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LOWER PASSAIC RIVER RESTORATION PROJECT DRAFT FOCUSED FEASIBILITY STUDY RISK EVALUATION

Remedial Options Work Group Meeting
June 27, 2007

Human Health and Ecological Risk Evaluation

Objective: Assesses current and future risk to assist USEPA in evaluating the need for undertaking early action.

Process: Two step process:

1. Estimate risks associated with current conditions
2. Compare current conditions to future risks

Methodology: Conducted a risk evaluation based on USEPA Risk Assessment Guidance. Part of the on-going comprehensive 17-mile study of the Lower Passaic River.

Human Health and Ecological Risk Evaluation

Overview of the Presentation

- Identification of chemicals of potential concern
- Human Health Risk Assessment
  - Pathways and receptor groups examined
  - Results for current conditions
  - Results for future conditions
- Ecological Risk Assessment
  - Pathways and receptor groups examined
  - Results for current conditions
  - Results for future conditions
- Comparison of Current and Future Conditions
- Preliminary Remediation Goals

Identification of Contaminants of Potential Concern

Data Compilation

- Included all data collected since 1993
- Surficial sediment and biota
  - White perch
  - American eel
  - Mummichog
  - Blue crab
- 19 Studies directed by various groups including USEPA, TSI, NJDEP, and CARP
- Calculated TEQs for dioxin/furans and coplanar PCB congeners
- Calculated aggregate totals for PAHs, DDx, and PCBs -

Identification of Contaminants of Potential Concern

Identification of Primary Risk Drivers

- Human Health COPCs:
  - Persistent in the environment
  - Toxic to humans
  - Compounds associated with fish and shellfish advisories
- Ecological COPECs followed a three-tier screening process:
  - Bioaccumulation
  - Effects value
  - Essential nutrients

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Identification of Contaminants of Potential Concern

Analyte	Human Health COPC	Ecological COPEC
Inorganic Compounds		
Copper		√
Lead		√
Mercury	√	√
Semivolatile Organic Compounds (PAHs)		
LPAHs		√
HPAHs		√
Polychlorinated Biphenyls (PCBs)		
Total PCBs (sum Aroclors)	√	√

Analyte	Human Health COPC	Ecological COPEC
Dioxins and Furans (D/F)		
TCDD TEQ (D/F)	√	√
TCDD TEQ (PCBs)	√	√
TCDD TEQ (Total)		√
Pesticides/Herbicides		
Chlordane	√	
Dieldrin	√	√
DDE	√	
DDD	√	
DDT	√	
Total DDx		√

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Human Health Risk Evaluation

Human Exposures Pathways

- Angler/Sportsman:
  - An adult consuming fish and blue crab
  - Shares catch with an adolescent (age 10 to 18 years) and child (age 0 to 6 years) family member
- Recreational User and Homeless will be considered in 17mile assessment

Human Health Risk Evaluation

Human Exposures

- Consumption of fish and shellfish is associated with the highest cancer risks and noncancer hazards
- Based on the results of similar Superfund sites for rivers:
  - Hudson River
  - Housatonic River
  - Fox River
  - Centredale Manor Woonasquatucket River
- NJDEP has “eat none” advisory for fish and shellfish
- NJDEP determined fishing and crabbing continue to occur

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Human Health Risk Evaluation

Risk Characterization – Current Conditions

- The assessment evaluates cancer risks and noncancer health hazards

  RME = Reasonable maximum exposure; and,

  CTE = Central tendency exposure (average exposure)
- Exposure point concentration (EPC) = 95% UCL on the arithmetic mean
- Exposures assumptions from EPA's exposure factors handbook and peered reviewed literature

