Aroclor-1254	
Barium	Arsenic	
Chromium	Barium	
Copper	Chromium	
Lead	Copper	
Manganese	Cyanide	
Mercury	Lead	
Selenium	Manganese	
Whole Fish	Whole Fish	
4-Methylphenol	Bis(2-ethylhexyl)phthalate	
alpha-Chlordane	di-n-butylphthalate	
4,4'-DDD	4-Methylphenol	
4,4'-DDE	alpha-Chlordane	
Aroclor-1254	4,4'-DDE	
Arsenic	Aroclor-1254	
Barium	Arsenic	
Chromium	Barium	
Copper	Chromium	
Lead	Cobalt	
Manganese	Copper	
Mercury	Cyanide	
Selenium	Lead	
Vanadium	Manganese	
	Mercury	
	Selenium	
	Vanadium	
Fish Concentration Modelling	Fish Concentration Modelling	Fish Concentration Modelling
Carbazole	Barium	Carbazole
Pyrene	Copper	Arsenic
Barium	Lead	Barium
Copper	Selenium	Cadmium
Cyanide		Chromium
Lead		Copper
Selenium		Cyanide
		Lead

TABLE 3-2
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

COMPARISON TO MAXIMUM CONCENTRATIONS TO AMBIENT WATER QUALITY CRITERIA

CONTAMINANT	MAXIMA			AWQC[1]	
	LAKE CASA LINDA	LAKE SCOTLIS	POLISHING POND	WATER AND ORGANISMS	ORGANISMS ONLY
Semivolatile Organic Compounds (SVOCs)					
Bis(2-ethylhexyl)phthalate	10	10	ND	15,000	50,000
Carbazole	10	ND	10	---	---
Di-n-butylphthalate	10	10	10	34,000	154,000
Pyrene	10	ND	ND	---	---
Inorganic Compounds					
Aluminum	45.4	51.9	270	---	---
Arsenic	ND	ND	1.5	0.0022	0.0175
Barium	49.6	37.4	12.9	1,000	---
Cadmium	ND	ND	5.4	10	---
Calcium	24,300	23,500	34,300	---	---
Chromium	ND	ND	39.2	50[2]	---[2]
Copper	3.2	4	8.3	---	---
Cyanide	3.7	ND	12.7	200	---
Iron	791	275	425	300	---
Lead	3.3	5.4	3.1	50	---
Magnesium	6,590	11,700	13,700	---	---
Manganese	9.2	3.9	54	50	100
Mercury	0.08	ND	ND	0.144	0.146
Nickel	ND	ND	49.2	13.4	100
Potassium	3,340	1,520	7,320	---	---
Selenium	1.9	ND	ND	10	---
Sodium	6,750	8,320	20,300	---	---
Zinc	9.8	14.6	26.2	---	---

Concentrations presented in ug/l
[1]Federal Ambient Water Quality Criteria (EPA 1991).
[2]Chromium VI value.

--- Indicates compound not listed.
▒ Indicates that the concentration exceeds AWQC for organisms only.

4.0 EXPOSURE ASSESSMENT

This document provides an assessment of the potential risks to humans associated with the ingestion of fish in Lake Casa Linda, Lake Scotlis and the Polishing Pond at the NAS - Jacksonville.

4.1 Exposure Point Concentration of Chemicals of Concern

Reasonable maximum exposure concentrations have been calculated for the contaminants of concern in fish. Table 4-1 presents the RME for COCs in fish fillets, whole fish and modelled estimates of whole fish. The RME was calculated according to EPA risk assessment guidance (EPA 1989a), as described below.

The 95% UCL of the arithmetic mean was considered the reasonable maximum exposure concentration. To determine the 95% UCL for the arithmetic mean for each COC in each surface water and fish sample, the following formula was used:

$$UCL_{95} = X_a + t\left(\frac{\sigma}{\sqrt{n}}\right)$$

where,

UCL_{95} = the upper 95% confidence limit for the arithmetic mean;

X_a = arithmetic mean of the raw data;

σ = arithmetic standard deviation of the raw data;

t = tabular statistic, depends on degrees of freedom (df = n-1) and selected degree of probability (one tailed @ $p<0.05$); and

n = sample size.

