USER SPREADSHEET INTRODUCTION

VERSION: 3.1 (2024) **The use of this version superseded previous versons of this tool**

Companion* User Spreadsheet to:

National Marine Fisheries Service (NMFS): 2024 Update to: Technical Guidance For Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater and In-Air Thresholds for Onset of Auditory Injury and Temporary Threshold Shifts (Version 3.0)

2024 Updated Technical Guidance web page

DISCLAIMER: NMFS has provided this spreadsheet as an optional tool to provide estimated effect distances (i.e., isopleths) where AUD INJ onset thresholds may be exceeded. Results provided by this spreadsheet do not represent the entirety of the comprehensive effects analysis, but rather serve as one tool to help evaluate the effects of a proposed action on marine mammal hearing and make findings required by NMFS's various statutes. Input values are the responsibility of the individual user.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's AUD INJ onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance.

INSTRUCTIONS

STEP 1: Determine what spreadsheet is appropriate for activity

HOW TO DETERMINE WHICH TAB TO USE

1) Is the sound source NON-IMPULSIVE or IMPULSIVE? (If it is unclear which category describes your source, consult NMFS)

a) NON-IMPULSIVE (e.g., drilling, vibratory pile driving, tactical sonar): Go to Question 2

b) IMPULSIVE (e.g., impact pile driving, DTH pile driving, seismic): Go to Question 5

2) Is the NON-IMPULSIVE sound source STATIONARY or MOBILE?

a) STATIONARY: Go to Question 3

b) MOBILE: Go to Question 4

3) Is the NON-IMPULSIVE, STATIONARY source CONTINUOUS or INTERMITTENTɪ?

a) CONTINUOUS: Use Tab A* — **RED**

*If source is vibratory pile driving: Use Tab A.1 — **BRICK**

b) INTERMITTENT: Use Tab B — **YELLOW**

ɪ A key distinction between continuous & intermittent sound sources is that intermittent sounds have a more regular (predictable) pattern of bursts of sounds & silent periods (i.e., duty cycle), which continuous sounds do not.

4) Is the NON-IMPULSIVE, MOBILE source CONTINUOUS or INTERMITTENT?

a) CONTINUOUS: Use Tab C ("safe distance" methodology from Sivle et al. 2014) — **BLUE**

b) INTERMITTENT: Use Tab D ("safe distance" methodology from Sivle et al. 2014) — **ORANGE**

5) Is the IMPULSIVE sound source STATIONARY or MOBILE?

a) STATIONARY: Use Tab E* — **GREEN**

*If source is impact pile driving: Use Tab E.1 — **EVRGRN**

*If source is DTH pile driving/installation: Use Tab E.2 — **TEAL**

b) MOBILE: Use Tab F ("safe distance" methodology from Sivle et al. 2014) — **PURPLE**

STEP 2: Within the appropriate tab, fill-in: **SAGE CELLS** specific to the activity

a) Please provide information used to support values in provided in sage boxes (e.g., surrogate data, direct measurements, etc.)

b) If information is unavailable to fill-out one or more of the sage boxes, please consult NMFS

STEP 3: Estimated PTS isopleths (meter) will be provided in: **SKY BLUE CELLS** by marine mammal hearing group

STEP 4: When using this spreadsheet to estimate marine mammal takes, please provide a copy of completed tab used to estimate isopleths

NOTE: The final tab is for determining appropriate weighting for frequency modulated (FM) broadband sources. **GRAY**

ASSUMPTIONS & ADDITIONAL INFORMATION

1) Marine mammals remain stationary during activity

2) Currently, recovery between intermittent sounds is not considered regardless of time between sounds (i.e., all sounds within the accumulation period are counted)

Suggested (Default*) Weighting Factor Adjustments (WFA) for Broadband Sources:

Source	WFA	Example Supporting Sources
Seismic airguns	1 kHz	Breitzke et al. 2008; Tashmukhambetov et al. 2008; Tolstoy et al. 2009
Impact pile driving hammers	2 kHz	Blackwell 2005; Reinhall and Dahl 2011
Vibratory pile driving hammers	2.5 kHz	Blackwell 2005; Dahl et al. 2015
DTH systems	2 kHz	Denes et al. 2016; Denes et al. 2019; Reyff and Heyvaert 2019
Drill vessels/platforms	2 kHz	Greene 1987; Blackwell et al. 2004; Blackwell and Greene 2006

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans (baleen whales)
High-frequency (HF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)
Very High-frequency (VHF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger & L. australis*)
Phocid pinnipeds (PW) (true seals)
Otariid pinnipeds (OW) (sea lions and fur seals)

* NMFS acknowledges default WFAs are likely conservative

Based on NMFS 2023 Revised Technical Guidance

WFAs should **only** be applied to marine mammals (do not use for sea turtles)

Literature Cited

Blackwell, S.B. 2005. Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications, 13-16 August 2004. Juneau, Alaska: Federal Highway Administration.

