Development of Bioaccumulation Guidance for Dredged Material Evaluations in EPA Region 2

Alex Lechich
U.S. Environmental Protection Agency Region 2, New York, New York

Introduction

The work described here was done under the auspices of the New York/New Jersey Harbor Dredging Forum, which was convened in the Summer of 1993 by the U.S. Environmental Protection Agency Region 2 (Region 2), the New York District Corps of Engineers (NYDCOE), the New York State Department of Environmental Conservation (NYSDEC) and the State of New Jersey Department of Environmental Protection (NJDEP). The Forum was convened to try to solve the serious problems facing dredging and disposal of dredged material from the Harbor. The problems stem from the implementation of revised dredged material testing procedures, which resulted in many more proposed projects being found not suitable for ocean disposal, and the lack of regional alternatives to ocean disposal. The Forum drew together representatives of all of the local interested parties, including government, industry, shipping, labor, and public environmental interests. In early Forum meetings, eight general areas to be addressed were identified and defined by the participants, and workgroups were assembled which were tasked to address these specific areas.

The Disposal Criteria Workgroup, chaired by Mario Del Vicario, Chief of the Place-Based Protection Branch in Region 2, was tasked to address the perceived "gaps" in criteria for evaluating tests for ocean disposal of dredged material. The workgroup initially identified eleven issues to address. The issue of evaluation of bioaccumulation test results was number one on the list. In prioritizing all eleven issues, however, the workgroup realized that some of the other eleven issues could be resolved more quickly and would address outstanding issues relating to the regional testing manual. After some of these issues were addressed, the Bioaccumulation Subgroup of the Disposal Criteria Workgroup was formed in the Spring of 1994, and began to seriously address bioaccumulation after evaluating the status of other ongoing efforts, including national efforts. The subgroup included a representative each from Region 2, NYDCOE, NYSDEC, NJDEP, Exxon Biomedical Services (as an industry representative), and from a consortium of environmental groups that included the Environmental Defense Fund, the American Littoral Society and Clean Ocean Action.

This discussion will describe the methods that were developed by the subgroup, the current status of the work, including other related work on development of BSAFs from project test results, and the actions that are anticipated in the future.

General Approach

The workgroup decided to develop information in two general areas, risk-based evaluation methods and field background data on benthic invertebrate tissue residues from areas around the ocean disposal site. This approach follows the general guidance on evaluation of bioaccumulation test results in the Green Book (1991), using eight guidance factors for evaluating bioaccumulation results (see *1991 Green Book Bioaccumulation Factors* on page 5-53). Of these eight factors, the workgroup felt there were important information needs for factors four and eight, the toxicological importance of contaminants which exceed reference material and exceedance of concentrations found in organisms living in the vicinity of the disposal site.

The various toxicological measures of a contaminant (i.e., human health, ecological endpoints) are the most important indicators of its potential for adverse effects, while information on background concentrations in benthic organisms is necessary to evaluate the potential for significantly degrading the existing conditions in the area around the disposal site. The toxicological importance of a contaminant needs to be related to the potential risk to an end receptor, which, for dredged material evaluations, is measured at the benthic invertebrate level of the food chain. The workgroup decided to use a method for estimating human health and wildlife risk proposed and developed by John Zambrano of NYSDEC with workgroup involvement. The method is a "standards"-based assessment, as opposed to a site-specific or

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case-specific risk assessment. Since the workgroup had been tasked to develop an approach on its own resources, a phased approach was recommended that initially used available information and established methods where possible. Information was readily available in the EPA IRIS (1994, 1995) database and elsewhere to derive risk-based guidance values with the principles that EPA used to derive water quality criteria. This would be compared to other risk-based information and field background tissue data, and combined in an overall strategy for evaluation of test results. As new information or national guidance values became available, the approach would be modified.

Depending on the level of confidence that could be placed on guidance values synthesized from the risk-based and background information, an overall evaluation strategy would probably still be necessary. This is because the level of confidence in guidance values that would be appropriate for passing or failing a proposed ocean disposal project based on exceedance of, for instance, one contaminant (essentially setting "bright line" standards) would be difficult to achieve, given the uncertainties and assumptions in the available methods. A weight-of-evidence type strategy would be necessary if the resulting guidance values do not have this level of confidence. The overall approach, then, would include a human health and ecological (aquatic and wildlife) risk-based component, a field background tissue component and a combined evaluation strategy.

