

The Sound of Freedom: Chronic Aircraft Noise Exposure and Children's Health



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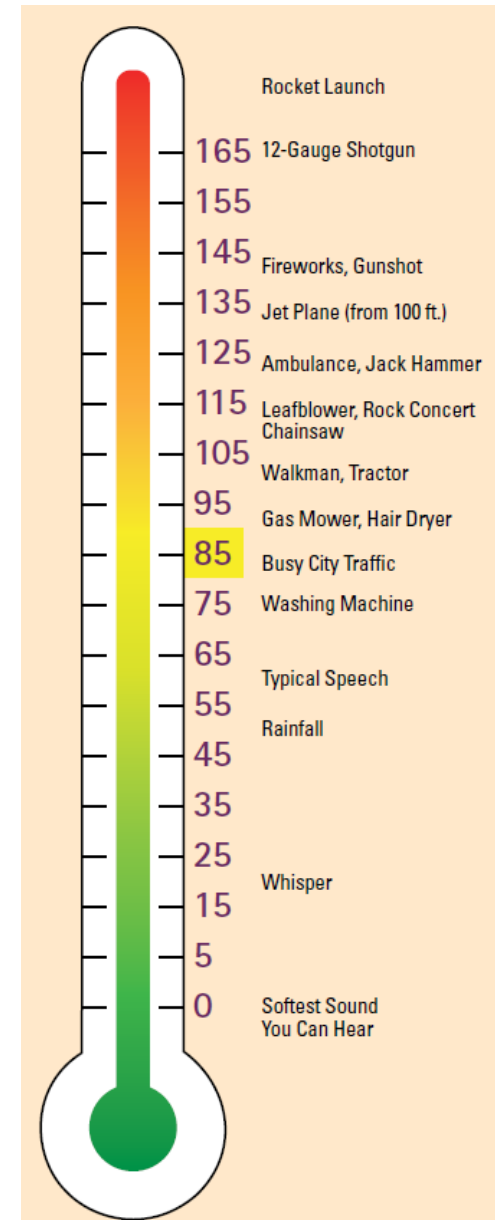
Pediatric Environmental Health Specialty Unit (PEHSU)

Outline

- Introduction to noise
- Vulnerability of children
- Health effects of noise exposure
- Comparison to Whidbey Island situation
- Prevention strategies
- Resources

Introduction - Noise

- Noise – Unwanted or disagreeable sound
- Interferes with normal activities
 - Sleeping, conversation
- Disrupts or decreases quality of life



How do we measure noise?

- Measured by sound level decibel (dB)
- A-weighting (dBA) – accounts for human ear's lower sensitivities to very high & very low frequencies (pitches)
- Maximum sound over a fraction of a second
 - L_{Amax}
- Average noise level over a defined time period
 - L_{Aeq}



Washington & National Noise Standards

- Washington State (Chapter 70.107 RCW NOISE CONTROL/WAC 173-60)
 - **Max** noise in a residential setting from a residential area: *55dBA*
 - 10pm-7am max noise is reduced by 10dBA: *45dBA*
- EPA sets community noise standards as:
 - *70-dBA 24 hour (Leq)*
- Occupational settings: $L_{Amax} = 115 \text{ dBA}$

Vulnerability of Children

- Developmental toxicity
- Dependency on adults for safe environments
- May be more exposed due to behavior and settings
- Origin for adult onset of disease



Health Effects Studied

- Most consistent evidence
 - Learning
 - Annoyance
 - Motivation
- Less consistent evidence
 - Memory & Attention
 - Perceived stress
 - Stress hormone changes
 - Cardiovascular effects
 - Hearing loss
 - Behavioral disorders
- No studies in children
 - Sleep disturbance