If the 95% UCL for the arithmetic mean exceeded the maximum detected concentration, then the maximum concentration was substituted as the reasonable maximum exposure concentration for the risk calculations.

TABLE 4-1
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

REASONABLE MAXIMUM EXPOSURE CONCENTRATIONS

	LAKE CASA LINDA FISH CONCENTRATIONS			LAKE SCOTLIS FISH CONCENTRATIONS			POLISHING POND FISH CONCENTRATIONS
CONTAMINANT	FILLET	WHOLE BODY	MODELLED	FILLET	WHOLE BODY	MODELLED	MODELLED
Semivolatile Organic Compounds (SVOCs)	(ug/kg)	(ug/kg)	(ug/l)	(ug/kg)	(ug/kg)	(ug/l)	(ug/l)
Bis(2-ethylhexyl)phthalate				1.67E+03	3.50E+03*		
Carbazole							
Di-n-butylphthalate				2.50E+02*	2.25E+03 *		
4-Methylphenol	6.78E+03	3.04E+04		6.90E+02*	2.69E+03 *		
Pyrene							
Pesticides/PCBs							
alpha-Chlordane	7.61E+00	2.77E+01		1.01E+02	1.96E+02		
4,4'-DDD	7.91E+00	3.50E+01					
4,4'-DDE	7.39E+01	4.92E+02*		3.30E+02	6.09E+02		
Aroclor-1254	2.38E+02	1.57E+03		2.22E+03	4.28E+03		
Inorganic Compounds	(mg/kg)	(mg/kg)	(ug/l)	(mg/kg)	(mg/kg)	(ug/l)	(ug/l)
Arsenic	3.41E-02	1.53E-01		4.32E-02	7.59E-02		6.60E-02*
Barium	9.42E-01	3.27E+00		7.80E-01*	2.18E+00		
Cadmium							2.51E-01*
Chromium	2.49E-01	6.35E-01		2.84E-01	6.76E-01	3.14E-01*	
Cobalt					1.70E-01		
Copper	1.08E+00	2.50E+00	6.40E-01*	1.00E+00	1.92E+00	7.50E-01*	1.66E+00*
Cyanide		4.85E-01		2.02E-01	2.72E-01		
Lead	2.07E-01	8.76E-01		1.06E+00	2.43E+00	1.24E-01*	4.48E-02*
Manganese	1.83E+00	6.62E+00		1.29E+00	3.69E+00		
Mercury	5.80E-02	8.93E-02		1.54E-01	2.10E-01		
Selenium	1.51E-01	4.42E-01	8.09E-02*	3.79E-01	6.78E-01	1.44E-02	
Vanadium		2.22E-01		8.94E-02	1.61E-01		

*Indicates maximum concentration is the reasonable maximum exposure.

Three different exposure point concentrations were utilized to estimate risks from each water body (Lake Casa Linda, Lake Scotlis and the Polishing Pond). The three different exposure point concentrations and the methods used to derive them follows.

- Fillet concentrations: Analytical data from the fillets only were utilized to derive the fish fillet RME;
- Whole body concentrations: Analytical data from the fillets plus carcasses, or fillets plus liver and gonads, were summed to determine the whole body RME. If a COC was not detected in one of the two (fillet and carcass or fillet and liver and gonads) analyses for a sample, one-half of the detection limit was added to the detected concentration, and the COC was considered detected in that whole body sample. If a COC was not detected in either of the two analyses for a sample, one-half of each detection limit was summed, and the COC was considered not detected in that whole body sample.
- Modelled concentrations: Analytical data from surface water were multiplied by the chemical-specific BCF to yield an estimated contaminant concentration in fish.