Human Health Approach

The risk-based approach for carcinogens starts with effects data and, after consideration of consumption and other exposure factors, ends with concentration-related levels of risk. In a site-specific approach, actual "project" concentrations are used through hazard and exposure assessments to result in a description of levels of risk for the project. For noncarcinogens, reference doses (RfDs) are used with the same exposure factors as in the cancer risk method. The standards approach used broad assumptions regarding exposure, although the method does include site-specific information that was developed for a representative food chain and wildlife species at potential risk.

The human health model first calculates an acceptable toxicological dose for carcinogens by dividing a selected cancer risk by the cancer potency factor and multiplying by a 70 kg body weight and a 10^3 unit conversion factor (see Human Health Method on page 5-53). For noncarcinogens, an RfD is multiplied by body weight. Toxicological data was obtained from IRIS, and information from the National Toxics Rule (1992) was used for a total PCB reference dose (RfD). An acceptable concentration in seafood is calculated by dividing an acceptable toxicological dose by a seafood consumption factor. This is then converted to an acceptable concentration in benthic invertebrates using a food chain factor, a whole fish-to-filet ratio, and a lipid adjustment (to 2 percent lipid).

EPA has recommended 6.5 g/day as a national average fish consumption rate in its guidance to the states and has utilized that value in the National Toxics Rule (1992). It is recognized that other values may be appropriate to reflect any regional differences; however, there was no effort made to determine a different regional rate. This issue involves extensive consideration of either regional survey data or comparable data, and of average versus higher percentile consumers. The workgroup felt that, for this initial effort, the procedures in the method includes other cancer and noncancer risk components that can account for geographic variables and population extremes.

Trophic Transfer

Initially, the workgroup evaluated food chain multipliers (FCMs) used in the EPA Water Quality Standards Handbook, which used a food chain model developed by Thomann (1989). Scientists from EPA's Office of Research and Development (ORD) recommended that the Gobas model (1993) be used, which was used in the EPA Great Lakes Initiative (GLI). The ORD recommendations came in a meeting held in Region 2 that was chaired by Bob Huggett, EPA Assistant Administrator for ORD, and included researchers from various ORD research laboratories as well as representatives from several EPA Headquarters offices and Regions to support Region 2 in this effort. The Gobas model assumes equilibrium partitioning in benthic organisms, and it was determined that this model reasonably represented field study data for the GLI. To use the Gobas model in our effort, a regional food chain with representative lipid values and organism masses for all trophic levels needed to be developed. A representative coastal ocean demersal food chain for the region was developed in consultation with National Marine Fisheries Service and other experts. It includes information on lipid and mass for each trophic level organism, as well as average values by trophic level for input into the model.

Larry Burkhard of EPA's Mid-Continent Ecology Division (Duluth, MN) performed the model runs. The resulting multipliers are applied on the basis of log K_{ow}, which were obtained from EPA guidance for the GLI (1993). Humans were assumed to eat primarily from the fourth trophic level, so the multipliers from level 2 to 4 were used to calculate the increase in concentration from benthos to human seafood (see Tables 5 and 6 on page 5-55). Since the Gobas model is considered applicable for lipophilic organics that do not metabolize, it is not applicable for metals and PAHs. For cadmium, it was assumed that bioaccumulation occurs through water, and biomagnification does not occur. The trophic transfer factor for methyl mercury was obtained from the GLI (1995). PAHs are metabolized in many higher trophic organisms, but not in some benthic organisms. A trophic transfer factor of one was initially assumed; however, since there is little evidence for the potential of a significant pathway to humans, the workgroup has not as yet decided whether to include PAHs in the human health method. Information from several studies on PAHs in lobsters, including hepatopancreas concentrations, is being evaluated with respect to modeling a potential human pathway. An ingestion rate adjustment, as well as adjustments according to EPA PAH Toxic Equivalences, will probably be used if the workgroup decides to include the carcinogenic PAHs in the human health method. These adjustments would result in higher human health guidance values than were initially calculated (see Table 7 on page 5-56).

Whole Body/Filet Ratio

A whole body-to-filet ratio was used in the human health method. New York State data indicated a range of 1.2 to 1.5 as being applicable to lipophilic substances. The mid-range of 1.35 was used in the model for all lipophilic substances. A value of one was used for cadmium and methyl mercury. A lipid adjustment to 2 percent lipid was used to reflect the average lipid content of trophic level 2 in the representative demersal food chain.

