TR 2022-40 – Geotechnical Hazards

TR Number	**2022-40**
Primary Reference	192.103
Secondary Reference	192.317, .613, .619, .705, .917(a), .935
Purpose	Review existing GM and revise as appropriate in light of ADB 22-01
Origin/Rationale	Federal Register Volume 87, Number 106 (Thursday, June 2, 2022) pages 33576 – 33579
Notes	TR 19-24 addresses the original advisory bulletin ADB 19-02 on geotechnical hazards. This ADB is similar but has a couple of additional considerations or suggestions. 2019 and 2022 references: Notices and Rulemaking Documents | PHMSA (dot.gov) *{TR 19-24 published in Addendum 2}*
Assigned to	Design Task Group

Section 192.103

1 **...**

2 **...**

3 **REFERENCES**

See Guide Material Appendix G-192-13 for design considerations. Numerous references are available for the calculation, investigation, or mitigation of external forces on pipelines. Methods include reliance on experience, empirical formula, and finite element analysis. A partial listing of references follows.

(a) API RP 5L1, "Recommended Practice for Railroad Transportation of Line Pipe" (see §192.7 for IBR).
(b) API RP 5LW, "Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels" (see §192.7 for IBR).
(c) API RP 1102, "Steel Pipelines Crossing Railroads and Highways."
(d) API RP 1117, "Movement of In-Service Pipelines."
(e) ASCE 428-5, "Guidelines for the Seismic Design of Oil and Gas Pipeline Systems" (Discontinued).
(f) GRI-91/0283, "Guidelines for Pipelines Crossing Railroads."
(g) GRI-91/0284, "Guidelines for Pipelines Crossing Highways."
~~(h) PRCI L52292, "Guidelines for Constructing Pipelines Through Areas Prone to Landslide and Subsidence Hazards."~~
(h) PRCI PR-000-18COMP-R04, "Geohazards Compendium."
(i) INGAA Foundation Report 2015-03, "Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lessons Learned from Constructing Pipelines in West Virginia."
(j) USGS Report 2008-1164, "Landslide and Land Subsidence Hazards to Pipelines."

Section 192.613

…

6 SEVERE FLOODING AND GROUND MOVEMENT

Severe flooding and ground movement can adversely affect the safe operation of a pipeline. Operators should consider the following actions in areas prone to, or previously affected by, flooding and ground movement.

(a) Identify pipeline facilities that are in the flood plain, such as overlaying 100-year flood elevations on GIS pipeline maps.

(b) For buried pipelines, consider the following.

(1) Engaging ~~Using~~ hydrologists, geomorphologists, or other experts in river flow to evaluate the potential for scour or channel migration that might affect the identified pipeline facilities.

(2) Evaluating terrain and vegetation conditions that can cause severe scouring of the watercourse. Such conditions could include burned areas subject to ~~soil~~ sediment erosion and long-term buildup of debris and vegetation.

(3) ...

...

(6) Installing trench breakers and slope breakers to mitigate trench seepage and divert trench flows along ground surface to a safe discharge point off the site or right-of-way.

(7) Evaluating geological and environmental conditions, changing weather patterns and soil stability~~,~~ near facilities and consider using available data and information resources to assess vulnerabilities related to landslides and earth movement (i.e., cascading hazards). Cascading hazards are chains of adverse events like floods leading to slope failures or denuded slopes, causing slope failures during the next storm, which cause more extreme flooding.

(8) Looking for indications of ~~changes in~~ ground movement (e.g., tension cracks along the surfaces ~~shoulders~~ of slopes, scarping, leaning posts or poles, curving tree trunks (gravitropism)). Tension cracks and scarps indicate possible failure is underway (downslope movement such as slips or landslides), while leaning posts or poles and curving tree trunks are indicators of slope creep. Both processes are types of slope failures.

(9) Examining infrastructure at ground level for cracks or indications that the infrastructure has shifted position. Ground movement can be caused by subsidence processes. For example, cracks in foundations are a good indication that ground level may be sinking over time.

(10) Monitoring for ground movement, if suspected. Equipment such as strain gauges, inclinometers, piezometers, or geodetic monitoring points could be considered to monitor movement.

(11) For information regarding preventative and mitigative measures, see guide material under §§ 192.935 or 192.1007(d).

(c) For aerial or aboveground pipeline crossings, consider ...

(d) Extend regulator vents and relief stacks ...

(e) Determine if facilities that are normally above ground ...

(f) For additional information regarding severe flooding and geological hazards, see the following OPS Advisory Bulletins ~~ADB-2019-01 (84 FR 14715, April 11, 2019; (~~see Guide Material Appendix G-192-1, Section 2)~~. regarding severe flooding and~~

(1) ADB-2019-01 (84 FR 14715, April 11, 2019).

(2) ADB-2019-02 (84 FR 18919, May 2, 2019)~~.; see Guide Material Appendix G-192-1, Section 2) regarding geological hazards.~~

(3) ADB-2022-01 (87 FR 33576, June 2, 2022).

Section 192.755

See guide material under §192.614, and Guide Material Appendices G-192-13, G-192-16, and G-192-18.