Blackwell, S.B., C.R. Greene, Jr., and W.J. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Journal of the Acoustical Society of America 116: 3199-3211.

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Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, and B. Werner. 2008 Broad-band calibration of marine seismic sources used by R/V Polarstern for academic research in polar regions. Geophysical Journal International 174: 505-524.

Dahl, P.H., D.R. DallOsto, and D.M. Farrell. 2015. The underwater sound field from vibratory pile driving. Journal of the Acoustical Society of America 137: 3544–3554.

Denes, S. L., G.J. Warner, M.E. Austin, and A.O. MacGillivray. 2016. Hydroacoustic Pile Driving Noise Study – Comprehensive Report. Document 001285, Version 2.0. Technical report by JASCO Applied Sciences for Alaska Department of Transportation & Public Facilities. Anchorage, AK: JASCO Applied Sciences.

Denes, S., J. Vallarta, and D. Zeddies 2019. Sound Source Characterization of Down-the-Hole Hammering: Thimble Shoal, Virginia. Document 001888, Version 1.0. Technical report by JASCO Applied Sciences for Chesapeake Tunnel Joint Venture. Silver Spring, MD: JASCO Applied Sciences.

Greene, R. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of the Acoustical Society of America 82: 1315-1324.

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3957.

Reinhall, P.G., and P.H. Dahl. 2011. Underwater Mach wave radiation from impact pile driving: Theory and observation. Journal of the Acoustical Society of America 130: 1209–1216.

Reyff, J., and C. Heyvaert. 2019. White Pass & Yukon Railroad Mooring Dolphin Installation: Pile Driving and Drilling Sound Source Verification. Cotati, CA: Illingworth & Rodkin, Inc.

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-567.

Tashmukhambetov, A.M., G.E. Ioup, J.W. Ioup, N.A. Sidorovskaia, and J.J. Newcomb. 2008. Three-dimensional seismic array characterization study: Experiment and modeling. Journal of the Acoustical Society of America 123:4094–4108.

Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnenstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of the R/V Marcus G. Langseth four-string seismic sources. Geochemistry Geophysics Geosystems 10: 1-15.

Technical questions or suggestion on User Spreadsheet: Please contact Amy Scholik-Schlomer (amy.scholik@noaa.gov)

Questions about the appllication of the User Spreadsheet related to coastal construction (vibratory or impact pile driving; DTH systems): Please contact Cara Hotchkin (cara.hotchkin@noaa.gov)

UPDATES (will be posted when change results in the need to recalculate an isopleth; other non-substantive changes may be made periodically but will not result in a version number change)

Original Version	Updated Version	Change	Date posted
1.0	1.1	Sheet A, error with formula for phocid pinniped	Aug. 22, 2016
1.1	2.0	Corresponds to 2.0 version of Revised Technical Guidance (2018). Added sheet specific to vibratory pile driving and explosives and added capabilities to calculate peak sound pressure level isopleths for impulsive sources	July 2018
2.0	2.1	Updated version based on comments from 2018 public comment period. Added Tab for DTH	July 2020
2.0	2.2	Updated version based on comments from 2018 public comment period (late) on seismic surveys from IAGC	December 2020
	2.2	Additional clarification on 1/repetition rate term	November 2021
		No changes to tool functionality	
3.0	3.1	2024 Updated Technical Guidance	October 2024 Updated AUD INJ criteria

A: STATIONARY SOURCE: Non-Impulsive, Continuous

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	
Please include any assumptions	
PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value.

