

## Vibration FAQ

Summer 2026

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### Background

The [SR 520 Portage Bay Bridge and Roanoke Lid Project](#) is the final major project in the SR 520 corridor. It is one of WSDOT’s largest and most complex megaprojects. Part of the complexity stems from the unique geography and geotechnical conditions of the area, including building new infrastructure within a historic landslide area. Geotechnical conditions refer to how underground conditions such as soil, rock and water respond to construction activities.

WSDOT has done extensive analysis to protect homes and other structures from potential vibration-related damage and implemented various monitoring strategies to track vibration and other types of ground movement.

The purpose of this document is to outline:

- Protection and mitigation practices WSDOT has in place to protect infrastructure, homes and the community during and after construction.
- Monitoring devices to track vibration around the project area.
- Resources available to neighbors who believe their homes have been damaged by construction vibration.

### Protection measures and mitigation practices

#### **Q: How did WSDOT prepare for and analyze potential construction-related vibration?**

In 2013, WSDOT hired a vibration expert to evaluate the I-5 to Medina Project corridor, including any potential haul routes along city arterial streets, and identify areas where impacts to properties within the affected area could occur because of vibration.

The vibration expert prepared a [Construction Noise and Vibration Report \(2013\)](#) for the I-5 to Medina corridor that identifies the expected vibration levels at nearby receivers, risk of exceeding the damage risk criteria for vibration (which were based on federal guidelines), control measures for Skanska to use where the criteria may be exceeded, and locations where monitoring would be conducted. The vibration expert used mathematical modeling based on the types of construction equipment and activities to determine the expected levels of vibration at nearby receivers. These measures and vibration limits informed the Portage Bay Project’s contract.

Additionally, in August and September of 2022, WSDOT conducted two test pile installations to collect noise and vibration data. The test pile installations helped further the team’s understanding of the soil behavior and how vibration travels in and around Portage Bay. The test pile data built upon the 2013 analysis and was used to inform the noise and vibration limits in the contract. The data also provided valuable information to Skanska – the project’s contractor – to plan their construction activities so they can stay under the allowable noise and vibration limits.

**Q: What measures did WSDOT take to make sure extreme vibrations won't adversely influence hillside geology for houses built on the hillsides?**

Our geotechnical design team has been studying this issue for many years to ensure our construction processes – including the use of heavy vehicles and the modification of the hillside for bridge-related structures – do not place unnecessary stresses on the area.

Before construction began, WSDOT’s geotechnical experts developed a comprehensive geotechnical report to summarize the expected geotechnical conditions for the project. The report was developed from geotechnical information and data collected through underground exploration, field and laboratory soil testing and analysis, and evaluation of groundwater levels and characteristics. The report also included a detailed review of historic geological and geotechnical data for the project area.

Because of the area’s history of earthquakes and landslides, the design and construction requirements are intended to protect the new bridge, nearby buildings and infrastructure from damage. The project design focuses heavily on protecting the new bridges and lid from potential landslides and stabilizing some of the steep slopes surrounding SR 520 between I-5 and Portage Bay. This is done by building retaining and slope-stabilization walls around the project area.

In addition, we continually monitor the site for vibration and movement with instrumentation, surveys and inspections throughout construction.

**Q: What methods does WSDOT use to protect homes from the potential effects of vibration during construction?**

The construction contract established vibration limits that the contractor must follow. These limits were developed based on the 2013 analysis to identify properties most vulnerable to vibration effects and U.S. Department of Transportation guidelines. Data gathered from the August and September 2022 test pile installations supplement the 2013 analysis.

Before construction began, WSDOT’s contractor – Skanska – was required to submit a vibration monitoring plan. The plan identifies how construction activities will be carried out to stay within the contract’s vibration limits and shows the locations of the vibration monitors.