Only modelled concentrations could be used for the Polishing Pond, as no fish were collected there. All three exposure point concentrations were used in calculating risk estimates for Lake Casa Linda and Lake Scotlis.

4.2 Calculation of Intake

Ingested quantities were estimated using standard EPA exposure assumptions (EPA 1989a, EPA 1991a, EPA 1991b and EPA 1992). See Table 4-2. The assumed ingestion rate for adults is 54 grams per day (g/day) and 27 g/day for children (EPA 1991a).

TABLE 4-2
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

INGESTION OF CONTAMINATED FISH
EXPOSURE ASSUMPTIONS

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CF*IR*FI*EF*ED}{BW*AT}$$

Where:

CF = Measured Chemical Concentration in Fish (mg/kg), or

$$CF = CSW*BCF$$

CF = Estimated Chemical Concentration in Fish (mg/kg)
CSW = Chemical Concentration in Surface Water (mg/l)
BCF = Bioconcentration Factor (l/kg)
IR = Ingestion Rate (kg/day)
FI = Fraction Ingested from Contaminated Source (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
NCAT = Noncarcinogenic Averaging Time (period over which exposure resulting in noncarcinogenic effects is averaged - days)
CAT = Carcinogenic Averaging Time (period over which exposure resulting in carcinogenic effects is averaged - days)

Variable Values:

CF: Site-specific measured value

CSW: Site-specific measured value

BCF: Chemical-specific bioconcentration factor (EPA 1986)

IR: 0.054 kg/day (EPA 1991a)
0.027 kg/day (child: assumes that the fish intake of a child equals one-half that of an adult)

FI: 1 (assumes the site is the source for all consumed fish)

EF: 350 days/year (EPA 1991a)

ED: 24 years (adult; EPA 1991a)
6 years (child; EPA 1991a)

BW: 70 kg (adult, average; EPA 1989a)
15 kg (child; EPA 1991a)

NCAT: 8,760 days (adult, ED * 365 days/year; EPA 1991a)
2,190 days (child, ED * 365 days/year; EPA 1991a)

CAT: 25,550 days (70-year lifetime * 365 days/year; EPA 1991a)

5.0 TOXICITY ASSESSMENT

The EPA toxicity criteria used in this FIRA are presented in Table 5-1.

TABLE 5-1
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

EPA QUANTITATIVE TOXICITY CRITERIA[a]

CONTAMINANT	ORAL RFD (mg/kg-day)	ORAL CPS $(mg/kg\text{-}day)^{-1}$
Semivolatile Organic Compounds (SVOCs)		
Bis(2-ethylhexyl)phthalate	2.00E-02	1.40E-02
Carbazole		2.00E-02
Di-n-butylphthalate	1.00E-01	
4-Methylphenol	5.00E-03	
Pyrene	3.00E-02	
Pesticides/PCBs		
alpha-Chlordane	6.00E-05	1.30E+00
4,4'-DDD		2.40E-01
4,4'-DDE		3.40E-01
Aroclor-1254		7.70E+00
Inorganics Compounds		
Arsenic	3.00E-04	1.75E+00
Barium	7.00E-02	
Cadmium	5.00E-04	
Chromium	5.00E-03[b]	
Cobalt		
Copper	3.71E-02	
Cyanide	5.00E-03[c]	
Lead		
Manganese	5.00E-03	
Mercury	3.00E-04	
Selenium	5.00E-03	
Vanadium	7.00E-03	

[a]EPA 1993.
[b]Chromium VI value.
[c]Most conservative cyanide compound value, copper cyanide.

6.0 RISK CHARACTERIZATION

6.1 Introduction

The potential carcinogenic and noncarcinogenic risks associated with ingestion of the fish in Lake Casa Linda, Lake Scotlis and the Polishing Pond at NAS - Jacksonville were calculated as described below.