Exposure Factor	RME	CTE
Fish ingestion (g/day)	25	8
Crab ingestion (g/day)	23	16

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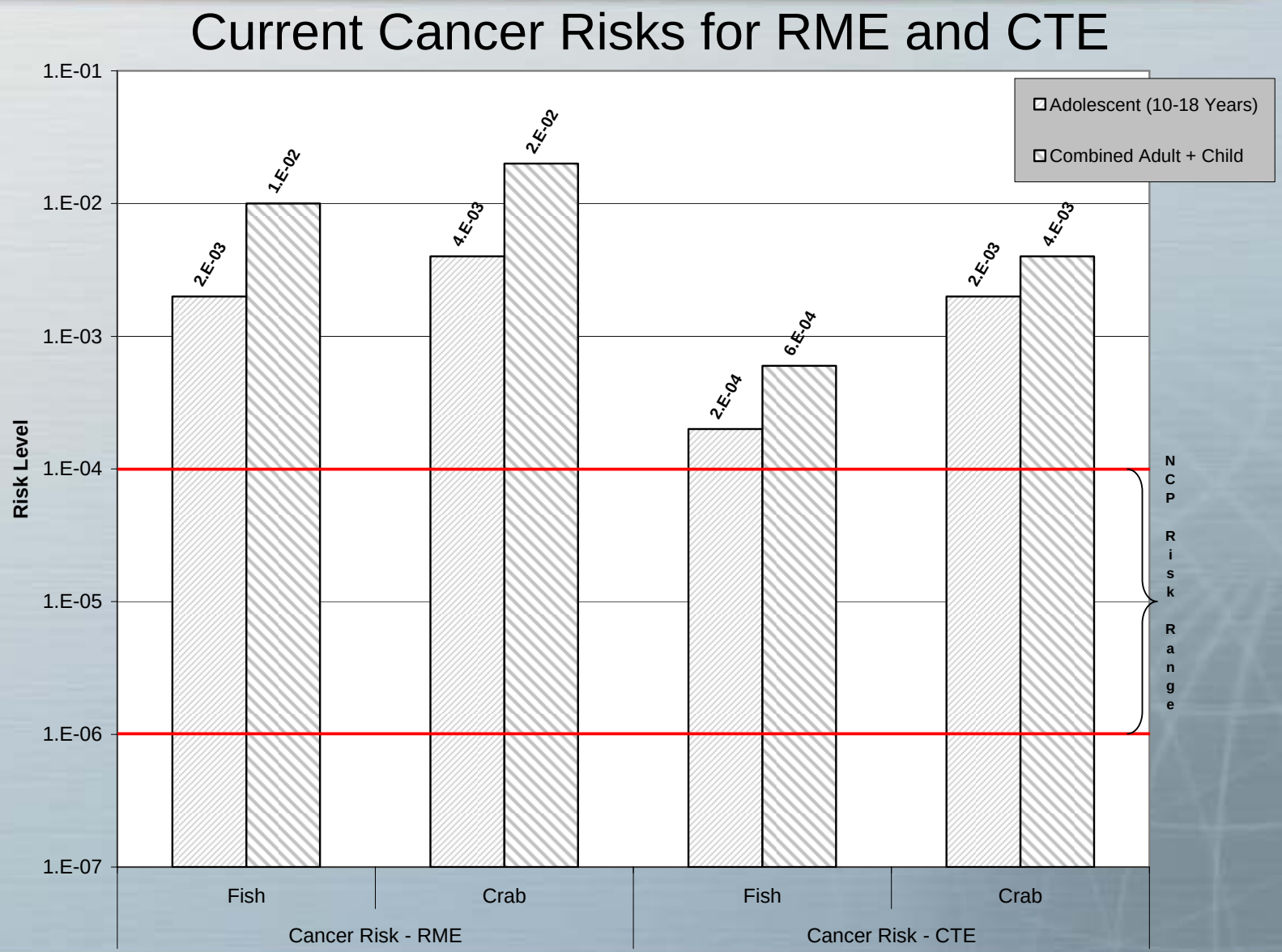
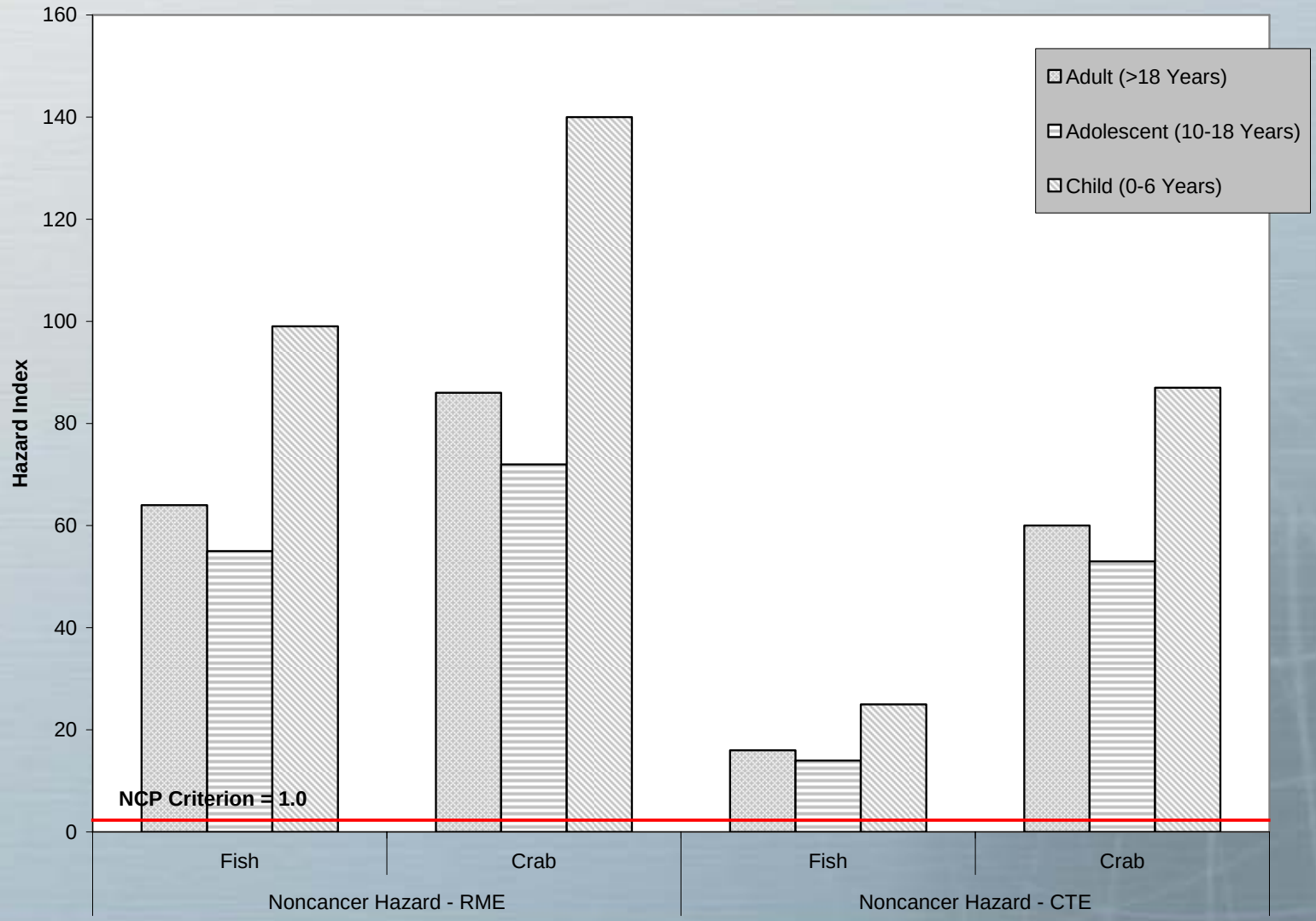
Human Health Risk Evaluation