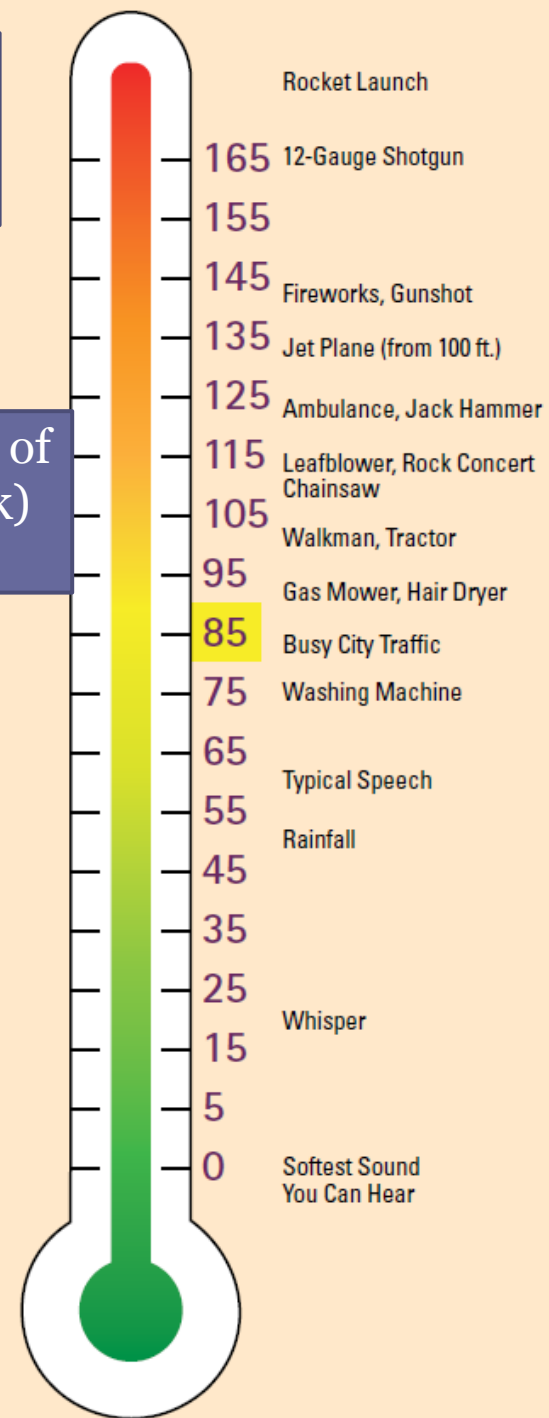


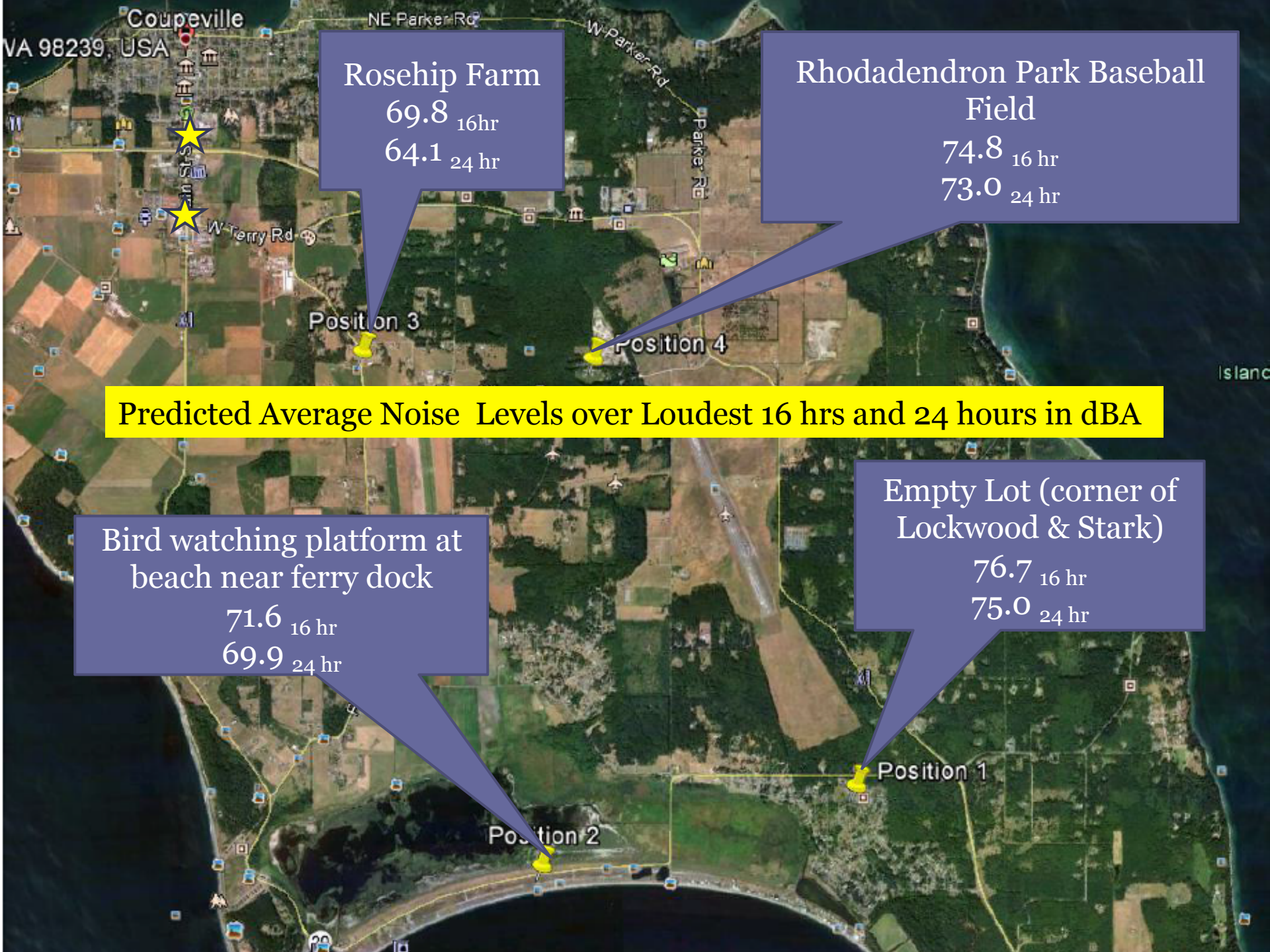
Jet Noise Levels near Coupeville, WA on Whidbey Island



JGL Acoustics Report

- Jet noise on May 7, 2013
 - 4 outdoor measurements during 4 jet practice sessions
 - 1 indoor measurement in private residence