6.2 Noncarcinogenic Hazards

The noncarcinogenic hazards associated with chronic exposure to contaminants in fish at NAS - Jacksonville were characterized by comparing the Non-Carcinogenic Chronic Daily Intake (NCCDI) to the Reference Dose (RfD).

The Hazard Quotient is the ratio of the NCCDI to the RfD measured in units of milligrams per kilogram per day (mg/kg-day).

$$\text{Hazard Quotient} = \frac{\text{NCCDI (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

The Hazard Index represents the overall potential for noncarcinogenic effects associated with ingestion of fish that have a variety of contaminants. It assumes that multiple subthreshold exposures could result in an adverse non-carcinogenic systemic health effect, and that the magnitude of the effect is proportional to the sum of the Hazard Quotients.

$$\text{Hazard Index} = \sum \frac{NCCDI_1}{RfD_1} + \frac{NCCDI_2}{RfD_2} + \ldots + \frac{NCCDI_i}{RfD_i}$$

where:

$NCCDI_i$ = noncarcinogenic intake for the i site-specific chemical

RfD_i = Reference Dose for the i site-specific chemical

Hazard Quotient and Index values below 1.0 suggest that noncarcinogenic toxic effects should not occur. Values above 1.0 indicate that effects could be of concern, especially in sensitive populations. The higher the dose is relative to the RfD, the more likely it is that a deleterious effect will occur.

6.3 Carcinogenic Hazards

Carcinogenic risks were estimated as the increased possibility, above background, that an individual would contract cancer in his lifetime under the exposure conditions assumed for fish ingestion at NAS - Jacksonville (see Table 4-2). The Carcinogenic Potency Slope (CPS) of a chemical is the 95% UCL of the slope of the extrapolated dose-response curve. The CPS converts the Carcinogenic Chronic Daily Intake (CCDI) for potential carcinogens to an incremental cancer risk estimate.

$$\text{Incremental Lifetime Cancer Risk} = \text{CCDI(mg/kg-day)} * \text{CPS(mg/kg-day)}^{-1}$$

The carcinogenic risk associated with each chemical in fish may be summed to yield an estimate of total cancer risks per pathway.

$$\text{Excess Lifetime Cancer Risk} = \sum (CCDI_i * CPS_i)$$

where:

$CCDI_i$ = intake for the i^{the} site-specific chemical

CPS_i = Carcinogenic Potency Slope for the i^{the} site-specific chemical

6.4 NAS - Jacksonville Fish Ingestion Hazards and Risks

6.4.1 Lake Casa Linda

Utilizing the concentrations detected in fish fillets alone, the ingestion of fish from Lake Casa Linda is estimated to be associated with a hazard index of 1.69 and 3.39 for an adult and child respectively, and an excess lifetime carcinogenic risk of 7.76E-04 (Table 6-1).

Utilizing the concentrations detected in whole fish (either fillets and "carcasses," or fillets, livers and gonads), the ingestion of fish from Lake Casa Linda is estimated to be associated with a hazard index of 6.76 and 15.8 for an adult and child respectively, and an excess lifetime carcinogenic risk of 5.03E-03 (Table 6-2).

Utilizing the fish concentrations modelled from surface water, the ingestion of fish from Lake Casa Linda is estimated to be associated with a hazard index of

TABLE 6-1
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - LAKE CASA LINDA
INGESTION OF FISH FILLETS

CONTAMINANT	HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Semivolatile Organic Compounds (SVOCs)			
4-Methylphenol	1.00E+00	2.34E+00	
Pesticides/PCBs			
alpha-Chlordane	9.38E-02	2.19E-01	3.97E-06
4,4'-DDD			7.63E-07
4,4'-DDE			1.01E-05
Aroclor-1254			7.37E-04
Inorganic Compounds			
Arsenic	8.41E-02	1.96E-01	2.40E-05
Barium	9.96E-03	2.32E-02	
Chromium	3.68E-02	8.59E-02	
Copper	2.15E-02	5.01E-02	
Lead			
Manganese	2.71E-01	6.33E-01	
Mercury	1.43E-01	3.34E-01	
Selenium	2.24E-02	5.23E-02	
TOTAL	1.69E+00	3.93E+00	7.76E-04