Weighting Factor Adjustment (kHz)*		

* Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 47), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	
Duration of Sound Production (hours) within 24-h period	
Duration of Sound Production (seconds)	0
10 Log (duration of sound production)	#NUM!
Propagation loss coefficient	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	
Please include any assumptions	
PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	2.5	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	
Number of piles within 24-h period	
Duration to drive a single pile (minutes)	
Duration of Sound Production within 24-h period (seconds)	0
10 Log (duration of sound production)	#NUM!
Transmission loss coefficient	
Distance of sound pressure level (L_{rms}) measurement (meters)	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	**-0.09**	**-2.32**	**-17.41**	**-0.45**	**-3.54**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

B: STATIONARY SOURCE: Non-Impulsive, Intermittent

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	
Please include any assumptions	
PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	1	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 62), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD B1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method B2 if SEL-based source levels are not available.

B2: METHOD (SINGLE PING/PULSE EQUIVALENT) PREFERRED METHOD (pulse duration not required)

Source Level ($L_{E,p\text{, single ping/pulse}}$)	
Activity Duration (hours) within 24-h period	
Number pulses in 1-h period	
Number of pulses in 24-h	0
10 Log (number of pulses)	#NUM!
Propagation loss coefficient	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

B1: METHOD USING RMS SPL SOURCE LEVEL

Source Level (L_{rms})	176
Activity Duration (hours) within 24-h period	1.1666667
Pulse duration (seconds)	0.2
1/Repetition rate* (seconds)	25
Duty cycle	0.008
Duration of Sound Production (seconds)	33.60
10 Log (duration of sound production)	15.26
Propagation loss coefficient	18.3

*Time between onset of successive pulses (inverse of repetion rate or inter-pulse interval)

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ Isopleth to threshold (meters)	**0.5**	**0.1**	**0.1**	**0.4**	**0.1**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	**-0.03**	**-9.00**	**-33.84**	**-3.29**	**-12.38**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

C: MOBILE SOURCE: Non-Impulsive, Continuous ("SAFE DISTANCE" METHODOLOGY)

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	
Please include any assumptions	
PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 45), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION‡

Source Level (L_{rms})	
Source Velocity (meters/second)	
Duty cycle	1
Source Factor	1

‡Methodology assumes propagation loss of 20 log R; Activity duration (time) independent

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	d
PROJECT/SOURCE INFORMATION	d

Please include any assumptions

PROJECT CONTACT	d

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	1	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 61), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD D1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method D2 if SEL-based source levels are not available.

D1: METHOD† (SINGLE PING/PULSE EQUIVALENT) PREFERRED METHOD (pulse duration not required)

Source Level ($L_{E,p,\text{single ping/pulse}}$)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation loss of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses (inverse of repetion rate or inter-pulse interval)

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

D2: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (L_{rms})	
Source Velocity (meters/second)	
Pulse Duration (seconds)	
1/Repetition rate^ (seconds)	
Duty Cycle	#DIV/0!
Source Factor	#DIV/0!

‡Methodology assumes propagation loss of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses (inverse of repetion rate or inter-pulse interval)

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	197	201	181	195	199
AUD INJ Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	-0.03	-9.00	-33.84	-3.29	-12.38

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E: STATIONARY SOURCE: Impulsive, Intermittent

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥		

¥Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 71), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD 12 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E2 if SEL-based source levels are not available.

E1: METHOD TO CALCULATE PK AND SEL_{cum} (SHOT/PULSE EQUIVALENT) PREFERRED METHOD (pulse duration not needed)

SEL_{cum}

Source Level ($L_{E,p,\text{single ping/pulse/shot}}$)	
Activity Duration (hours) within 24-h period	
Number of pulses in 1-h period	
Propagation loss coefficient	
Number of pulses in 24-h period	0
10 log (number of pulses)	#NUM!

PK

Source Level ($L_{p,0\text{-pk}}$)	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	**NA**	**NA**	**NA**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E2: METHOD TO CALCULATE PK AND SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

Source Level (L_{rms})	
Activity Duration (hours) within 24-h period	
Pulse Duration$^{\Delta}$ (seconds)	
1/Repetition rate^ (seconds)	
Duty cycle	#DIV/0!
Duration of Sound Production (seconds)	#DIV/0!
10 Log (duration of sound production)	#DIV/0!
Propagation loss coefficient	

$^{\Delta}$Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

^Time between onset of successive pulses (inverse of repetion rate or inter-pulse interval)

PK

Source Level ($L_{p,0\text{-pk}}$)	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ SEL_{cum} Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	**NA**	**NA**	**NA**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION 3.1: 2024

KEY

(green)	Action Proponent Provided Information
(pink)	NMFS Provided Information (Technical Guidance)
(blue)	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	2	

[¥] Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based source levels are not available.