Rosehip Farm
69.8_{16hr}
64.1_{24 hr}

Rhodadendron Park Baseball Field
74.8_{16 hr}
73.0_{24 hr}

Predicted Average Noise Levels over Loudest 16 hrs and 24 hours in dBA

Bird watching platform at beach near ferry dock
71.6_{16 hr}
69.9_{24 hr}

Empty Lot (corner of Lockwood & Stark)
76.7_{16 hr}
75.0_{24 hr}

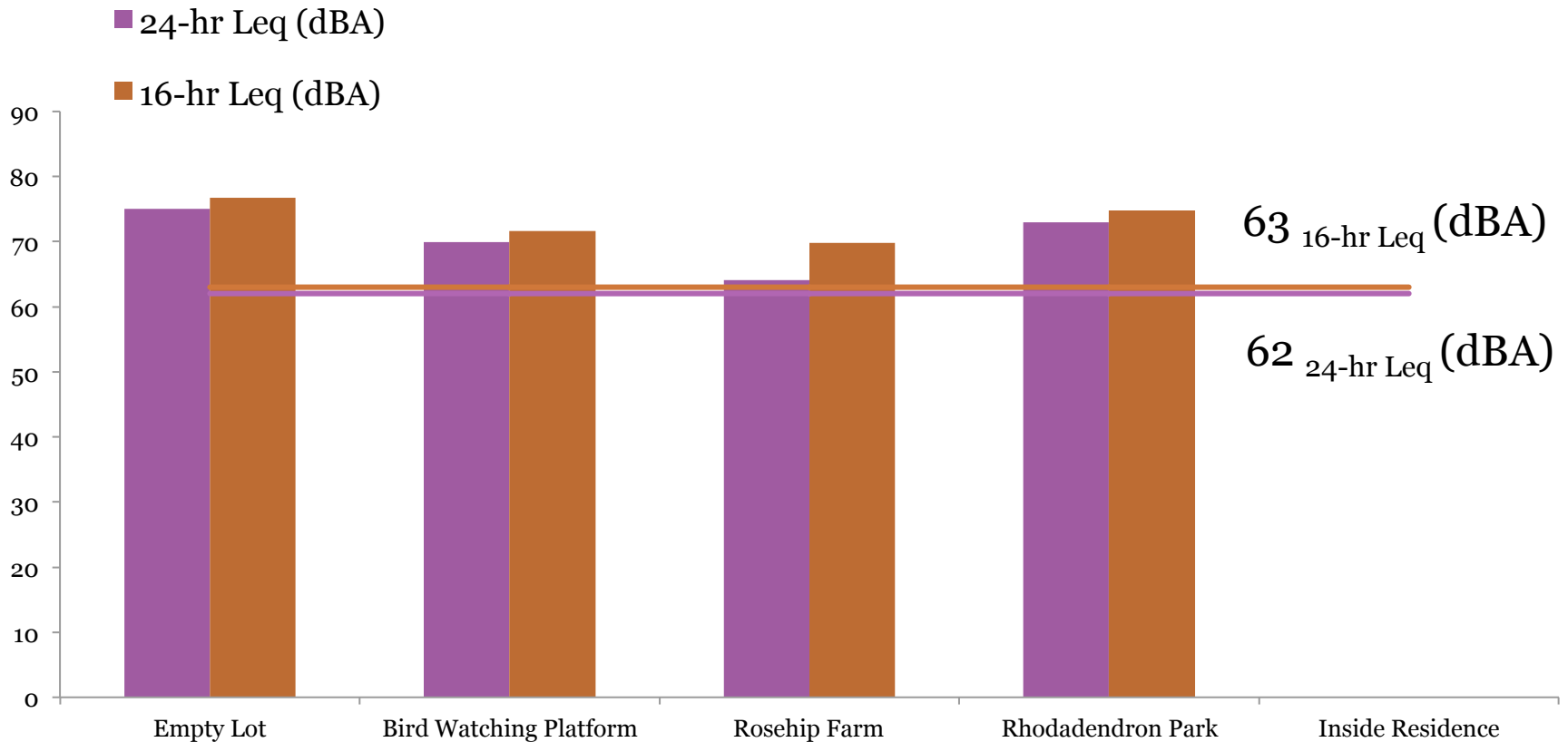