For example, to reduce noise and vibration impacts during bridge construction, Skanska is using a smaller number of large-diameter drilled shaft casings for the bridge foundations. These casings are installed only with a vibratory hammer. The alternative would be a larger number of smaller drilled shaft casings and driven piles requiring both vibratory and impact hammer installation methods. In addition, during bridge demolition activities, Skanska plans to use a “surgical” approach to removing the structural elements of the existing Portage Bay Bridge. Large, manageable sections of the bridge will be carefully removed and transferred from the area for off-site processing.

**Q: What is WSDOT doing to work with the community to protect historic properties near construction?**

Since the start of the SR 520 Program, WSDOT has regularly consulted with community members and project partners in accordance with Section 106 of the National Historic Preservation Act. A Programmatic Agreement (PA) was executed in 2011 that outlines the measures WSDOT and contractors must take to avoid, reduce and mitigate for project effects to nearby properties that are eligible for listing on the National Register of Historic Places. One of these measures was the development of the [Community Construction Management Plan](#) to address construction effects such as traffic, noise, vibration and dust.

In addition to the Community Construction Management Plan, the PA requires Skanska to operate a 24-hour construction hotline for the duration of construction for all project-related questions or concerns, including reporting potential property damage in real time.

Other measures, including the [2013 Construction Noise and Vibration Report](#), analyzed the likely effects of planned activities so that appropriate limits and monitoring requirements for protecting neighborhood properties could be incorporated into contract documents. WSDOT continues to consult with the state Department of Archaeology and Historic Preservation (DAHP), Section 106 concurring parties and members of the public to ensure compliance with the Programmatic Agreement for protecting historic properties.

**Q: What are the vibration limits in the contract?**

The allowable vibration levels vary depending on structure type (e.g., historic homes and fragile buildings have a lower allowable vibration limit than a reinforced concrete structure) and are intended to protect buildings and structures from construction-related vibration damage.

The SR 520 Program measures vibration as peak particle velocity. Peak particle velocity (PPV) is the maximum instantaneous positive or negative peak of the vibration signal. PPV is often used in monitoring construction vibration from activities such as blasting or impact piledriving, since it is related to the stresses that are experienced by buildings and is generally not used to evaluate human response. To be conservative, the SR 520 Program uses the “extremely susceptible” category of 0.12 in/sec for all historic properties. The Program has also set a threshold level of 0.09 in/sec to function as a warning trigger if activities begin to approach the allowable limit.

While ground vibrations from construction activities do not often reach the levels that can damage structures, fragile buildings must receive special consideration. As such, the construction vibration criteria includes consideration of the building condition. Meaning, depending on the condition of the structure, a higher structural category/lower PPV allowance may be applied.

Location	Threshold Limit	Allowable Limit
<b>On-land Facilities/Structures Category</b>	<b>Peak Particle Velocity</b> (from transient or continuous vibration source)	
<b>Type I.</b> Reinforced-concrete and steel structures (no plaster)	0.38 in/sec	0.5 in/sec
<b>Type II.</b> Engineered concrete and masonry (no plaster)	0.26 in/sec	0.3 in/sec
<b>Type III.</b> Non-engineered timber and masonry buildings	0.15 in/sec	0.2 in/sec
<b>Type IV.</b> Structures identified as historic that are extremely susceptible to vibration damage	0.09 in/sec	0.12 in/sec

*The vibration limits listed in the table above are adapted from the Federal Transit Administration’s Transit Noise and Vibration Impact Assessment ([Publication No. 38 FTA-VA-90-1003-06](#)).*

### **Q: How do people experience vibration levels?**

One of the major challenges in developing suitable criteria for ground-borne vibration (vibration that travels through the ground) is that there has been relatively little research on human response to vibration, in particular, human annoyance from building vibration. The American National Standards Institute (ANSI) developed criteria for evaluating human exposure to vibration in buildings in 1983 and the International Organization for Standardization (ISO) adopted similar criteria in 1989 and revised them in 2003.