Wildlife Approach

Initially, the workgroup considered developing wildlife protection values similarly to the human health model, but including adjustments for less stringent effects protection and reflecting the need to protect populations instead of individuals. There was no consensus reached by the workgroup on appropriate adjustments. Also, recommendations by ORD GLI reviewers to address their concerns related to this technique could not, in the opinion of the workgroup, be implemented within the scope of this effort. Therefore, the workgroup decided to calculate wildlife reference doses (WRfD) from the GLI information for three compounds common to the GLI and regional contaminants being addressed, DDT, PCB and mercury. The WRfDs were calculated using the test doses and uncertainty factors from the GLI Tier 1 wildlife criteria equation and criteria documents for protection of wildlife. The WRfDs are conceptually equivalent to the human RfDs. An acceptable toxicological dose is calculated by multiplying the WRfDs by the body weights of species to be protected (see Wildlife Method and related information on pages 5-56 through 5-57).

Representative wildlife species information was developed that included body weight and fish consumption rate at each trophic level. A variety of sources were used to develop the wildlife species information, including discussions with marine observers and scientists and the EPA Wildlife Exposure Factors Handbook.

Based on observations and review of studies in the area, it was determined that the harbor seal would be a good representative mammal potentially at risk, since it has been observed in the dump site vicinity. Other marine mammals and sea turtles were not determined to be at much risk in this scenario, based on information from sightings regarding their regional residence times and feeding behavior. Studies of food consumption and weights of harbor seals in the wild were not available, so information was obtained from the NY Aquarium, which has held several specimens at different times.

Discussions were held with seabird observers, including the Mahomet Observatory and Cape May Observatory in New Jersey, and available information on avian species potentially at risk was compiled. A critical factor for evaluating species at risk was the ability to feed from the demersal food chain at the depths found at the Mud Dump Site (50-80 feet). Cormorants, old squaw duck and red-throated loons were observed in the area and can dive to these depths. Since there was no information available on body weights or food consumption for these species, input parameters used in the GLI for the belted kingfisher were used in the model. Although it is acknowledged that these birds have different body weights and probably different ingestion rates than the belted kingfisher, the ingestion rate to body weight ratios, which are used in the model, are probably within reasonable limits. The herring gull data as used in the GLI was used directly for New York Bight apex gulls to compare with the other wildlife results. A full description and assessment of the above information is available upon request.

The food chain for wildlife was assumed to be similar to the one constructed for humans. Wildlife values for individual species are calculated using the acceptable doses, aquatic food consumption rates and trophic transfer factors. The trophic transfer factors are weighted according to the relative food consumption at each trophic level. As was done in the GLI, the final wildlife value is considered the most stringent of the mammalian and avian results.

Aquatic Risk-Based Approach

An aquatic risk-based approach was also proposed that would estimate risk levels for finfish, which were considered the upper trophic level predators in the aquatic system. In this approach, toxicity information in the EPA AQUIRE (Aquatic Toxicity Information Retrieval) and other databases would be evaluated and the appropriate data compiled and manipulated to yield benthic organism guidance levels (see Aquatic Risk-Based Approach on page 5-58). An order of preference for acceptability of toxicity information was developed, with the key preference being tissue residue-based toxicological data. Uncertainty factors would be obtained from Calabrese and Baldwin (1993). Bioconcentration factors, if necessary, would be obtained from the GLI or other sources, as available. The food chain multipliers developed for the other risk-based approaches would be used here also.

Additional databases are currently being reviewed for tissue residue-based toxicity information, since the amount of information that has been identified thus far is meager for many compounds. It is hoped that information on aquatic risk will be completed in the near future and can be incorporated with any additional information or modifications that are identified for the overall evaluation strategy.

Background Tissue Residue Database

There were benthic tissue contaminant data available from various studies that had been conducted in the vicinity of the Mud Dump Site. This information was preliminarily evaluated and summarized, but it was determined by the workgroup that a dedicated sampling survey should be conducted to get a better representation of overall field background benthos concentrations. Sampling stations for this effort were located farther from the disposal site than the existing studies, but included areas of potential contamination from other sources. Surveys were conducted in the Spring and Summer of 1995. The data has been evaluated by the workgroup, and the appropriate statistical representation and use of the data will be determined. An interesting finding in this effort is that, although the preliminary information was carefully selected to exclude data from potentially contaminated sediments, the more recent data is generally lower in concentrations for most contaminants. This seems to indicate a general improvement in the benthic conditions of the New York Bight apex since cessation of sewage sludge disposal in June 1992. This is, in fact, the determination of NOAA's National Marine Fisheries Service laboratory in Sandy Hook, New Jersey, from studies conducted in the area since cessation of sludge disposal (NOAA,1995).