Position 3

Position 4

Position 1

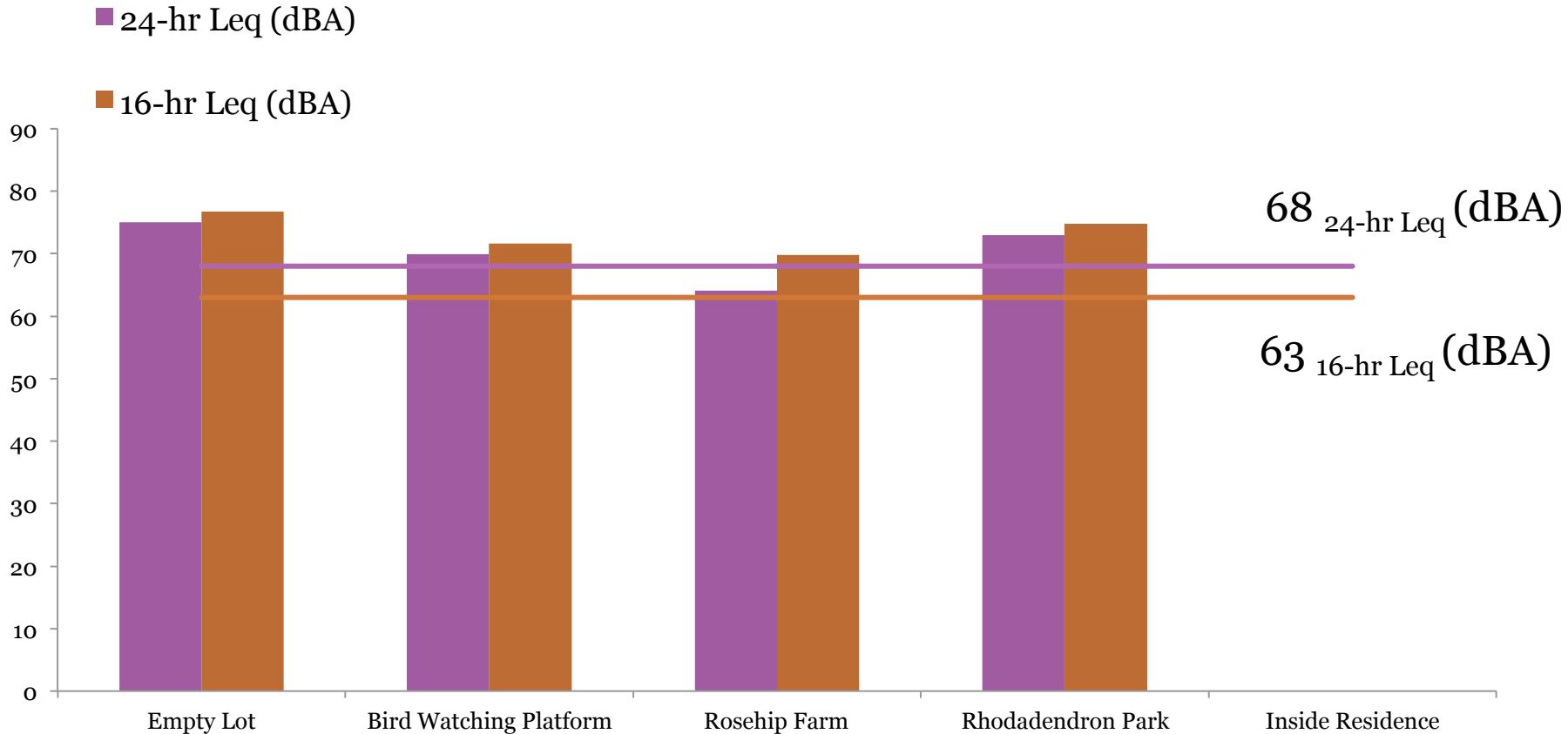
Position 2

Coupeville Noise Measurement Comparison w/Research Data



Impaired Reading Comprehension in Children

Coupeville Noise Measurement Comparison w/Research Data



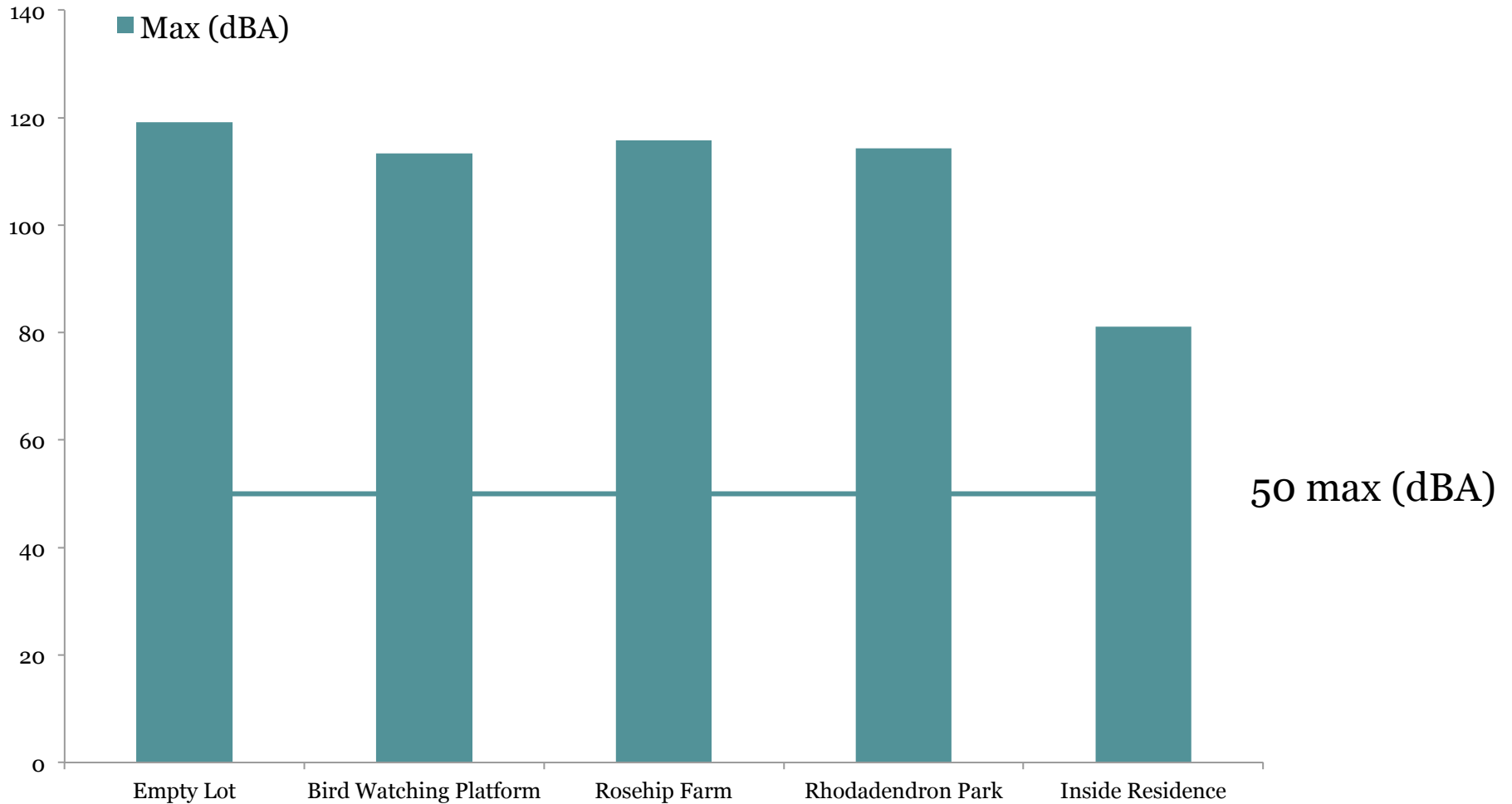
Annoyance in Children

Coupeville Noise Measurement Comparison w/Research Data