The ISO acknowledges that “human response to vibration in buildings is very complex.” It further indicates that the degree of annoyance cannot always be explained by the magnitude of the vibration alone. Other phenomena, such as noise, rattling, visual effects like movement of hanging objects, and time of day (e.g., late at night) can all play a role in an individual’s response.

While low vibration levels may be imperceptible or only slightly noticeable, higher levels could be more noticeable to the point of being annoying or unpleasant. Researchers have done several studies mapping out human reactions to different vibration levels – from perceptible, to disturbing, to intolerable. The key takeaways from these studies were that humans feel and perceive vibration, even at low levels. For most people, vibration levels as low as 0.02 inches per second peak particle velocity are perceptible and 0.1 inches per second are readily perceptible – meaning it’s clearly and immediately noticeable. People generally describe levels above 0.2 inches per second as disturbing.

## **Vibration monitoring**

### **Q: How does WSDOT monitor potential vibration-related effects?**

WSDOT offers pre- and post-construction visual inspections of adjacent homes and potentially affected historic properties located close to construction areas. The initial inspections were performed before construction began in fall 2024 to capture a dwelling’s existing conditions and create a baseline against which any changes from construction-related vibration can be measured. WSDOT continues to offer home inspections, at WSDOT’s discretion, on an as-requested basis.

In addition, Skanska has installed vibration monitors around the project area to measure and record vibration levels 24/7 and ensure construction activities stay within the allowable vibration levels set in the project contract. A vibration monitor is a specialized device used to measure and record vibration levels generated by construction activities. Each vibration monitor has a device inside that tracks multidirectional movement – backward and forward (longitudinal), side to side (transverse), and up and down (vertical).

### **Q: What happens if construction activities reach the vibration limits?**

WSDOT has included both “warning thresholds” and “exceedance thresholds” into the contract.

- **Warning threshold (also referred to as “Threshold limit”)** = The level of vibration that must be reached before a real-time alert is sent to WSDOT and Skanska notifying them that current vibration levels are close to exceeding the allowable limit.
- **Exceedance threshold (also referred to as “Allowable limit”)** = The level of vibration that must be reached before a real-time alert is sent to WSDOT and Skanska notifying them that the allowable vibration level has been exceeded.

While vibration inducing activities are underway, the project team keeps a close eye on the monitor readings. If/when the warning threshold alert is triggered, crews are required to pause work, investigate the source of the trigger and determine if a change in construction approach is needed or if work must stop.

If/when the exceedance threshold alert is triggered, crews are required to pause work, investigate the source of the exceedance and determine if a change in construction approach is needed or if work must stop. If vibration can be reduced, crews will resume work. If vibration cannot be reduced, Skanska must submit a formal plan to WSDOT on how the vibration will be reduced for review before any vibratory work can proceed.

**Q: How are the vibration monitor locations selected? Who decides where the monitor should be placed at a property?**

There are more than a dozen locations required in the project contract for vibration monitoring prior to and during construction work. These locations were selected based on proximity of work and sensitivity of nearby properties. As of summer 2026, there are 19 vibration monitors deployed around the project area. Additional monitoring locations may be added at WSDOT and/or Skanska's discretion.

Monitor placement at a property is determined by an instrumentation expert. Because vibration travels outward from its source in a wave pattern, similar to ripples spreading across water after a rock is thrown, sensors are placed along anticipated vibration paths to capture representative vibration levels. The home or structure's proximity to the vibration source and installation practicality are also considered. Final placement of the monitor is coordinated with the property owner to accommodate access needs and installation preferences, such as mounting the sensor in the ground or attaching it to a structure such as a home's foundation.

**Q: What type of sensors are used for vibration monitoring?**

The device we use for vibration monitoring is called a geophone. A geophone is a sensor that detects ground vibrations and converts them into an electrical signal. It works like a tiny seismometer, picking up everything from earthquake waves to footsteps, and is one of the most widely used tools in environmental monitoring.

The simplest geophones measure motion along a single axis, typically vertical. For this project, we use three-component geophones that contain three sensing elements. This allows them to capture the full three-dimensional motion of the ground at a single point.