Future Actions

An example of the issues that will need to be resolved in completing an overall evaluation strategy is illustrated by the results for PCB and DDT. For DDT, the lower bound (10^{-6}) human health risk level at 20 ppb is within reasonable proximity to the wildlife value and the background range. For PCB, however, an approximation to these other values is only seen at the upper bound risk range of 70 ppb. For many of the contaminants, the risk levels are in the range of the more recent (lower) background levels. For PAHs, as was noted above, if it is decided that PAHs should be included in the human health risk method, application of other factors would raise the preliminary human health risk levels. The upper bound risk levels would then range considerably greater than background values. These varying factors will have to be weighed by the workgroup in completing an evaluation strategy.

Bioaccumulation tests are expensive and time-consuming. Biota-sediment accumulation factors (BSAFs) are being developed from some of the regional testing results. This could enable the estimation of bioaccumulation in benthos from sediment chemical analyses using the theoretical bioaccumulation potential (TBP) relationship, expressed as

$$TBP = AF\ (C_s/\%TOC)\ \%L\ ,$$

where TBP is expressed on a whole-body wet weight basis in the same units of concentration as C_s, and

C_s = concentration of nonpolar organic contaminant in sediment

%TOC = total organic carbon content of sediment expressed as a decimal fraction

%L = organism lipid content expressed as a decimal fraction

A suite of tests that were conducted for federal navigation projects in New York/New Jersey Harbor has produced a large and comparable data set. Preliminary results are promising; calculated BSAFs for 2,3,7,8-TCDD in sandworms were in the range of 0.11 to 0.19, with a standard deviation of 0.03. Pruell et al. (1993) conducted a long-term bioaccumulation study using sediments with high dioxin content (~600 pptr 2,3,7,8-TCDD) and several benthic species, and determined the time to steady state and accumulation factors for PCBs, dioxins and furans. Applying an empirically derived 28-day to steady-state exposure ratio factor for sandworms (~4.0) from this study, the calculated 28-day BSAFs compare closely to the steady-state accumulation factor for sandworms (0.46) derived from the 1993 study.

As additional data for other projects are incorporated for dioxin and other contaminants, the level of confidence in the ability to accurately estimate tissue accumulations from sediment concentrations should be such as to greatly reduce the need to conduct individual bioaccumulation tests.

References

Calabrese, E.J., and L.A. Baldwin. 1993. *Performing ecological risk assessments*. Lewis Publishers, Chelsea.

Gobas, F.A. 1993. A model for predicting the bioaccumulation of hydrophobic organic chemicals in aquatic food webs: application to Lake Ontario. *Ecological Modeling* 69: 1-17. Elsevier Science Publishers B.V., Amsterdam.

NOAA. 1995. *Effects of cessation of sewage sludge dumping at the 12-Mile Site*. NOAA Technical Report NMFS 124.

Pruell, R.J., N.I. Rubenstein, B.K. Taplin, J.A. LiVolsi, R.D. Bowen. 1993. Accumulation of polychlorinated organic contaminants from sediment by three benthic marine species. *Arch. Environ. Contam. Toxicol*. 24: 290-297.

Thomann, R.V. 1989. Bioaccumulation model of organic chemical distribution in aquatic food chains. *Envir. Sci. Technol*. 23: 699.

USEPA. 1992. Water quality standards; establishment of numeric criteria for priority toxic pollutants; states compliance. *Federal Register* 57:60848-60923.

USEPA. 1993. *Derivation of proposed human health and wildlife bioaccumulation factors for the Great Lakes Initiative*. Draft. U.S. Environmental Protection Agency, Washington, DC.

USEPA. 1994 and 1995. On line. Integrated Risk Information System (IRIS). Office of Research and Development, Environmental Criteria and Assessment Office, Cincinnati, OH.

USEPA. 1995. *Great Lakes Water Quality Initiative technical support document for the procedure to determine bioaccumulation factors*, Appendix E. U.S. Environmental Protection Agency, Washington, DC.

USEPA/USACE. 1991. *Evaluation of dredged material proposed for ocean disposal - Testing manual*. EPA-503/8-91/001.