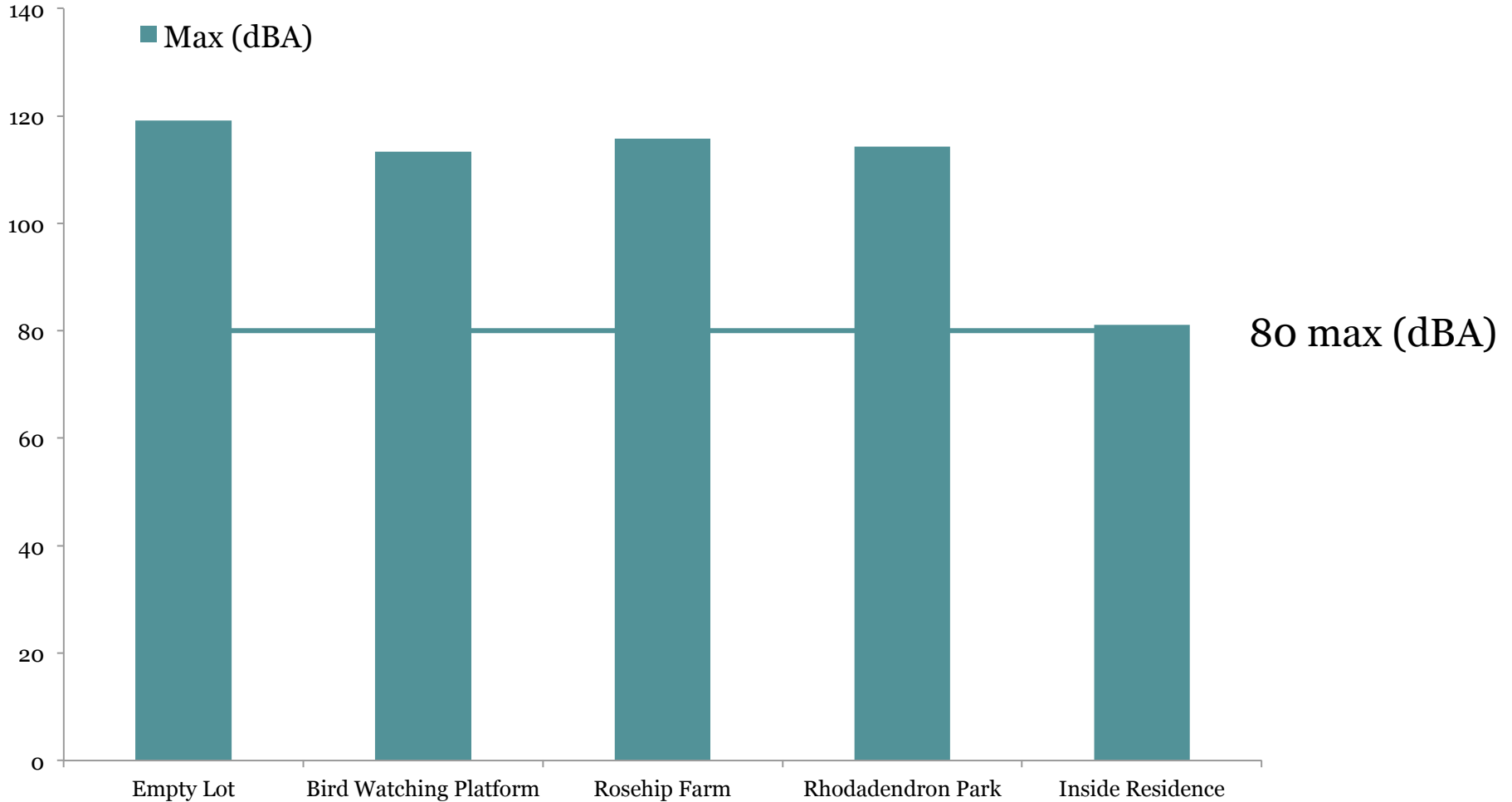
Decreased Motivation in Children

Coupeville Noise Measurement Comparison w/Reference Values



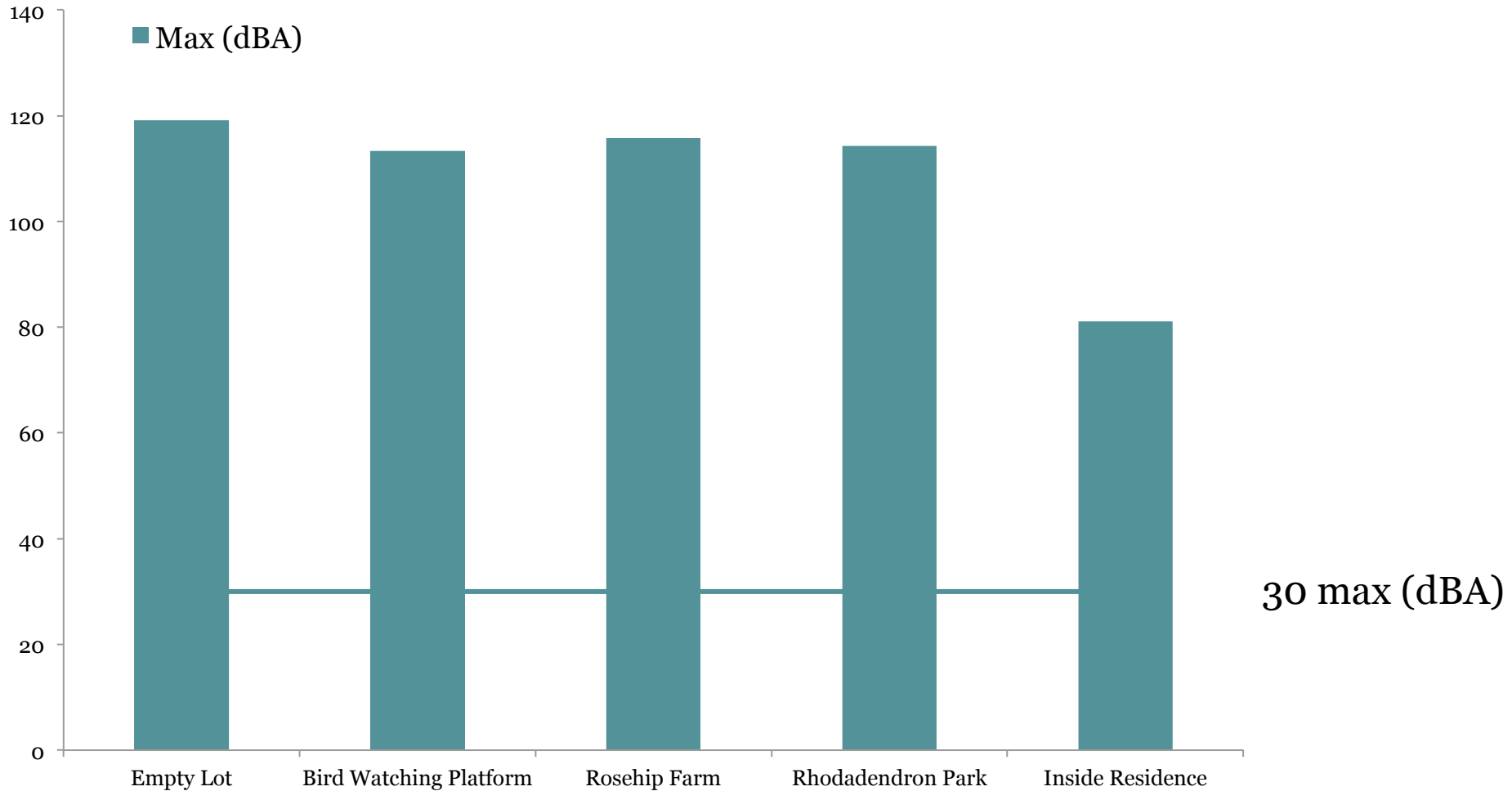
WHO Annoyance

Coupeville Noise Measurement Comparison w/Reference Values



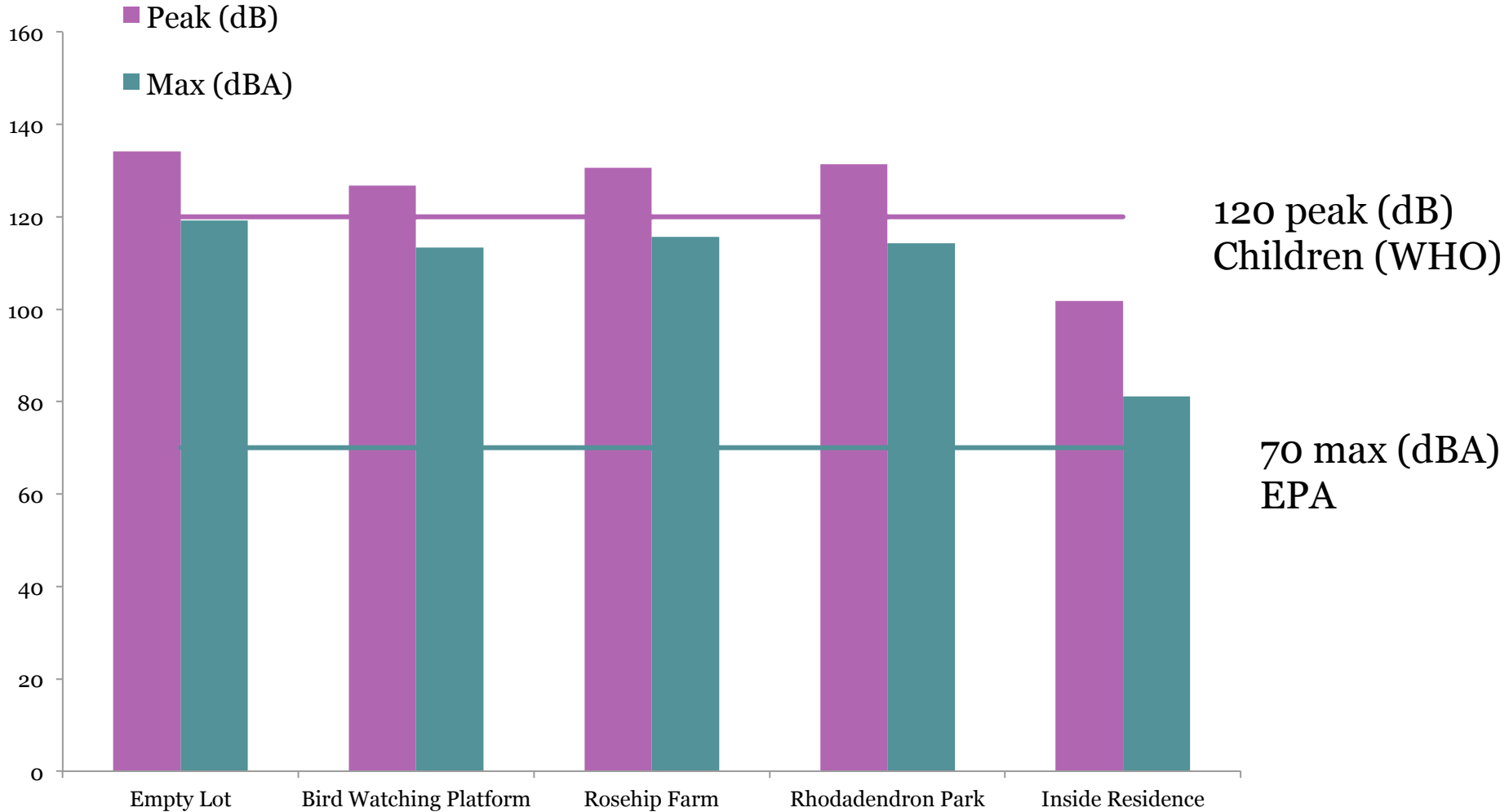
WHO Decreased Motivation/Increased Helplessness

