When sound is at odds with its context, it can be harmful. In a word, sound becomes noise. Managing noise means understanding three things: the sound source, the receptor—which is a space used by humans, animals or machines—and the path between them.

Sound sources can become a problem in the environment for several reasons. Excess sound can spark complaints from neighbors or employees, which can escalate into legal battles. Changes in land use can prompt a regulatory reassessment, especially if the new arrangements change the relationship of source and receiver. Sound (or sometimes vibration) can cause sensitive machines to work poorly or need extra maintenance. Wildlife populations can be disrupted as noise or vibration affects behavior.

Our service

We help you understand and manage sound and vibration sources within your regulatory and community context. We're experts at predicting, modeling, measuring and interpreting sound in the environment, and we're deeply familiar with the complex regulations that govern it. We have the in-depth expertise, judgment and insight to find the most elegant and efficient solution—or to find a solution where it looks like there wasn't one.

We've worked with noise and vibration sources large and small, from many sectors, such as mining, energy, construction, transportation, medical and commercial, and in many community contexts. We understand how needs differ depending on the receptor space (e.g., workplace, residence, daycare, school, place of worship or culturally important space) or wildlife population (e.g., caribou, birds or whales). And we have an exceptionally strong understanding of how to navigate the regulatory landscape and have advised government agencies in the development of current guidelines in certain regions.

Our work starts with defining the character and key properties of your sound source. In particular, we specialize in separating the contributions of multiple sources whose effects may be cumulative. This step determines whether compliance is an issue and, if so, where effort should be focused.

If sound sources need to be controlled, we look first at ways to limit the generation of sound. Often, we also need to control sound at some
intermediary point. This is where we draw on our world-leading expertise in weather and climate: Atmospheric conditions are key to the transmission of sound. We look for ways to modify the transmission path; here we also draw on our understanding of your industry and our resources in building engineering.

At this point, we may use the computer models and measurement strategies established during initial investigations to fine-tune a solution. We have developed a prediction and assessment methodology that is more comprehensive than many other approaches but ultimately delivers better accuracy. This approach is highly regarded by regulatory authorities. These models are sophisticated, but the phenomena are complex and sometimes can’t be modeled fully. That’s why our professional judgment is key to interpreting your modeling results correctly.

Real-time measurement can also be critical to successful noise mitigation and community relations, so we’ve developed our own prediction and real-time monitoring system that we can customize to your needs. We are able to predict likely noise impacts in advance of the development and advise on noise mitigation methods. The mitigation often involves the detailed design of industrial buildings and noise control modifications, to reduce the noise impact on occupants and the surrounding community. We work closely with construction contractors and manufacturing facilities to assist them in managing out of hours works in urban, suburban and rural areas.

**Typical scenarios**

**Environmental standards**

- Sound-level limits for a new development
- Environmental impact of a large infrastructure project, such as wind farms
- Protection of wildlife or traditional use lands

**Land use changes**

- Development of residences in an industrial area, or vice versa, impinging on a regulatory buffer zone
- Development of major transportation routes
- Development of new activities, e.g., tractor-trailer deliveries to a new supermarket in a residential area

**Neighborliness**

- Concern for sound mitigation as part of good design and community responsiveness

**Disputes**

- Complaints by neighbors, e.g., about a pumping station or concert venue

**Typical noise sources**

- Alert devices (horns/back-up alarms)
- Amusement parks
- Blasting
- Building services equipment (MEP)
- Concert venues
- Construction and tunneling activity
- Cruise ship horns
- Dog kennels
- Industrial operations
  - Manufacturing
  - Resource extraction
  - Upstream and midstream oil & gas
  - Power generation (conventional & renewable)
  - Pollution control devices
  - Ventilation fans
- Transportation
  - Aircraft (airports & helipads)
  - Highways
  - Trains
  - Shipping (ports)
- Motocross tracks
- Occupational noise
- Power tools
- Shooting ranges
RWDI is a valuable partner to clients seeking to...