Human Health Risk Evaluation

Current Noncancer Hazards for RME and CTE



Human Health Risk Evaluation

Future Exposures

- Future exposure concentrations were developed for the following:
  - Each COPC
  - Each of the remedial scenarios
  - For three time periods
  - Fish and crab concentrations were based on modeled concentrations from forecasted contaminant concentrations in sediment

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Human Health Risk Evaluation

Future Cancer Risks for RME

	Remediation Scenario	Time Period	Adult	Child	Adult + Child
			Risk	Risk	Combined Risk
Fish	Monitored Natural Recovery	2018	4.E-03	2.E-03	6.E-03
		2019-2048	2.E-03	1.E-03	4.E-03
	Primary Erosional Zone/Primary Inventory Zone	2018	3.E-03	1.E-03	4.E-03
		2019-2048	1.E-03	1.E-03	2.E-03
	Area of Focus	2018	6.E-04	2.E-04	9.E-04
		2019-2048	3.E-04	2.E-04	5.E-04
	Current	2007	7.E-03	3.E-03	1.E-02

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Human Health Risk Evaluation

Future Cancer Risks for RME

	Remediation Scenario	Time Period	Adult	Child	Adult + Child
			Risk	Risk	Combined Risk
Crab	Monitored Natural Recovery	2018	3.E-03	1.E-03	4.E-03
		2019-2048	2.E-03	1.E-03	3.E-03
	Primary Erosional Zone/Primary Inventory Zone	2018	2.E-03	9.E-04	3.E-03
		2019-2048	1.E-03	8.E-04	2.E-03
	Area of Focus	2018	6.E-04	2.E-04	8.E-04
		2019-2048	2.E-04	2.E-04	4.E-04
	Current	2007	1.E-02	5.E-03	2.E-02

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Human Health Risk Evaluation

Future Noncancer Hazards for RME

	Remediation Scenario	Time Period	Adult Hazard	Child Hazard
Fish	Monitored Natural Recovery	2018	24	37
		2019-2025	20	31
		2042-2048	6.8	ND
	Primary Erosional Zone/Primary Inventory Zone	2018	21	33
		2019-2025	18	29
		2042-2048	6.1	ND
	Area of Focus	2018	16	25
		2019-2025	14	22
		2042-2048	4.7	ND
	Current	2007	64	99

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Human Health Risk Evaluation

Current Noncancer Hazards for RME

	Remediation Scenario	Time Period	Adult Hazard	Child Hazard
Crab	Monitored Natural Recovery	2018	19	31
		2019-2025	16	27
		2042-2048	5.2	ND
	Primary Erosional Zone/Primary Inventory Zone	2018	17	28
		2019-2025	14	24
		2042-2048	4.7	ND
	Area of Focus	2018	13	21
		2019-2025	11	19
		2042-2048	3.5	ND
	Current	2007	86	140

Ecological Risk Evaluation

Ecological Receptors of Concern

- The following species were selected based on known sensitivity to COPECs
  - Benthic invertebrates
  - Great blue heron
  - Mink
  - Herring gull embryo
  - Mummichogs
  - American eel and white perch (AE/WP)

Ecological Risk Evaluation

Risk Characterization

- Benthic Invertebrates
  - Sediment benchmarks (ER-Ls)
  - NOAEL and LOAEL Critical body residues (CBR)
  - Oysters tissue threshold for dioxin developed by USFWS
- Fish (AE/WP, mummichog)
  - Life-stage specific CBRs to fish (both adult and embryonic) tissue EPCs
- Wildlife (heron and mink)
  - NOAEL and LOAEL TRVs to dose estimates
- Avian embryos (herring gull embryo)
  - CBRs to estimated egg tissue concentrations