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted SEL_{cum} (at measured distance) = SEL_{ss} + 10 Log (# strikes)	#NUM!

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\text{single strike}}$) specified at "x" meters (Cell B32)	
Number of strikes per pile	
Number of piles per day	
Transmission loss coefficient	
Distance of single strike SEL_{ss} ($L_{E,p,\text{single strike}}$) measurement (meters)	

PK

$L_{p,0\text{-pk}}$ specified at "x" meters (Cell G29)	
Distance of $L_{p,0\text{-pk}}$ measurement (meters)	
$L_{p,0\text{-pk}}$ Source level	#NUM!

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

"NA": PK source level is < to the threshold for that marine mammal hearing group.

E.1-2: METHOD TO CALCULATE PK AND SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B53)	
Number of piles per day	
Strike (pulse) Duration[∆] (seconds)	
Number of strikes per pile	
Duration of Sound Production (seconds)	0
10 Log (duration of sound production)	#NUM!
Transmission loss coefficient	
Distance of sound pressure level (L_{rms}) measurement (meters)	

[∆] Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

PK

$L_{p,0\text{-pk}}$ specified at "x" meters (Cell G47)	
Distance of $L_{p,0\text{-pk}}$ measurement (meters)	
$L_{p,0\text{-pk}}$ Source level	#NUM!

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

"NA": PK source level is < to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	-0.03	-3.45	-21.19	-0.80	-5.23

NOTE: If user decided to override these Adjustment values they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E.2: DTH SYSTEMS (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	
PROJECT/SOURCE INFORMATION	

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2	

¥ Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 50), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**#NUM!**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B30)	
Strike rate (average strikes per second)	
Duration to drive pile/drill hole (minutes)	
Number of piles/holes per day	
Transmission loss coefficient	
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	
Total number of strikes in a 24-h period	0

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G26)	
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	
$L_{p,0\text{-}pk}$ Source level	#NUM!

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	**-0.03**	**-3.45**	**-21.19**	**-0.80**	**-5.23**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

F: MOBILE SOURCE: Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 3.1: 2024

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	hello
PROJECT/SOURCE INFORMATION	helllo

Please include any assumptions

PROJECT CONTACT	t

Bars	$L_{p,pk-pk}$
	#NUM!

SEISMIC METRIC CONVERSIONS

Source Level ($L_{p,pk-pk}$)			
Source Level ($L_{p,0-pk}$)	-6	Source Level ($L_{p,0-pk}$)	
Source Level (L_{rms})	-12	Source Level (L_{rms})	-6
Source Level ($L_{E,p,\text{single shot}}$)	-22	Source Level ($L_{E,p,\text{single shot}}$)	-16

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Weighting Factor Adjustment (kHz)[¥]	1	Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

[¥] Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 68), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD F1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method F2 if SEL-based source levels are not available.

F1: METHOD† TO CALCULATE PK and SEL_{cum} (SINGLE SHOT/PULSE EQUIVALENT) PREFERRED METHOD (pulse duration not needed)

SEL_{cum}

Source Level ($L_{E,p,\text{single ping/pulse/shot}}$)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

PK

Source Level ($L_{p,0-pk}$)	

†Methodology assumes propagation loss of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses (inverse of repetion rate or inter-pulse interval)

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ SEL_{cum} Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	NA	NA	NA	NA	NA

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

F2: METHOD‡ TO CALCULATE PK and SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

Source Level (L_{rms})	
Source Velocity (meters/second)	
Pulse Duration[Δ] (seconds)	
1/Repetition rate^ (seconds)	
Duty Cycle	#DIV/0!
Source Factor	#DIV/0!

PK

Source Level ($L_{p,0-pk}$)	

‡Methodology assumes propagation loss of 20 log R; Activity duration (time) independent

[Δ]Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

^Time between onset of successive pulses (inverse of repetion rate or inter-pulse interval)

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	193	159	183	185
AUD INJ SEL_{cum} Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
PK Threshold	222	230	202	223	230
AUD INJ PK Isopleth to threshold (meters)	NA	NA	NA	NA	NA

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	High-Frequency Cetaceans	Very High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	0.99	1.55	2.23	1.63	1.58
b	5	5	5	5	5
f_1	0.168	1.73	5.93	0.81	2.53
f_2	26.6	129	186	68.3	43.8
C	0.12	0.32	0.91	0.29	1.37
Adjustment (-dB)†	**-0.03**	**-9.00**	**-33.84**	**-3.29**	**-12.38**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$