Coupeville Noise Measurement Comparison w/Reference Values



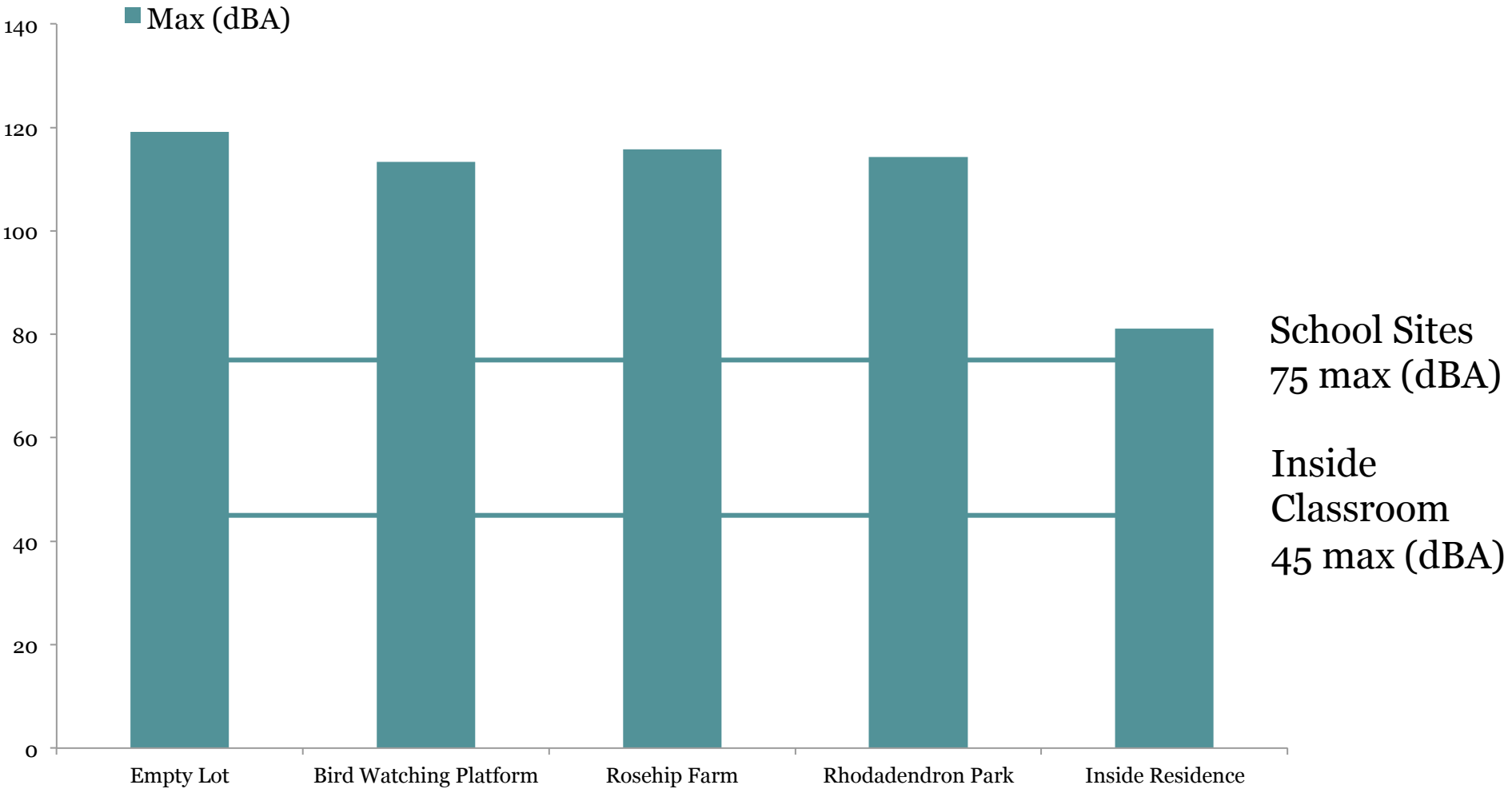
WHO Sleep Disturbance

Coupeville Noise Measurement Comparison w/Reference Values

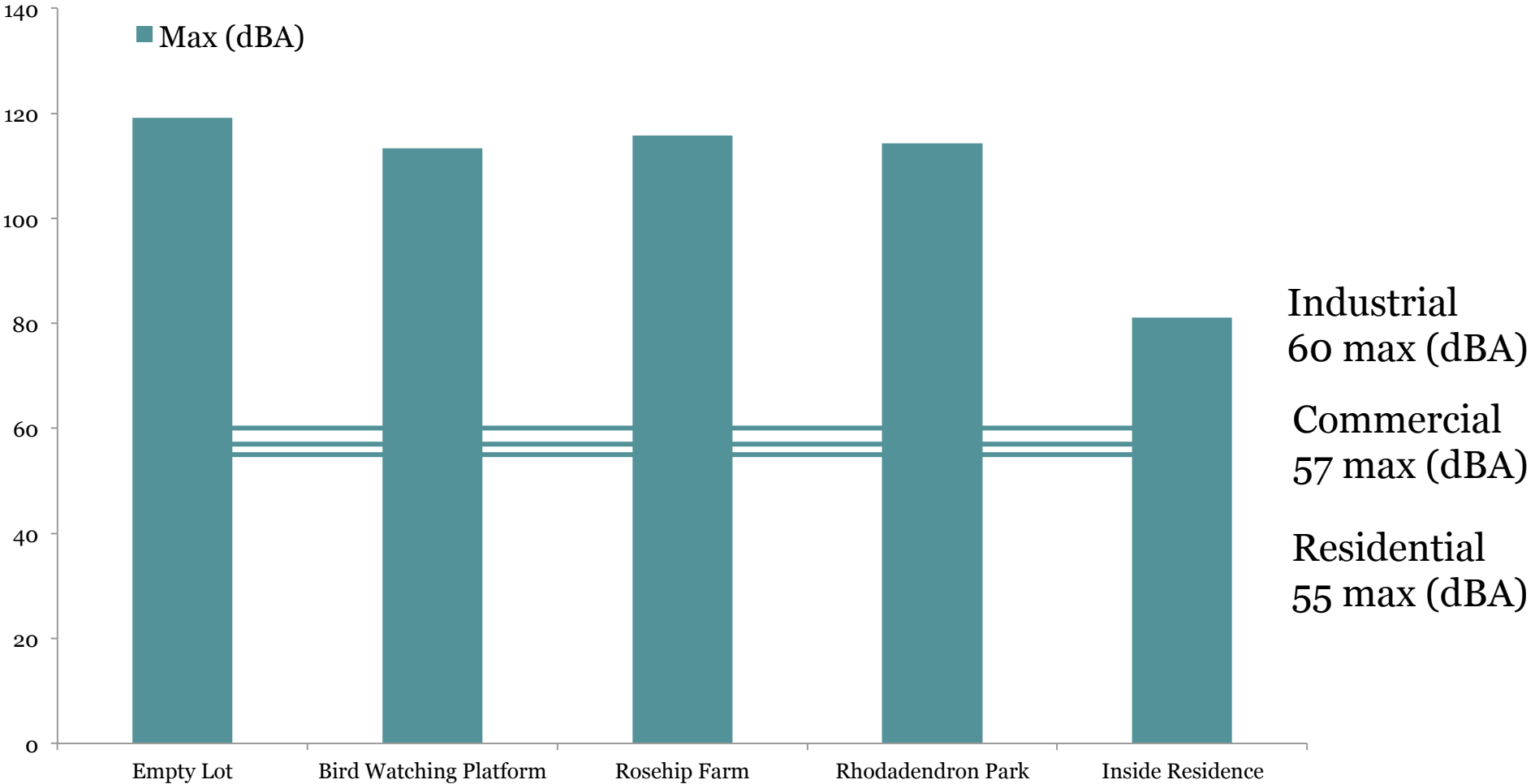


WHO/EPA Hearing Loss

Coupeville Noise Measurement Comparison w/Reference Values



Coupeville Noise Measurement Comparison w/Reference Values



Summary of Findings



Summary of Findings

- Child Health Impacts with Conclusive Evidence
 - Learning
 - Annoyance
 - Motivation
- Whidbey Island measurements exceed levels that protect human health

Recommendations and Resources

A decorative graphic consisting of a solid teal horizontal bar that spans the width of the slide. Below this bar, on the right side, there are three thin, parallel white horizontal lines that extend to the right edge of the slide.

Hierarchy of Hazard Control

- Eliminate the hazard
 - Relocate touch and go training activity
- Administrative controls
 - Schedule touch and go training when children are not in school
- Disrupt the pathway
 - Relocate outdoor child play/study areas to quiet settings
 - Engineering controls in schools, daycares and homes to reduce indoor noise exposure
 - Acoustic insulation
 - Community design policy for new buildings
 - Prioritize low exposure (siting and building design)
- Personal protection
 - Ensure that child wears child-sized hearing protection such as earplugs during touch and go training
 - Guard against additional noise exposure, musical devices, etc

Educate: instruct child to walk away from sources of loud noises

Health Impact Assessment (HIA)

- Used to assess the potential health effects of a project or policy prior to implementation
- Focus on child health
- Health impacts (i.e. noise, jet fuel combustion products)