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Ecological Risk Evaluation
Current Conditions – Benthos and Fish

COPECs	Benthic Invertebrates			American Eel/White Perch		Mummichog	
	Sediment Benchmarks	Macroinvertebrates					
	HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Inorganic Compounds							
Copper	6.9	410	41	12,400	**1,200**	**1,900**	**190**
Lead	8	1.0	0.1	23	2.3	45	4.5
Mercury	24	10	1.0	350	35	41	4.1
Semivolatile Organic Compounds (PAHs)							
LPAHs	74	6.9	0.69	0.82	0.082	0.82	0.082
HPAHs	36	74	0.74	0.48	0.048	0.31	0.031
Pesticides/Herbicides							
Dieldrin	**936**	2.2	0.28	2.5	0.25	0.00033	0.00012
Total DDx	239	**3,000**	**300**	**13,000**	290	0.55	0.1

Ecological Risk Evaluation
Current Conditions – Benthos and Fish

COPECs	Benthic Invertebrates			American Eel/White Perch		Mummichog	
	Sediment Benchmarks	Macroinvertebrates					
	HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Polychlorinated biphenyls (PCBs)							
Total PCBs	79	13	5	1,400	140	160	16
Dioxin-Like Compounds							
TCDD TEQ (D/F)	493	1500	170	7.4	4.3	2.2	0.22
TCDD TEQ (PCBs)	1.2	170	19	0.15	0.088	0.027	0.0027
TCDD TEQ (Total)	494	1670	189	7.55	4.4	2.23	0.22
Total HI	**1,897**	**5,187**	**538**	**27,184**	**1,672**	**2,150**	**215**

Ecological Risk Evaluation
Current Conditions – Wildlife

COPECs	Mink		Great Blue Heron (AE/WP) Diet		Great Blue Heron (Mummichog Diet)	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Inorganic Compounds						
Copper	1.7	1	0.97	0.32	0.52	0.17
Lead	0.52	0.27	1.2	0.61	1.6	0.63
Mercury	2	0.62	6.5	0.65	3.1	0.31
Semivolatile Organic Compounds (PAHs)						
LPAHs	--	--	--	--	--	--
HPAHs	0.04	0.04	--	--	--	--
Polychlorinated biphenyls (PCBs)						
Total PCBs	15	12	3.9	0.98	1.6	0.39

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Ecological Risk Evaluation
Current Conditions – Wildlife

COPECs	Mink		Great Blue Heron (AE/WP) Diet		Great Blue Heron (Mummichog Diet)	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Pesticides/Herbicides						
Dieldrin	0.53	0.26	0.039	0.00074	0.011	0.00021
Total DDx	0.2	0.04	20	2	6.5	0.65
Dioxin-Like Compounds						
TCDD TEQ (D/F)	**1,000**	**37**	27	2.7	19	1.9
TCDD TEQ (PCBs)	560	20	**87**	**8.7**	**46**	**4.6**
TCDD TEQ (Total)	1560	57	114	11.4	65	6.5
Total HI	**1,580**	**72**	**147**	**16**	**78**	**9**

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Ecological Risk Evaluation

Future Exposures

- Future exposure concentrations were developed for the following:
  - Each COPECs
  - Each of the remedial scenarios
- Fish and crab concentrations were estimated using site-specific BSAFs and future cast sediment concentrations
- Risk estimated for 2 time periods, 2018 and 2048

