

## **Track Movement Monitoring Guidelines for Trenchless Pipe Installation**

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The monitoring of track settlement should be accomplished by means of surface and subsurface settlement points. The intent of subsurface settlement points is to measure soil voids created just above the pipe during construction in order to help predict the potential movement of tracks above. The settlement point essentially consists of a small diameter pipe anchored at the bottom of a vertical borehole and an outer casing to isolate the pipe from down drag forces caused by settlement of soil above the anchor. The subsurface settlement points will be installed to 1 m above the crown of the casing profile. A total of (specified the number) subsurface settlement points will be installed within the CPR right of way along the axis of the proposed pipe crossing installation. The proposed locations are shown on the attached sketch. The surface settlement points should be monitored in pairs at the base of rails perpendicular to the center line of the track. As a minimum, the first pairs of surface settlement points have to be monitored at the intersection of the proposed center line of the pipe crossing and the existing center line of track. The next pairs of surface settlement points are to be monitored at a distance of 9.45 m (31') along the center line of track on each side of the first surface monitoring pairs taken at the intersection of the center line of the pipe crossing. Any additional surface monitoring points should be spaced with the same measurement of 9.45 m (31') from the last monitored pairs. The intent is to monitor differential transversal elevation between both rails over the projected settlement trough. A total of at least (specified the number) surface points will be installed on the right of way. The proposed locations are shown on the attached sketch. These points would be monitored simultaneously with the subsurface settlement points which act as a precursor to potential surface movement during pipe installation.

Once the installation is complete, a monitoring program of all points is to be conducted in accordance with the following instructions:

1. Monitoring should start before the excavation of the pits and pipe installation begins and be done at least twice per day for no less than two days. This is required to establish a reliable methodology and demonstrate the accuracy achievable.
2. Monitoring should proceed through the construction period and should be completed at least twice daily.
3. Monitoring should continue for at least 3 days after the completion of construction.
4. If there is any loss of ground during pipe installation, any reason to believe settlement may be delayed or any settlement is identified during the installation of pipe or subsequent monitoring period, the monitoring must be continued until the proponent's geotechnical engineer deems it is safe to discontinue such monitoring.

Monitoring measurements should be taken with sufficient frequency to capture the unexpected performance at the earliest possible stage and be evaluated in a timely manner. Additional measures will be proposed should this monitoring protocol is considered insufficient based on the ground conditions or installation process. Two alarm levels are proposed:-

### **Level 1:**

"WARNING" will be indicated on the field memo when a settlement of 50% of the critical monitoring threshold is obtained from the subsurface settlement point. A survey of the surface points will then be conducted and work will be authorized to continue if no movement has been measured from the previous reading. If movement of the rails is recorded, monitoring will be continued until movement is stopped at which time the drilling work will then be authorized to continue.

### **Level 2:**

"CRITICAL" will be indicated on the field memo when a settlement of (specified monitoring threshold) is obtained from the subsurface settlement point. A survey of the surface points will then be conducted and work will be authorized to continue if no movement is measured for at least two (2) readings taken 12 hours apart. If movement of the rails is recorded, monitoring will be continued until movement is stopped and a new pipe installation procedure has been submitted by the proponent and approved.

**The proponent and their engineer are responsible for ensuring that track settlement does not occur and are to notify the CP Flagman should unforeseeable track settlement occur or be expected. The above guidelines do not relieve the proponent and their engineer of this responsibility. The proponent or their engineer shall provide the settlement information and their interpretation of the data (no track settlement, deep settlement, etc. and how much track settlement has occurred, is likely to occur and when it is likely to occur). These concerns must be escalated to the following individuals: CP Geotechnical Service Provider, and Regional Utility Representative, along with copying the CP Director Geotechnical Engineering and local Roadmaster.**