**Explore Innovations**
- Use novel solutions to minimize noise impact, creating high-value, well-regarded projects

**Create Opportunities**
- Increase community buy-in by demonstrating and communicating effectiveness of noise mitigation

**Meet Challenges**
- Balance noise sources against community needs to
  - Achieve a successful regulatory approval
- Address community concerns for planned projects
- Address complaints
- Protect wildlife and traditional use lands while proceeding with responsible development
- Evaluate noise concerns in the context of litigation

**Fulfill Expectations**
- Comply with regulatory environmental standards (sound-level limits)
- Meet commitments to the community
- Provide mandated environmental assessments or permit applications
How we work

Applications

Understanding when sound becomes noise

We prefer to present our results as neutral scientific data that refer to “sound” rather than “noise.” Your needs and context determine when sound crosses the line into nuisance. We can also work with you to find metrics that translate sound data into criteria appropriate to your project.

• For humans, conflicts may arise when sound impinges on the health and enjoyment of daily life. People may be unable to enjoy their property (e.g., a backyard is too noisy due to a neighboring business); have difficulty sleeping, learning or praying; or be constantly distressed by noise-induced events (e.g., rattling of windows or dishes).

• For wildlife, noise can impair communication with prospective mates (thus limiting procreation of that species), scare individuals away from their preferred habitat, or provoke anxiety-induced behaviors that cause an animal to harm itself (e.g., whales that become beached, birds that fly in to obstacles).

Addressing occupational noise

Many industries must consider the impact of sound on workers (i.e., on a factory floor): in particular, how sound levels may impair their hearing over time or affect their ability to do their job. Noise in this instance is not a question of nuisance but rather of clear health effects: Elevated sound levels are known to cause hearing damage. In addressing occupational noise, we use methods similar to those for exterior noise but apply them for interior settings (usually).

Methods

Evaluating the source

Compliance is based on assessment of sound levels at the receptor (a “sound audit”), but these sound levels are mostly determined by the source. Thus, the key to compliance is understanding the properties of the source and how they radiate into the environment. Source characterization is especially important if your facility has multiple noise sources. In such a facility, a sound audit at a receptor may register the sum of sound from many sources. In that case, using receptor-based data to determine which source is problematic—out of hundreds of candidates—may be impossible. Instead, we start from the sources. We use specialized modeling and analysis techniques to isolate and quantify the contributions of various sound sources. By understanding each source, you can prioritize any needed mitigation. The most offending sources can be resolved in descending order of severity, until the remaining noise is inconsequential.
Evaluating the path of travel

We also look at the path by which the sound or vibration wave travels from source to receiver. Once we understand the path, we study how the wave could be modified along that path—slowed, deflected, attenuated, altered. In particular, for sound, atmospheric conditions (weather, wind, humidity) play a key role in how sound travels from one point to another. With vibration, the subsurface composition of the ground (e.g., type of soil, level of compaction, presence of boulders or bedrock) can be important. Our engineers have a widely acknowledged reputation in relation to groundborne noise from construction tunnelling and tunnels, with particular knowledge of rail vibration generation and propagation. The result of this work is a “propagation evaluation.” From this evaluation, we identify which sources may be influential and which can be disregarded. Also, we can use this evaluation to create a model that predicts the effects of sound where a new source may not yet exist (e.g., for a proposed factory or transit line).

Measuring, modeling and monitoring sound

We use a variety of techniques to evaluate noise and vibration: source measurement, computer modeling, judgment/experience and receptor monitoring.

- Measurement can include use of sophisticated tools, such as sound intensity probes or acoustic cameras, to characterize a noise source in three dimensions.

- For decades our sound specialists have been advising the resource and construction industries on how to blast efficiently without causing damage or community disturbance from the associated vibration and air blast. Our knowledge on the environmental effects of blasting places us among the world leaders in this area.

- Measurements are then used as input to computer models that represent sound propagation paths in three dimensions, under a variety of atmospheric conditions, directed to a myriad of surrounding receptor points. The computer models are sophisticated: For example, they can represent moving trains and aircraft or large, stationary machinery that radiates sound differently in every direction. Yet even these sophisticated models are limited when faced with all the complexities that exist in the atmosphere. In these instances, we rely on judgment and experience to validate results or adjust the model to better represent reality.

- Finally, monitoring can be used to measure the sound or vibration level at the point of reception, perhaps to validate a model. Monitoring can range from simple spot checks with a hand-held sound-level meter to automated real-time systems. We have developed a real-time monitoring solution that can send alerts and post data to websites for remote viewing. We will customize this platform to meet your monitoring needs.