TABLE 6-2
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - LAKE CASA LINDA
FISH INGESTION - WHOLE FISH

CONTAMINANT	HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Semivolatile Organic Compounds (SVOCs)			
4-Methylphenol	4.50E+00	1.05E+01	
Pesticides/PCBs			
alpha-Chlordane	3.41E-01	7.96E-01	1.44E-05
4,4'-DDD			3.37E-06
4,4'-DDE			6.71E-05
Aroclor-1254			4.84E-03
Inorganic Compounds			
Arsenic	3.77E-01	8.80E-01	1.07E-04
Barium	3.45E-02	8.06E-02	
Chromium	9.40E-02	2.19E-01	
Copper	4.99E-02	1.16E-01	
Cyanide	7.17E-02	1.67E-01	
Lead			
Manganese	9.79E-01	2.28E+00	
Mercury	2.20E-01	5.14E-01	
Selenium	6.54E-02	1.53E-01	
Vanadium	2.34E-02	5.47E-02	
TOTAL	6.76E+00	1.58E+01	5.03E-03

less than 1 for both adults and children. There are no estimated carcinogenic risks associated with this pathway (Table 6-3).

6.4.2 Lake Scotlis

Utilizing the concentrations detected in fish fillets alone, the ingestion of fish from Lake Scotlis is estimated to be associated with a hazard index of 3.21 and 7.49 for an adult and child respectively, and an excess lifetime carcinogenic risk of 1.03E-03 (Table 6-4).

Utilizing the concentrations detected in whole fish (either fillets and "carcasses," or fillets, livers and gonads), the ingestion of fish from Lake Scotlis is estimated to be associated with a hazard index of 4.3 and 10.6 for an adult and child respectively, and an excess lifetime carcinogenic risk of 1.35E-02 (Table 6-5).

Utilizing the fish concentrations modelled from surface water, the ingestion of fish from Lake Scotlis is estimated to be associated with a hazard index of less than 1 for both adults and children. There are no estimated carcinogenic risks associated with this pathway (Table 6-6).

6.4.3 Polishing Pond

Utilizing the fish concentrations modelled from surface water, the ingestion of fish from the Polishing Pond is estimated to be associated with a hazard index of 1.43 for children and less than 1 for adults; an excess lifetime carcinogenic risk of 4.64E-05 (Table 6-7).

6.5 Risk Characterization Summary

Risks from ingestion of fish in Lake Casa Linda, Lake Scotlis and the Polishing Pond exceed EPA target risk levels of a 1E-06 excess cancer risk and a hazard index of 1.0. The risks from fish ingestion developed using modelled concentrations from surface water data and BCFs are lower than those developed using fish concentrations. This can be attributed to the fact that several of the contaminants detected in the NAS - Jacksonville surface water lack EPA-approved BCFs. The following compounds were detected in NAS - Jacksonville surface water but could not be used to estimate modelled concentration risks because BCFs were not available: carbazole, pyrene, barium and cyanide in Lake Casa Linda; barium in Lake Scotlis; and carbazole, barium and cyanide in the Polishing Pond.

TABLE 6-3
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - LAKE CASA LINDA
FISH CONCENTRATIONS MODELLED FROM SURFACE WATER CONCENTRATIONS

CONTAMINANT		HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Semivolatile Organic Compounds (SVOCs)				
Carbazole				
Pyrene				
Inorganics Compounds				
Barium				
Copper		1.28E-02	2.98E-02	
Cyanide				
Lead				
Selenium		4.50E-03	1.05E-02	
	TOTAL	1.73E-02	4.03E-02	NA