**Q: What other factors affect vibration levels that the monitors are picking up (e.g. other traffic, animals, etc.)?**

The vibration monitors can detect vibrations from a variety of everyday activities, not just construction work. Common sources include passing traffic, garbage collection, yard maintenance equipment, other nearby construction activity, animals, or accidental contact with the monitor itself. Whether these vibrations are detected depends on how close the source is to the monitor and how strong the vibration is.

In some cases, these outside sources can create vibration spikes that exceed allowable limits and trigger a real-time alert. WSDOT and Skanska treat all vibration alerts equally – meaning, when an alert occurs, WSDOT and Skanska pause work (if work is occurring) and investigate the source of the vibration to determine whether it was caused by project construction activities or another external source.

**Q: What other instrumentation is being used around the project area to measure ground movement?**

The project teams are using a variety of instrumentation to measure ground movement, including tiltmeters, survey prisms, utility monitoring points along relevant utilities, inclinometers and piezometers.

Put simply, we use several types of instruments around our project area to record and understand the behavior of the ground conditions on our project. These tools measure and record tilts in the ground or on structures, elevation changes on various surfaces, movement or changes in utility locations, and underground movement or changes in groundwater pressure. These tools are located within the general project area as well as our active construction zones.

Geotechnical monitoring is a complex science because the ground is not uniform. Even within short distances, the combination of soil and rock can change significantly, which affects how the ground responds to construction vibration. Dedicated engineers and geotechnical experts, both from WSDOT and Skanska, use their years of experience in the geotechnical industry, historical data collection and present-day monitoring to understand what is happening below ground and make informed decisions and recommendations during construction.

## Resources for neighbors

**Q: What resources has WSDOT created for neighbors in the event of vibration-related damage?**

WSDOT offers neighbors living near the project area pre- and post-construction home inspections free of charge. The initial inspections were performed before construction began to capture a dwelling's existing conditions and create a baseline against which any changes from construction-related vibration can be measured. WSDOT continues to offer home inspections, at WSDOT's discretion, on an as-requested basis.

Additionally, WSDOT has created a vibration damage fund for construction-related damages under \$50,000. This fund streamlines the regular [tort claim process](#). If construction activities cause building damages over \$50,000, the claim is routed through the regular tort claim process. That process determines liability and compensates for damages and losses accordingly.

## Tort claim process

**Q: What happens if I believe my home has sustained vibration damage due to construction activities?**

Neighbors who believe their home has sustained vibration-related damage caused by project activities should email the SR 520 Program at [SR520bridge@wsdot.wa.gov](mailto:SR520bridge@wsdot.wa.gov) with specific information about the damage. WSDOT and Skanska may offer a site visit to the property to determine whether the damage could be addressed through the vibration damage fund. To be eligible for the vibration damage fund, the alleged damage must be caused by the project's vibration-type work (e.g., piledriving, compaction work, excavation, etc.). The vibration damage fund is intended to simplify the tort claim process described below. If a claim is not accepted through the vibration damage fund – either because it is ineligible or the cost exceeds the \$50,000 limit – the claim will be routed through the regular tort claim process.

During the site visit, the homeowner will have the opportunity to identify the damage directly and explain their concerns to the representatives. Skanska will document the alleged damage by taking photographs, while WSDOT will discuss the available options, specifically outlining the process for filing a formal tort claim and explaining the vibration damage fund.

In addition to the site visit, WSDOT and/or Skanska may examine (if available):

- Nearby vibration monitors to determine if past vibration has ever met and/or exceeded threshold levels and if that aligns with the homeowners' claims.
- Home inspection documentation to determine if a baseline was captured and documented before the alleged damage occurred.
- Other documents, reports or evidence that would help determine if the damage can be attributed to vibration from SR 520 construction, such as inspection reports from either WSDOT or Skanska's Quality Assurance team documenting piledriving operations or other heavy construction in the vicinity of the property.