NEW YORK/NEW JERSEY HARBOR
DREDGING FORUM

EPA REGION 2

NEW YORK DISTRICT CORPS OF ENGINEERS

NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

STATE OF NEW JERSEY DEPARTMENT OF
ENVIRONMENTAL PROTECTION

REPRESENTATIVES FROM GOVERNMENT, INDUSTRY, PUBLIC
ENVIRONMENTAL INTERESTS, SHIPPING, LABOR

Disposal Criteria Workgroup
(Chair, Mario Del Vicario, EPA Region 2)

Bioaccumulation Subgroup

EPA REGION 2 - Alex Lechich

NYD CORPS OF ENGINEERS - Lisa Rosman/Oksana Yaremko
NEW YORK STATE DEPT. OF ENVIR. CONSERVATION -
John Zambrano

STATE OF NEW JERSEY DEPT. OF ENVIR. PROTECTION -
Ruth Prince, Ph.D.

EXXON BIOMEDICAL SERVICES - Tom Parkerton, Ph.D.
(Industry representative)

RAMAPO COLLEGE - Angela Christini, Ph.D.
(Representing public environmental interests including Environmental
Defense Fund, American Littoral Society and Clean Ocean Action)

CRITERIA WORKGROUP
BIOACCUMULATION STRATEGY DEVELOPMENT

THREE COMPONENTS:

1. Human health & ecological (aquatic and wildlife) - risk-based

2. Field benthic (background) tissue level

3. Combined evaluation strategy

NY DREDGED MATERIAL FORUM CRITERIA WORKGROUP
(BIOACCUMULATION SUBGROUP)

➤ GENERALLY USED GREEN BOOK PROCEDURES:

IF STATISTICALLY ABOVE REFERENCE, GO TO 8 FACTORS

FOCUSED ON COMBINATION OF FACTORS ASSOCIATED WITH TOXICOLOGICAL IMPORTANCE AND TISSUE LEVELS IN VICINITY OF DISPOSAL SITE (BACKGROUND) COMPARISON

➤ WORKGROUP DECIDED ON "STANDARD" AS COMPARED TO "SITE SPECIFIC" RISK-BASED APPROACH BECAUSE OF TIME AND RESOURCE CONSTRAINTS

INFORMATION FROM THIS EFFORT CAN BE USED TO LATER "FEED INTO" A SITE SPECIFIC RISK APPROACH

➤ TOXICOLOGICAL INFORMATION USED IN RISK-BASED APPROACHES FOR

HUMAN HEALTH (CANCER AND NON-CANCER)

AQUATIC RESOURCES

WILDLIFE RESOURCES

➤ ALL APPROACHES BEGIN WITH CALCULATION OF ACCEPTABLE CONCENTRATION IN FISH, THEN APPLICATION OF ADJUSTMENTS FOR TROPHIC TRANSFER, LIPID AND OTHERS, RESULTING IN BENTHIC INVERTEBRATE TISSUE LEVEL

1991 GREEN BOOK BIOACCUMULATION FACTORS

(1) number of species in which bioaccumulation from the dredged material is statistically greater than bioaccumulation from the reference material

(2) number of contaminants for which bioaccumulation from the dredged material is statistically greater than bioaccumulation from the reference material

(3) magnitude by which bioaccumulation from the dredged material exceeds bioaccumulation from the reference material

(4) toxicological importance of the contaminants whose bioaccumulation from the dredged material exceeds that from the reference material

(5) phylogenetic diversity of the species in which bioaccumulation from the dredged material statistically exceeds bioaccumulation from the reference material

(6) propensity for the contaminants with statistically significant bioaccumulation to biomagnify within aquatic food webs

(7) magnitude of toxicity and number and phylogenetic diversity of species exhibiting greater mortality in the dredged material than in the reference material

(8) magnitude by which contaminants whose bioaccumulation from the dredged material exceeds that from the reference material also exceed the concentrations found in comparable species living in the vicinity of the proposed disposal site.