TABLE 6-4
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - LAKE SCOTLIS
FISH INGESTION - FILLET CONCENTRATIONS

CONTAMINANT	HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Semivolatile Organic Compounds (SVOCs)			
Bis(2-ethylhexyl)phthalate	2.48E-01	5.78E-01	
Di-n-butylphthalate			
4-Methylphenol			
Pesticides/PCBs			
alpha-Chlordane			1.38E-05
4,4'-DDE			1.02E-03
Aroclor-1254			
Inorganic Compounds			
Arsenic	4.56E-04	1.06E-03	
Barium	1.15E-01	2.69E-01	
Chromium	5.65E-03	1.32E-02	
Copper			
Cyanide	2.98E-02	6.96E-02	
Lead	2.62E+00	6.11E+00	
Manganese	1.92E-01	4.47E-01	
TOTAL	3.21E+00	7.49E+00	1.03E-03

TABLE 6-5
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - LAKE SCOTLIS
FISH INGESTION - WHOLE FISH CONCENTRATIONS

CONTAMINANT	HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Semivolatile Organic Compounds (SVOCs)			
Bis(2-ethylhexyl)phthalate	1.29E-01	3.02E-01	1.97E-05
Di-n-butylphthalate	1.66E-02	3.88E-02	
4-Methylphenol	3.98E-01	9.29E-01	
Pesticides/PCBs			
alpha-Chlordane	2.42E+00	5.64E+00	1.02E-04
4,4'-DDE			8.32E-05
Aroclor-1254			1.32E-02
Inorganic Compounds			
Arsenic	1.87E-01	4.37E-01	5.33E-05
Barium	2.30E-02	5.37E-02	
Chromium	1.00E-01	2.34E-01	
Cobalt			
Copper	3.83E-02	8.94E-02	
Cyanide	4.02E-02	9.37E-02	
Lead			
Manganese	5.45E-01	1.27E+00	
Mercury	5.18E-01	1.21E+00	
Selenium	1.00E-01	2.34E-01	
Vanadium	1.70E-02	3.96E-02	
TOTAL	4.53E+00	1.06E+01	1.35E-02

TABLE 6-6
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - LAKE SCOTLIS
FISH INGESTION - CONCENTRATION MODELLED FROM SURFACE WATER

CONTAMINANT		HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Inorganic Compounds				
Barium				
Copper		1.50E-02	3.49E-02	
Lead				
Selenium		2.13E-03	4.97E-03	
	TOTAL	1.71E-02	3.99E-02	NA

TABLE 6-7
FISH INGESTION RISK ASSESSMENT
U.S. NAVAL AIR STATION - JACKSONVILLE
JACKSONVILLE, FLORIDA

RISK ESTIMATES - POLISHING POND
FISH INGESTION - CONCENTRATION MODELLED FROM SURFACE WATER

CONTAMINANT	HAZARD INDEX ADULT HQ	HAZARD INDEX CHILD HQ	EXCESS LIFETIME CARCINOGENIC RISK
Semivolatile Organic Compounds (SVOCs)			
Carbazole			
Inorganic Compounds			
Arsenic	1.63E-01	3.80E-01	4.64E-05
Barium			
Cadmium	3.71E-01	8.67E-01	
Chromium	4.64E-02	1.08E-01	
Copper	3.31E-02	7.72E-02	
Cyanide			
Lead			
TOTAL	6.14E-01	1.43E+00	4.64E-05

For the Polishing Pond, measured fish concentrations are not available; therefore, risk estimates could be based only upon modelled concentrations.

Fish could not be collected from the Polishing Pond because no fish of any sort were observed there during sampling. As the sampling event report notes (page B-11), it is extremely unusual for a water body such as the Polishing Pond to be devoid of fish species of any sort.

The surface water and sediment quality data presented in the sampling event report indicate that contaminant concentrations in both surface water and sediments of the Polishing Pond exceed by orders of magnitude the relevant ecological benchmarks for protection of benthic macroinvertebrate and fish receptors (i.e., the National Oceanic and Atmospheric Administration [NOAA] sediment guidelines and the EPA AWQC for protection of aquatic life).