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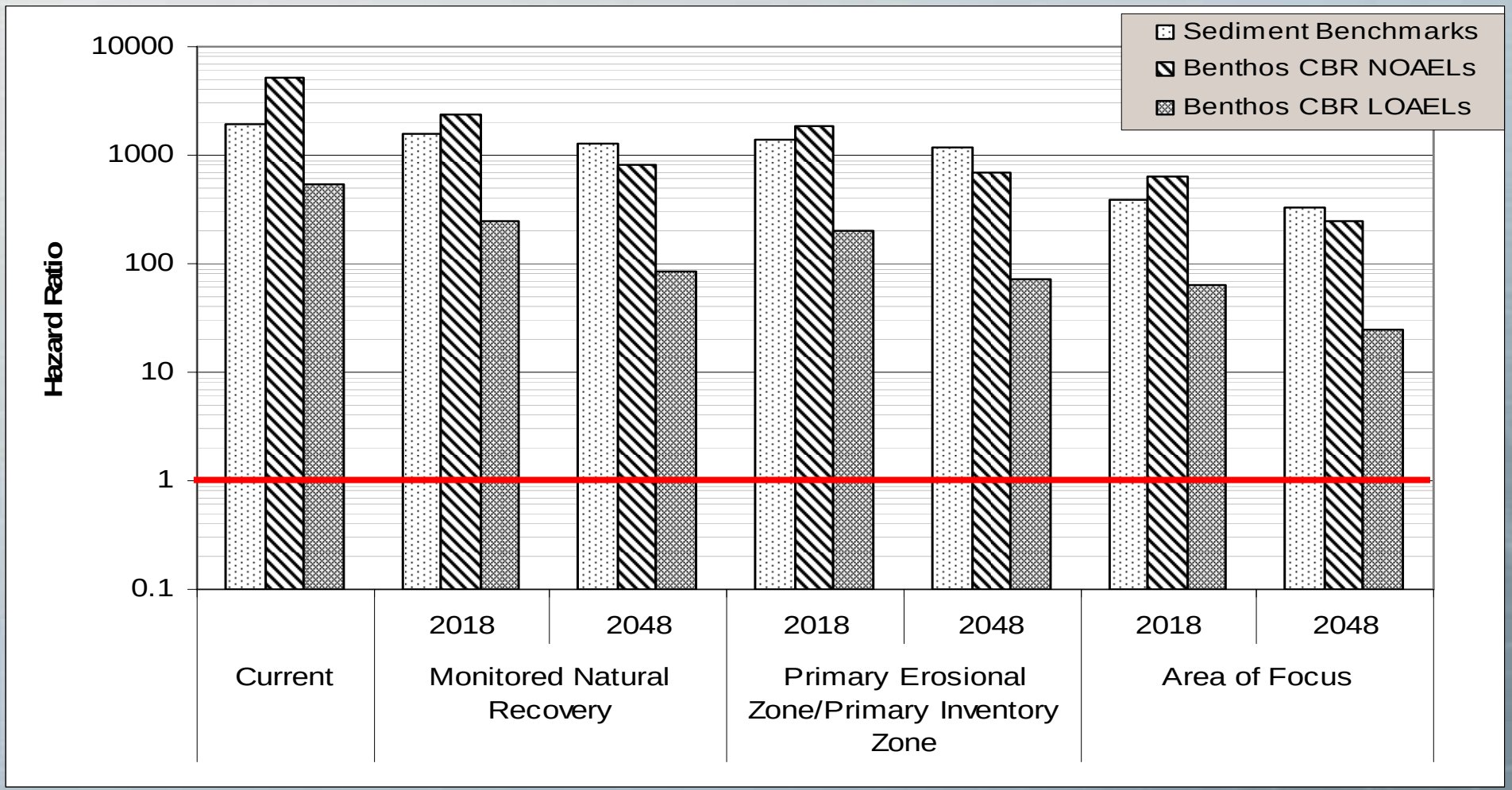
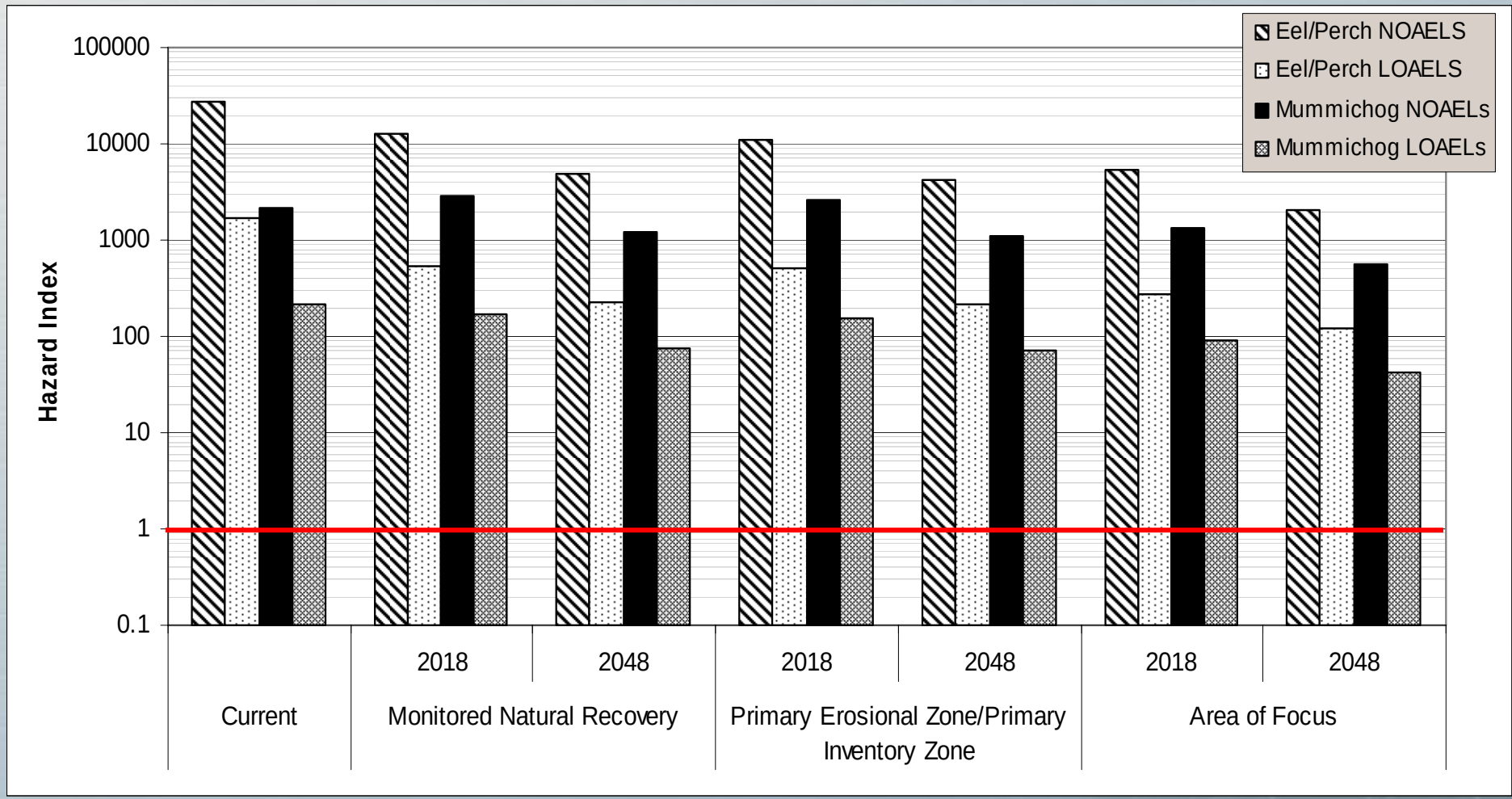
Ecological Risk Evaluation