If the homeowner has not received a visual home inspection, WSDOT and/or Skanska may offer one at its discretion. These visual inspections serve as a snapshot in time. The inspection report includes written observations and photographs of things like existing surface-level cracks or damage, existing cracks or gaps in foundations, walls, etc., interior inspections of windows, doors and plumbing fixtures, and amenity inspections of spaces like paved driveways, fences and retaining walls.

If the homeowner has their own dated photographs or other documentation capturing conditions immediately prior to work occurring, that may be helpful information to share with WSDOT.

**Q: How can I file a tort claim?**

Any neighbor who believes their home has sustained vibration-related damage can [file a tort claim](#) through the Office of Risk Management. All tort claims – no matter the size – are required by law to be submitted to the Office of Risk Management (see [RCW 4.92.100](#)). For smaller vibration-related damage claims (less than \$50,000), the Office of Risk Management should route the claim through the SR 520 vibration damage fund. As noted above, the SR 520 vibration damage fund streamlines the regular tort claim process.

**Q: Do I need to complete home repairs before filing a claim?**

No, the homeowner does not need to complete repairs before filing a claim. However, they should be prepared to provide a cost estimate for potential repairs when submitting a claim.

**Q: Who should I contact if I need assistance filing my tort claim form?**

Homeowners can contact Office of Risk Management Customer Service at 360-407-9199. Customer Service is available Monday through Friday, 8 a.m. to 5 p.m. If assistance is needed outside of those hours, homeowners can call the Customer Service number and leave a voicemail. Voice messages will receive a response the following business day.

**Q: What can I expect after a tort claim is filed?**

Once the tort claim is assessed by WSDOT, one of two scenarios will occur:

1. If the claim is verified to be caused by vibration attributable to project activities, and the damage repair is eligible for payment through the vibration fund, WSDOT will direct Skanska to issue payment to the homeowner and reimburse Skanska through the fund.

2. If the claim is denied or falls outside the vibration damage fund, WSDOT will follow up with the Office of Risk Management and alert them of the denial. The Office of Risk Management will then tender the claim over to Skanska for its insurance carrier to conduct its own investigation. If the Skanska/insurer investigation determines the claim is verified to be caused by vibration attributable to project activities and a covered claim, the homeowner will be reimbursed through Skanska's insurance carrier. If Skanska also denies the claim, the decision is final and WSDOT will not challenge it. The homeowner could then seek reimbursement through litigation or choose to fund the repairs themselves.

**Q: What are the monetary limits on claims that fall under the vibration damage fund?**

Approved claims under \$50,000 related to the Portage Bay Project can be reimbursed through the vibration damage fund. Monetary limits are per claim, not per residence.

**Q: Can I modify or amend a claim?**

Yes, the homeowner may modify or amend existing claims if they find additional damage.

**Q: Can I submit more than one claim?**

Yes. If the homeowner suspects a subsequent construction activity has caused new property damage, they may file another tort claim.

**Q: What is the statute of limitations for filing a claim?**

The homeowner should be mindful that Washington law requires claims (or a lawsuit, if necessary) to be brought within a certain timeframe called the statute of limitations. The statute of limitations for a given claim depends on the specific circumstances and may require legal analysis. If the homeowner believes their home has experienced vibration-related damage, the sooner a tort claim is filed, the easier it is to investigate the potential source of damage.

**Q: Should I expect to retain legal counsel if I file a claim?**

The decision to retain legal counsel is completely up to the homeowner. If a property sustains construction-related damage, the homeowner can file a tort claim to seek reimbursement. The vibration damage fund mentioned above is intended to make the tort process easier and simpler. If the claim is not accepted through the vibration damage fund – either because it is ineligible or the cost exceeds the limit – the claim will be routed through the regular tort claim process.

Again, it is up to the property owner regarding if and when they might want to retain legal counsel. For example, if the claim is ultimately denied through the tort claim process, the property owner may choose to retain legal counsel and address the issue through the court system.