HUMAN HEALTH METHOD

ACCEPTABLE TOXICOLOGICAL DOSE

1. CANCER - <u>CANCER RISK LEVEL</u> X BODY WEIGHT
CANCER SLOPE FACTOR

2. NONCANCER - (RfD) (BODY WEIGHT)

<u>ACCEPTABLE TOXICOLOGICAL DOSE</u> = ACCEPTABLE CONCENTRATION IN FISH
FISH CONSUMPTION

<u>(ACCEPT. CONC. IN FISH) (WHOLE BODY/FILET FACTOR)</u> = ACCEPTABLE CONCENTRATION IN BENTHIC INVERTEBRATES
(TROPHIC FACTOR)

BODY WEIGHT - 70 Kg
FISH CONSUMPTION - 6.5 g/day
WHOLE BODY/FILET RATIO - 1.35
LIPID ADJUSTMENT - to 2%

FOOD CHAIN MODEL

➛ INITIALLY USED FCMs IN EPA WATER QUALITY STANDARDS (1993) HANDBOOK - THESE USED THOMANN 1989 FOOD CHAIN MODEL

- DOES NOT INCLUDE BENTHIC COMPARTMENT
- USED 10% LIPID FOR ALL TROPHIC LEVELS

➛ BOB HUGGETT (AA, ORD) MEETING HELD ON MARCH 22-23, 1995 WITH ORD SCIENTISTS, HQ OFFICES AND REGIONS IN SUPPORT OF REGION 2 EFFORT

- RECOMMENDED USE OF GOBAS 1991 MODEL

➛ GOBAS MODEL

- ASSUMES EQUILIBRIUM BETWEEN SEDIMENT AND BENTHOS
- EPA FOUND GOOD CORRELATION FOR EQUILIBRIUM AND USED MODEL IN THE GREAT LAKES INITIATIVE (GLI)
- CONSIDERED APPLICABLE FOR LIPOPHILIC ORGANICS THAT AREN'T METABOLIZED - WASN'T ASSUMED APPLICABLE FOR METALS OR PAHs
  - FOR CADMIUM, BIOAC THRU WATER, NO BIOAMAG TTF = 1
  - FOR MERCURY, TTF FROM GLI TSD, APPENDIX E
  - FOR PAHs, METABOLIZED IN MANY HIGHER ORGS TTF = 1

➛ Adjusted results to reflect two percent lipid - as was found for trophic level two (benthos) in the representative food chain

TROPHIC LEVEL (food preferences)	**% LIPID (wet wt.)**	**MASS (gms) (wet wt.)**
TL IV		
● fluke (summer flounder) (sand lance, juvenile fish, mysid shrimp)	1.2	500
● hake (mix red, silver, others) (small crabs, mysids, bivalves, polychaetes)	1.1	200
● bluefish (fish, small crabs, mysids, polychaetes, squid)	11	1000
● tautog (mussels, barnicles, mysids, crabs)	3.8	800
● lobster (hepato + muscle) (crustaceans, polychaetes, live and dead fish, mollusks)	6	500
approx. average	**4.5**	**600**
● juvenile finfish/sandlance (copepods, mysids, cladocerans, fish eggs, mollusca larvae)	4.2	10
● crustaceans (crabs, shrimp) (small polychaetes & mollusks, deposited and suspended organic matter, smaller crustaceans)	4.5	10
approx. average	**4.4**	**10**
TL II		
● polychaetes (Nephtys) (deposit and sediment ingesting or organic matter, carnivores of minute organisms)	2.0	1
● bivalve mollusks (Nucula) (deposit and filter feeders-phytoplankton, organic detritus)	3.0	0.1
● crustaceans (Crangon, mysids) (deposit and filter feeders-phytoplankton, organic detritus, carnivores of minute organisms)	1.0	0.1
approx. average	**2**	**0.4**

Table 5

TROPHIC TRANSFER FACTORS
VS.
LOG KOW

Log Kow	Level 3 to 2	Level 4 to 2
4.0	1.0	1.0
4.1	1.0	1.1
4.2	1.0	1.1
4.3	1.0	1.1
4.4	1.0	1.1
4.5	1.0	1.1
4.6	1.0	1.2
4.7	1.0	1.2
4.8	1.0	1.3
4.9	1.0	1.3
5.0	1.0	1.4
5.1	1.0	1.5
5.2	1.0	1.5
5.3	1.0	1.6
5.4	1.0	1.8
5.5	1.1	1.9
5.6	1.1	2.0
5.7	1.1	2.1
5.8	1.1	2.3
5.9	1.1	2.4
6.0	1.1	2.6
6.1	1.1	2.7
6.2	1.1	2.8
6.3	1.1	2.9
6.4	1.2	3.0
6.5	1.2	3.0