Current and Future Hazards for Each Remediation Scenario For Benthic Invertebrates



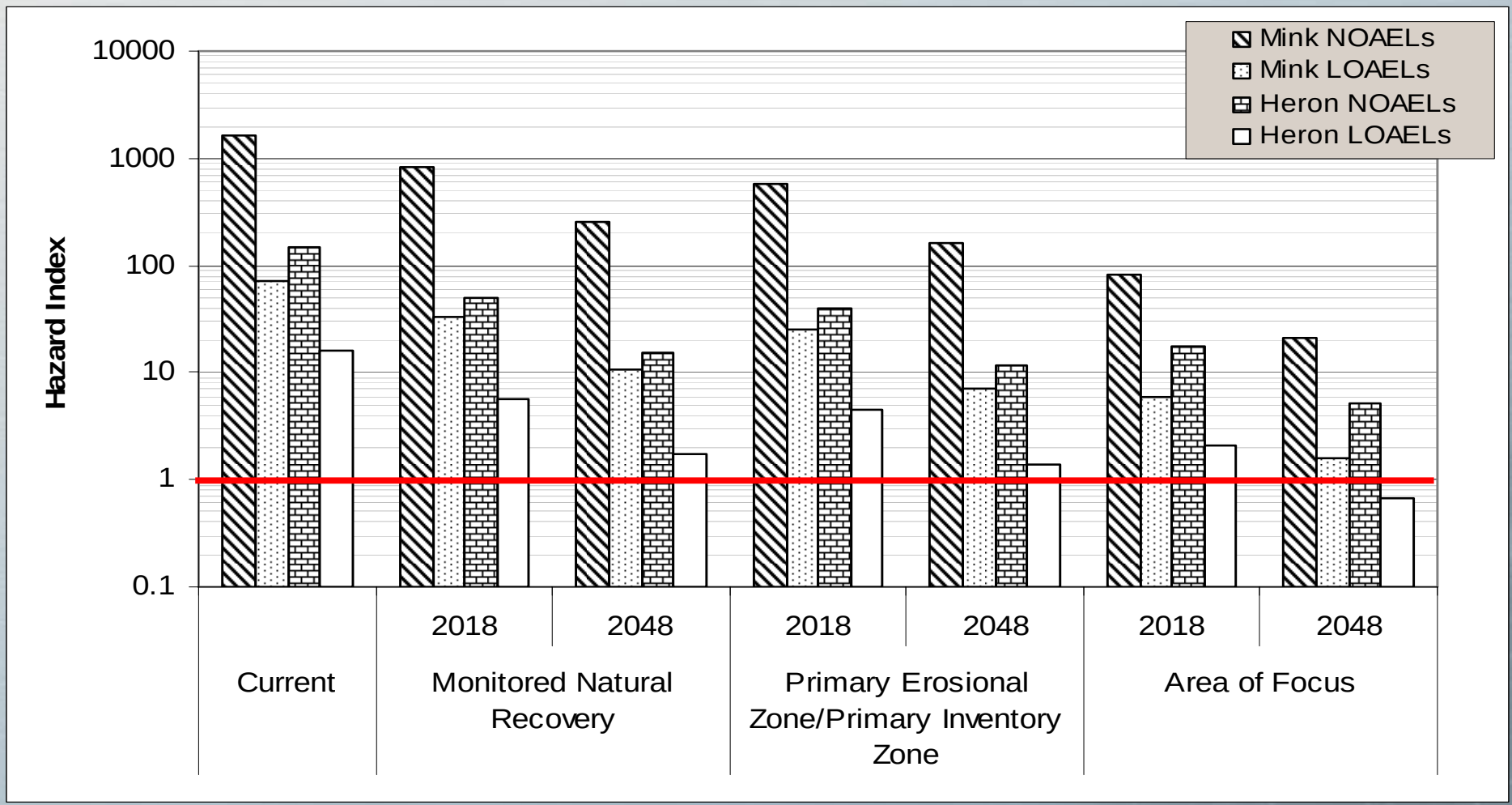
Ecological Risk Evaluation

Comparison of Current and Future Hazards for Each Remediation Scenario Based on Fish CBRs