The screenshot shows the CDC website's 'Healthy Places' section. At the top, it features the CDC logo and the text 'Centers for Disease Control and Prevention' with the tagline 'CDC 24/7: Saving Lives. Protecting People.™'. A search bar is located on the right. Below the navigation bar, the 'Healthy Places' title is displayed. A sidebar on the left lists various topics under 'Healthy Places', including 'About Healthy Places', 'Recent Accomplishments', 'Fact Sheets', 'HIA Stories from the Field', 'Additional Resources', 'Conferences & Events', 'News Releases', 'Publications & Selected Current Projects', 'Related Articles', 'Healthy Places Terminology', and 'Healthy Topics'. The main content area is titled 'Health Impact Assessment' and includes a photograph of a person on a bicycle. The text explains that HIA provides advice to communities on improving public health through design and that it is a process for evaluating potential health effects of plans, projects, and policies. Social media sharing options (Recommend, Tweet, Share) are visible. On the right side of the page, there are links for 'Email page link', 'Print page', and 'Contact Us'. The contact information for the CDC is provided, including the address (1600 Clifton Rd, Atlanta, GA 30333), phone numbers (800-CDC-INFO, 800-232-4636, TTY: (888) 232-6348), and a link to 'Contact CDC-INFO'. The 'New Hours of Operation' are listed as 8am-8pm ET/Monday-Friday, with closed holidays.

More Information - EPA Factsheet



Noise and Its Effects on Children

INFORMATION FOR PARENTS, TEACHERS, AND CHILDCARE PROVIDERS

Children often participate in recreational activities that can harm their hearing.

These activities include attending music concerts and sporting events, fireworks, playing with

What Is Noise?

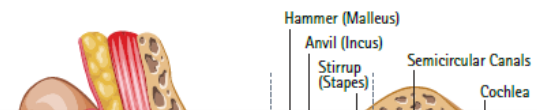
Noise is defined as any unwanted or disagreeable sound and is often dismissed simply as a "nuisance." However, noise can become harmful when it interferes with a child's normal activities, such as sleeping or talking, or disrupts or diminishes a child's health or quality of life.

Measurement of Noise

Noise, like all sounds, is measured by the intensity and frequency of the sound waves that hit the ear. The unit used to measure the volume of sound is the decibel (dB). The greater the number of decibels, the louder the noise and the more harmful it is to your ears.