Table 6
Trophic Transfer Factors

		Trophic Transfer Factor	
Substance	**Log Kow**	**Level 4 to 2**	**Level 3 to 2**
aldrin	6.0	2.6	1.1
anthracene-	1	1	
benzo(a)anthracene	-	1	1
benzo(k)fluoranthene	-	1	1
benzofluoranthene, 3,4-	-	1	1
benzo(a)pyrene	-	1	1
cadmium -	1	1	
chlordane5.8	2.3	1.1	
chrysene -	1	1	
DDD	6.1	2.7	1.1
DDE	6.4	2.9	1.2
DDT	6.2	2.8	1.1
dibenz(a,h)anthracene	-	1	1
dieldrin	5.0	1.4	1.0
fluoranthene	-	1	1
fluorene -	1	1	
heptachlor5.0	1.4	1.0	
heptachlor epoxide	4.1	1.1	1.0
inden(1,2,3-cd)pyrene	-	1	1
methyl mercury	-	6.3	1.3
PCBs	6.1	2.7	1.1
pyrene	-	1	1

[1]Factors for trophic level 4 to 2 are used to derive the criteria for human health.

Table 7

PRELIMINARY BENTHIC ORGANISM GUIDANCE VALUES, ug/kg
(Human Health)

Substance	Cancer (10-6)	Noncancer
aldrin	0.3	200
benzo(a)anthracene*	2*	--
benzo(k)fluoranthene*	2*	--
benzofluoranthene,3,4*	2*	--
benzo(a)pyrene*	2*	--
cadmium	--	10,000
chlordane	5	300
chrysene*	2*	--
DDD	20	--
DDE	10	--
DDT	20	1,000
dibenz(a,h)anthracene*	2*	--
dieldrin	0.7	500
heptachlor	2	5,000
heptachlor epoxide	1	200
indeno(1,2,3-cd)pyrene*	2*	--
methyl mercury	--	200
PCBs, Total	0.7	100

***NOTE:** Values for 7 carcinogenic PAHs will be either revised upward (by incorporation of lower ingestion rate - based on Quincy Bay study of lobster hepatopancreas consumption - and application of TEFs), or will not be included in human health assessment.

WILDLIFE METHOD

INITIALLY, CONSIDERED USING ADJUSTMENTS TO HUMAN HEALTH METHOD, FOR LESS STRINGENT OVER-ALL EFFECTS PROTECTION AND REFLECTING NEED TO PROTECT POPULATIONS INSTEAD OF INDIVIDUALS - NO CONCENSUS; IMPRACTICAL

USED EPA GREAT LAKES INITIATIVE (GLI) INFORMATION FOR 3 COMPOUNDS (DDT, PCB, MERCURY) IN THIS EFFORT

CALCULATED WRfDs WITH TEST DOSES AND UFs FROM GLI TIER 1 WILDLIFE CRITERIA EQUATION AND CRITERIA DOCUMENTS FOR PROTECTION OF WILDLIFE

Calculated WRfDs (ug/kg-d)

Species	DDT	PCB	Mercury
mammalian	80	30	16
avian	9	200	13

(WrfD)(body weight) = Wildlife Acceptable Dose

Wildlife Acceptable Dose (ug/d)

harbor seal	9600	3600	1920
belted kingfisher	1.4	30	2
herring gull	9.9	220	14.3

WILDLIFE PARAMETERS

Selected Species	Adult Body Weight (Kg)	Aquatic Food Ingestion Rate (F), (kg/day) Troph.Lev.3	Troph.Lev.4
Harbor Seal	120	0	9.6
Belted King Fisher	0.15	0.0672	0
Herring Gull	1.1	0.192	0.0480

Example Computation

Acceptable Doses (AD), divided by the aquatic food consumption rates (F) and the trophic transfer (TT) factors. The trophic transfer factors are weighted according to the relative food consumption at each trophic level. An example computation is presented below for the Herring Gull and DDTr.

$$\text{Species Criterion (Gull, DDTr)} = \frac{AD}{[(F_{TL3})(TT_{3\text{-}2})+(F_{TL4})(TT_{4\text{-}2})]}$$

$$\text{Species Criterion (Gull, DDTr)} = \frac{9.9}{[(0.192)(1.1)+(0.0480)2.8]}$$

Species Criterion (Gull, DDTr) = 29.2 ug/kg

WILDLIFE GUIDANCE VALUES (ug/kg)

Individual Species

Species	DDTr	Mercury	PCBs
Harbor Seal	357	31.7	134
Belted King Fisher	18	22.2	405
Herring Gull	29.2	26	637

PRELIMINARY
FINAL WILDLIFE VALUES (ug/kg)

DDTr	20
Mercury	20
PCBs, Total	100

DDT and PCB values are based on two percent lipid. Concentrations are based on wet weight.