Ecological Risk Evaluation

Comparison of Current and Future Hazards for Each Remediation Scenario Based on Wildlife Exposures



Risk Reduction Analysis

- Estimated residual risks under the 3 remedial scenarios
- Compared to MMNR (No Action) projections to assess relative risk reduction
- Human health evaluated consumption of fish and crab pathway – cancer only, noncancer showed similar results
- Ecological analysis evaluated direct contact (benthos), tissue residue (benthos, fish) and dose assessment (wildlife)
- Up to 85% lower residual risk under AOC scenario compared to MNR (No Action)
- Intermediate benefits for the PIZ/PEZ scenario.

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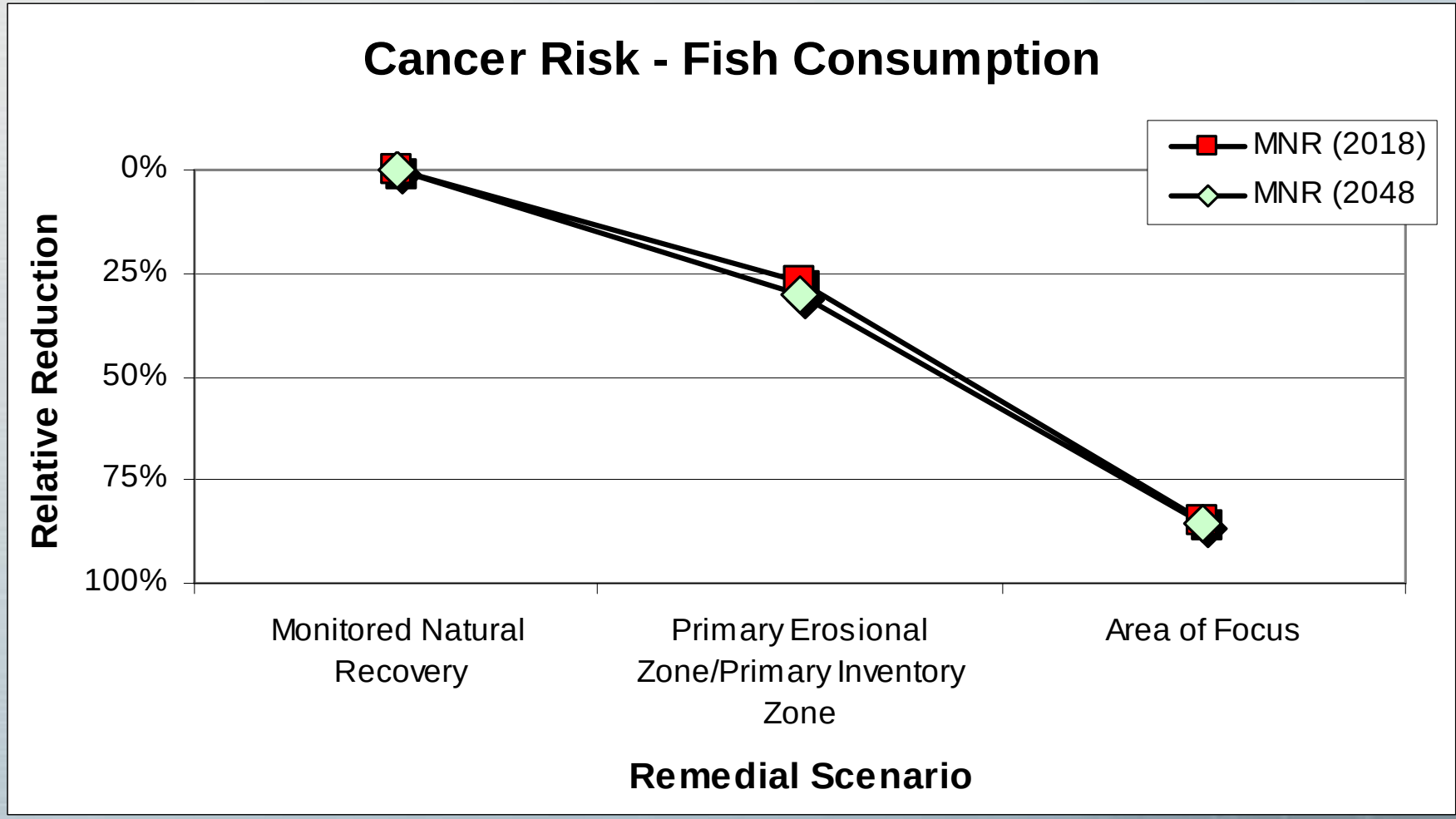
Risk Reduction Analysis – Human Health



