Fish Injury and Disturbance Thresholds

Fish ≥ 2 grams	Behavior effects threshold 150 dB$_{RMS}$[1]	187 dB SEL$_{cum}$[2]
Fish < 2 grams		183 dB SEL$_{cum}$[2]
Fish all sizes		Peak 206 dB

[1] Hastings 2002, as cited in BA Manual

[2] Memorandum on the Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities

Marine Mammal Injury and Disturbance Thresholds

Functional Hearing Group	In Air Noise Thresholds	Underwater Noise Thresholds				
		Impulsive Sound Impact Pile Driving			Non- Impulsive Sound Vibratory Pile Driving	
	Disturbance Threshold	Auditory Injury Threshold (PTS)		Behavioral Disturbance Threshold	Auditory Injury Threshold (PTS)	Behavioral Disturbance Threshold
	dB RMS (unweighted)	Peak SPL	dB SEL$_{cum}$	dB RMS	dB SEL$_{cum}$	dB RMS
Low-frequency Cetaceans	NA	219	183 LF, 24h	160	199	120
Mid-frequency Cetaceans	NA	230	185 MF, 24h	160	198	120
High-frequency Cetaceans	NA	202	155 HF, 24h	160	173	120
Harbor Seals	90	218	185 PW,24 h	160	201	120
Non-harbor seal pinnipeds	100	232	203 OW,24h	160	219	120

New thresholds: ▯

Hearing Frequency Groups:

Low-frequency Cetaceans = baleen whales (includes humpback ,Northern minke, Sei, gray, blue)

Mid-frequency Cetaceans = dolphins, toothed whales, beaked whales, bottle nose whales (includes sperm whale, killer whale, bottlenose dolphin, Pacific White-sided dolphin)

High-frequency Cetaceans = true porpoises, river dolphins, cephalorhynchid. (Dall's Porpoise)

Phocid Pinnipeds – true seals (harbor seal, Northern elephant sea, ribbon seal).

Otariid Pinnipeds – sea lions, fur seals (California and Stellars sea lion, northern fur seal)

Determining In-water Zones of Injury and Zones of Disturbance (Harassment)

1. **Impact pile driving.**
   a. Calculate Injury Threshold (This is a dual threshold and both must be calculated – use the larger of the two isopleths. Note that the threshold varies by Functional Hearing Group -5 groups)
      i. Peak SPL unweighted – use practical spreading loss model
      ii. SEL_{cum} M weighted – use NOAA calculator sheet E.1 and use the weighting factor adjustment provided in the introduction tab of the spreadsheet. See http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm
   b. Calculate Disturbance Threshold (same for all hearing frequency groups)
      i. 160 dB RMS – use practical spreading loss model
2. **Vibratory pile driving/ removal**
   a. Calculate Injury Threshold (Threshold varies by Functional Hearing Group -5 groups)
      i. SEL_{cum} – using NOAA calculator sheet A. See http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm
   b. Calculate disturbance threshold (the same for all Functional Hearing Groups – 5 groups)
      i. 120 db RMS - use practical spreading loss model

In-air Disturbance for Pinnipeds

Calculate in air disturbance threshold

- 90 dB RMS un-weighted for Harbor seals – use practical spreading loss model
- 100 dB RMS un-weighted for non-harbor seals – use practical spreading loss model