AQUATIC RISK-BASED APPROACH

1. Using EPA AQUIRE (Aquatic Toxicity Information Retrieval) database, searched for information on BCCs encompassing all finfish species - (Class Osteichthyes - bony fishes)

-also used review chapter in CRC Critical reviews in Aquatic Sciences, entitled "Effects of Environmetnal Pollutants on Early Fish Development"

2. AQUIRE Data: Order of Preference

Chemical Reporting:

1. Tissue Concentrations
2. Water Concentrations

- UFs from Calabrese and Baldwin (1993). Performing Ecological Risk Assessments
- BCFs from GLI Derivation of Proposed HH and Wldlf BCFs for GLI

Effects Reporting:

1. Reproductive Endpoints

    a) Embryonic or Larval Malformation
    b) Egg Production
    c) Hatchability/Survivorship
    d) Embryonic or Larval Mortality

2. Adult Chronic
3. Adult Acute

Endpoints Reporting:

1. NOAEC
2. MATC
3. LOAEC
4. Effects Concentrations
5. EC50, LC50

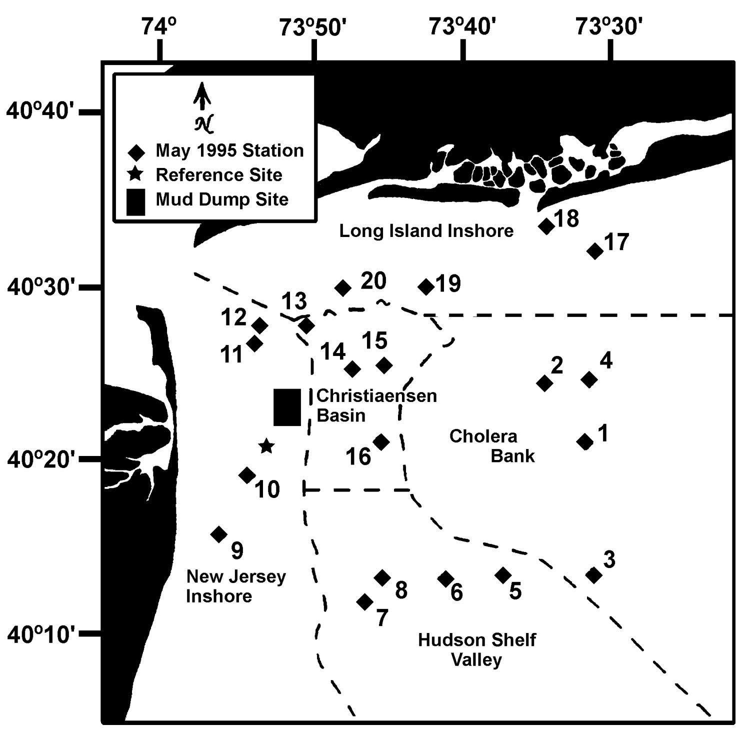

Figure 1. Map showing the five New York Bight Apex Regions and sampling locations for May 1995 Body Burden Survey.

ISSUES TO BE ADDRESSED

- try to reach concensus on appropriate statistical use of background data
- try to reach concensus on contaminant-specific guidance values that include human health, ecological and background values
  - how do they compare?
  - in some cases, roughly comparable @10^{-6} HH carc. risk level
  - for PCBs and PAHs, HH carc. values are comparable only @ 10^{-5} - 10^{-4} risk levels
- will evaluate comments from peer/public review on acceptability of approach and on derivations and conclusions

Biota-Sediment Accumulation Factors From Regional Dredging Projects

- (draft) results of bioaccumulation tests of nine NY/NJ Harbor dredging sites (federal projects) plus a reference site

$$BSAF = \frac{(Tc/L)}{Sc/TOC}$$

- Dioxin/Furan 28-day BSAFs

  TCDD - 0.11 - 0.19 (mean 0.14, SD 0.03)

  TCDF - 0.14 - 0.28 (mean 0.20, SD 0.04)

- Comparable to Pruell et al. 1993 AFs for dioxins/furans 28-day and steady state results
- Validation with other project results

COMPOUND	HUMAN HEALTH		WILDLIFE		FIELD BKGRD
	10-4	10-6	1	2	(rough approx.)
PCB	70	0.7	300	110	50 - 150
DDT	2000	20	20	260	10 - 20

Wildlife:

1. Sub-group effort
2. New York State Dept. Of Envir. Conser. - Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife, Newell, et al., July 1987

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