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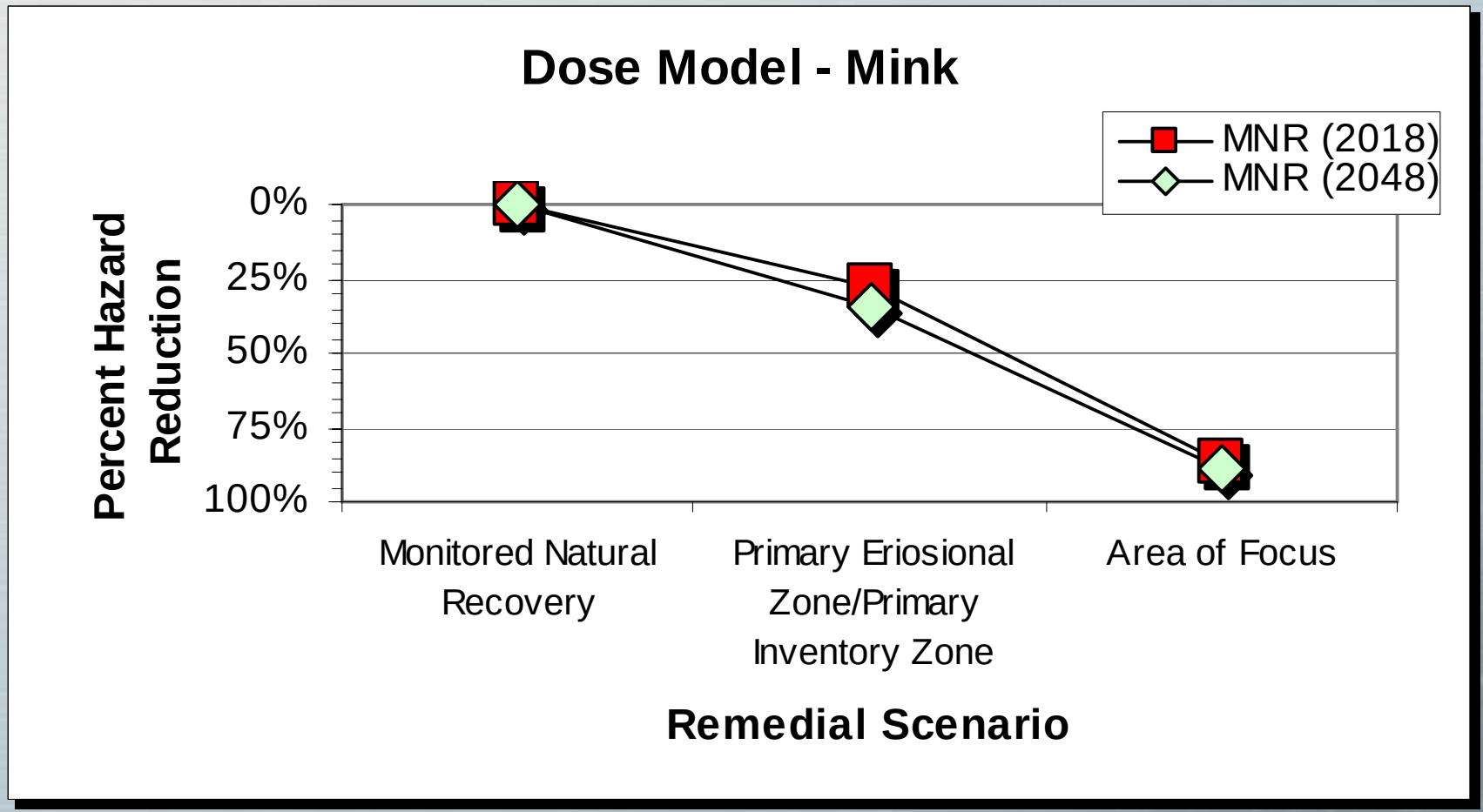
Relative Risk Reduction – Ecological



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Development of Preliminary Remediation Goals (PRG)

PRG Development Considers the Following:

- ARARs/TBCs
- Risk based PRGs protective of human health and ecological receptors
- Evaluation of background levels

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Development of Preliminary Remediation Goals (PRG)

PRG Development

- No appropriate ARARs/TBCs for sediment
- Human health PRGs established for fish consumption pathway
- Ecological PRGs established for direct contact (benthos) and bioaccumulation (wildlife) pathways
- Risk level set at 1×10^{-6} and/or a non-cancer Hazard Index = 1
- Background COPC concentrations based on data from Dundee Lake
- Background COPC concentrations pose unacceptable risks

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Preliminary Remediation Goals

COPC	PRG (ng/g)	Basis
Copper	80,000	Background
Lead	140,000	Background
Mercury	720	Background
Low Mol. Wt. PAH	8,900	Background
High Mol. Wt. PAH	65,000	Background
Total PCB	660	Background
DDx	91	Background
Total Chlordane	92	Background
Dieldrin	4.3	Background
2,3,7,8-TCDD	0.0020	Background

Units in ng/g; parts per billion

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