Cadmium, chromium, lead, mercury, nickel, silver and zinc concentrations in the sediments of the Polishing Pond are markedly elevated above NOAA sediment guidelines (see page 4-27 of the sampling event report). Aluminum, arsenic, cadmium, cyanide, iron and nickel in surface water of the Polishing Pond are all at levels exceeding EPA's ambient water quality criteria (see page 4-19). The absence of fish of any sort in the Polishing Pond may be attributed either to direct toxic effects from surface water upon the fish or to indirect effects related to degradation of the macroinvertebrate community in the sediments.

7.0 UNCERTAINTY ANALYSIS

The process of quantifying the toxic hazards and excess lifetime carcinogenic risks applied in this risk assessment has a number of inherent sources of uncertainty. The method used represents the best available process for consistent quantitative estimates of risk, as outlined in EPA risk assessment guidance (EPA 1989a). Some limitations in the risk assessment are summarized below:

- There is statistical uncertainty associated with the estimates of exposure and the level of noncarcinogenic and carcinogenic risks presented in this assessment. The degree of uncertainty cannot be quantified; however, due to the conservative assumptions incorporated in the EPA standard default exposure factors and EPA toxicity criteria used in this assessment (EPA 1991a), the risks presented may overestimate the actual risks faced by human receptors at the site (EPA 1992, EPA 1991a, EPA 1991b, EPA 1989a and EPA 1989b).

- Professional and technical judgments incorporated in the risk assessment contribute to uncertainty.

- Due to the conservative assumptions used in the development of the rationale for selection of contaminants of concern, it is very likely that all chemicals contributing to risk at the site have been identified.

- Exposure point concentrations are assumed to be equal to the 95% UCL on the arithmetic mean concentration in each medium. This conservative estimate of the average concentration encountered by receptors may result in a slight overestimation of risk.

- The use of animal models to estimate human toxicity results in uncertainty due to metabolic differences and problems of scaling to adjust dosages according to body weight. EPA incorporates a number of conservative assumptions in the development of quantitative toxicity criteria to ensure that risks are not underestimated.

- Since reference doses incorporate large margins of safety, it is possible that no toxic effects will occur even where hazard quotients or indices exceed unity.

- Summing each contaminant to yield an estimate of total risks per pathway does not take into account the potential for either synergistic or antagonistic chemical interactions. It is assumed that the conservatism inherent in the estimation of the CPS and the conservatism employed in the calculation of the chronic dose will exceed the greatest multiplicative synergistic effect possible in any population.

The risk estimates developed in this risk assessment are based on conservative standard EPA risk assessment assumptions and toxicity values. It is likely that the calculated toxic hazards or excess cancer risks slightly overestimate the actual risks presented by contaminants in fish at Naval Air Station - Jacksonville.

8.0 REFERENCES

1. ABB Environmental Services, Inc., Sampling Event Report Number 17 - Electrofishing Fisheries Investigation at Selected Water Bodies, Naval Air Station, Jacksonville, Florida (June 1993).

2. U.S. Environmental Protection Agency, Superfund Public Health Evaluation Manual, 1986.

3. U.S. Environmental Protection Agency, Risk Assessment Guidance for Superfund (1989a).

4. U.S. Environmental Protection Agency, Exposure Factors Handbook (1989b).

5. U.S. Environmental Protection Agency, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (1991a).

6. U.S. Environmental Protection Agency, Risk Assessment Guidance for Superfund - Volume I: Human Health Evaluation Manual, Part B (1991b).

7. U.S. Environmental Protection Agency, Water Quality Criteria Summary Table (1991c).

8. U.S. Environmental Protection Agency, New Interim Region IV Guidance (1992).

9. U.S. Environmental Protection Agency, Risk-Based Concentration Table, Second Quarter, 1993 (1993).