How the Ear Works

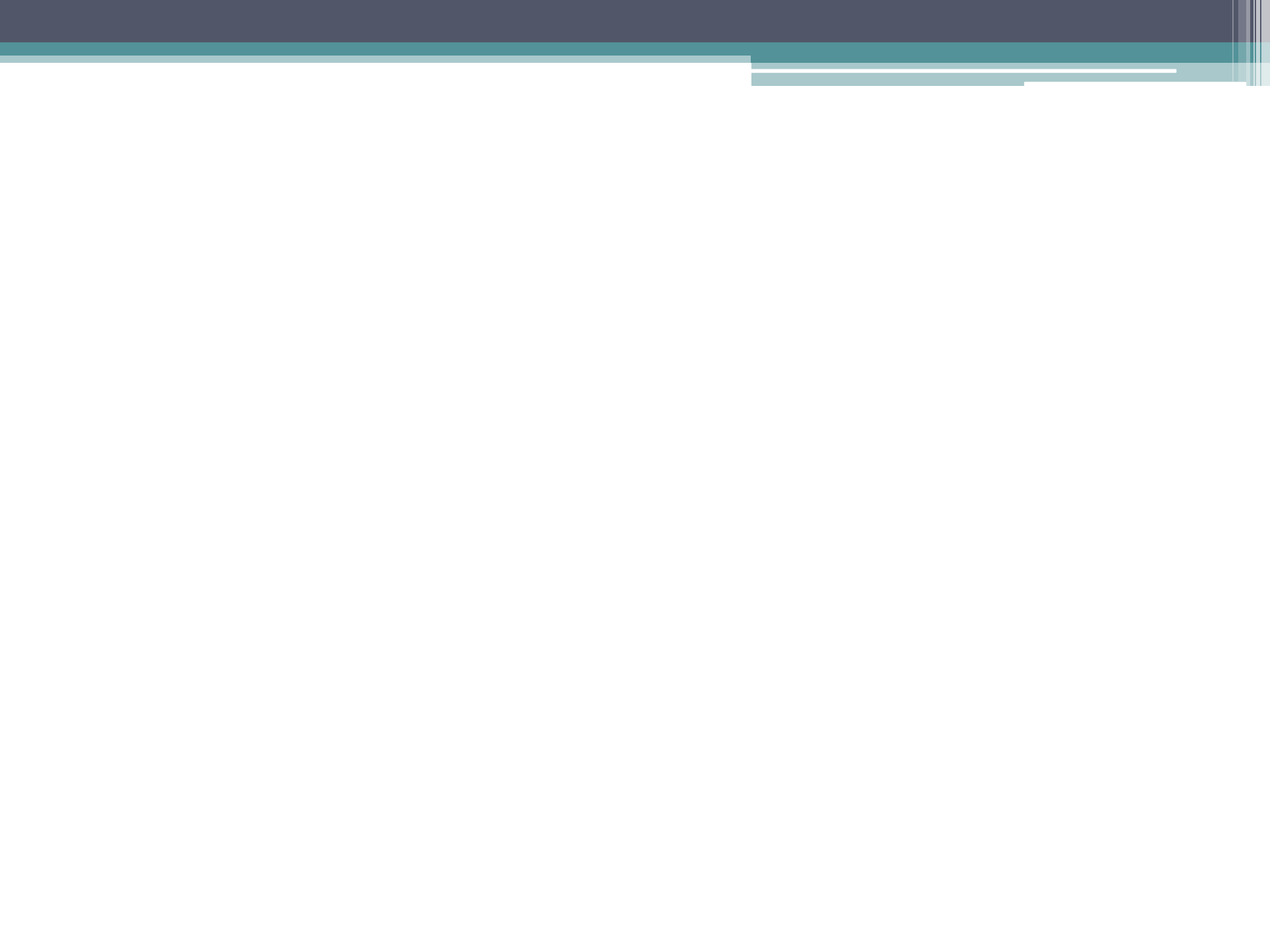
The ear is divided into three parts-



Questions?

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Reading Comprehension & Academic Performance

- ↑ aircraft noise dose ↓ reading comprehension (most difficult questions)
- Noisy school reading comprehension < Quiet school
- ↓ failure rates on standardized tests after noise reduction



Annoyance

- Annoyance: triggers feelings of irritation, discomfort, distress, frustration, and offence
- ↑ aircraft noise dose ↑ annoyance
 - Netherlands
 - Spain
 - UK
- Annoyance in noisy schools/homes > Quiet schools/homes
 - China
 - Germany
 - UK
 - South Africa



Motivation

- Motivation impacted by aircraft noise
- Motivation of noisy school < Quiet school



Less consistent evidence

Memory and Attention

- Sustained Attention
 - 3 studies
- Memory
 - 4 studies
- Inconsistent effects, no effects, small effect size



Perceived Stress/Well-Being/Health

- 3 studies
 - Tendency toward higher quality of life in quiet group
 - No difference in perceived stress between noise and quiet groups

Stress Hormones

Exposure (L_{eq})	N	Adrenaline	Noradrenaline	Cortisol	Author
53, 62	217	+	+	+	Evans, 1998
56, 70	40	0	0	0	Ising, 1999
<57, >66	238			0	Stansfeld, 2001
53, 62	204	0	0	0	Haines, 2001

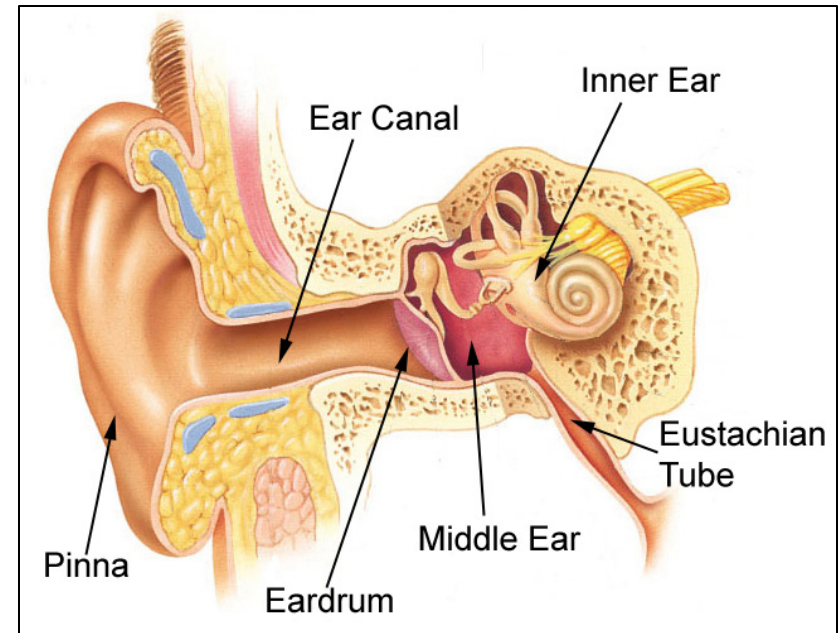
Hypertension

- Tendency toward positive association between aircraft noise exposure and children's blood pressure
- Uncertainty based on methodological differences between studies
- Future research needed



Hearing Loss

- Three studies published in 1990s
 - Two negative
 - One with mild hearing loss for students near airport
- Standards to protect hearing loss
 - Occupational settings: $L_{Amax} = 115$ dBA
 - Indoor and outdoor educational/residential areas:
 $L_{eq, 24\text{ hr}} = 70$ dBA



No field studies in children

Sleep Disturbance

- Sleep is important for learning, memory and behavior
- No recent studies identified directly addressing this question in children
- Federal Aviation Administration (FAA) has identified research on noise-induced sleep disturbance as high priority