Section 192.917

…

11 WEATHER AND OUTSIDE FORCES

Weather-related and outside force threats have the capability to create extreme loading conditions on pipelines. In assessing this type of threat, ASME B31.8S, Appendix A9 provides a list of data that the operator is required to gather and evaluate to determine whether pipelines are being subjected to extreme loading conditions caused by weather or outside forces. Aboveground facilities are also prone to weather-related events. See Guide Material Appendix G-192-13 for additional information on possible geological threats that can create outside forces upon a pipeline.

11.1 Pipe joining method.

...

Section 192.935

…

3 OUTSIDE FORCE DAMAGE (§192.935(b)(2))

To comply with §192.935(b)(2) for the specific threat of outside force damage (e.g., earth movement or other geological hazards, floods, unstable suspension bridge), an operator must take additional measures to minimize the consequences of outside force.

(a) The measures include the following.
- (1) Increasing the frequency of patrols to allow for faster recognition of damage.
- (2) Adding external protection. This might include the following.
  ...
- (3) Reducing external stress. This might include the following.
  - (i) Installing expansion joints.
  - (ii) Removing overburden.
- (4) Relocating the pipeline to an area with less exposure to outside forces. This might include lowering or raising the pipeline. Horizontal directional drilling, when feasible, might avoid stresses caused by geological hazards.
- (5) Conducting inline inspections to determine whether geometric deformation has occurred.
- (6) Installing dewatering or drainage best management practices (e.g., drain tile, coconut boom, vegetation, trenching)
- (7) For additional guidance on protection from outside forces, see Guide Material Appendix G-192-13.

(b) An operator might also consider installing the following.
- (1) River anchors where appropriate.
- (2) Elevated relief or vent stacks on regulator stations.
- (3) Additional bridge hangers or pipe supports.
- (4) Identifying geodetic monitoring points (e.g., survey benchmarks) to track potential ground movement.
- (5) Installing slope inclinometers to track ground movement at depth which might otherwise not be detectable during ROW patrols.

(6) Installing standpipe piezometers to track changes in groundwater conditions that might affect slope stability.
(7) Evaluating the accumulation of strain in the pipeline by installing strain gauges on the pipeline.
(8) Conducting stress-strain analysis using in-line inspection tools equipped with inertial mapping unit technology and high-resolution deformation in-line inspection for pipe bending and denting from movement.
(9) Using aerial mapping light detection and ranging (LiDAR) or other technology to track changes in ground conditions.

GMA G-192-1

1.14 OTHER DOCUMENTS (Continued)		
INGAA Foundation Report 2015-03	Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lessons Learned from Constructing Pipelines in West Virginia.	§192.103 GMA G-192-13
Nature Conservancy	Improving Steep-Slope Pipeline Construction to Reduce Impacts to Natural Resources	GMA G-192-13
~~PRCI L52292~~	~~Guidelines for Constructing Pipelines Through Areas Prone to Landslide and Subsidence Hazards~~	~~§192.103~~
PRCI PR-000-18COMP-R04	Geohazards Compendium	§192.103 GMA G-192-13

2 GOVERNMENTAL DOCUMENTS (Continued)		
OPS ADB-2019-01	Advisory Bulletin – Potential for Damage to Pipeline Facilities Caused by Severe Flooding (84 FR 14715, April 11, 2019)	§192.613 §192.615
OPS ADB-2019-02	Advisory Bulletin – Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards (84 FR 18919, May 2, 2019)	§192.613
OPS ADB-2022-01	Advisory Bulletin – Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards (87 FR 33576, June 2, 2022)	§192.613
...	...	...

USGS Report 2008-1164	Landslide and Land Subsidence Hazards to Pipelines.	§192.103

6 SUMMARY OF PRIMARY WEBSITES

Site Reference	Website Link	Guide Location
NCIE website for National Maps	www.ncei.noaa.gov/access/monitoring/us-maps	GMA G-192-13
...	...	...
USGS Landslide Hazards Program website	www.usgs.gov/programs/landslide-hazards/maps	GMA G-192-13

GMA G-192-13

GUIDE MATERIAL APPENDIX G-192-13

(See guide material under §§192.103, 192.183, 192.199, 192.203, 192.317, 192.321, 192.327, 192.353, 192.355, 192.361, 192.367, 192.613, 192.614, 192.707, 192.755, 192.917, 192.935, and Guide Material Appendix G-192-6)

CONSIDERATIONS TO MINIMIZE DAMAGE BY OUTSIDE FORCES

1 INTRODUCTION

This Guide Material Appendix is intended as an aid in minimizing the possibility of damage to pipelines by outside force.

2 DESIGN

2.1 Selecting pipe locations. ...

2.2 Cover. ...

2.3 Earth movement.

(a) Identify areas surrounding the pipeline that might be prone to earth movement and could result in excessive strain on the pipeline. Earth movement might include slope instability, landslides, subsidence, frost heave, soil settlement, erosion, or earthquakes.

(b) Consider performing geological studies to determine mitigative measures that might be employed to avoid or minimize negative impact of earth movement on the pipeline. Measures might include ensuring drainage of water from the pipeline trench, ensuring drainage of surface water off ~~of~~ the pipeline right-of-way, or stabilizing earth slopes by building retaining walls or installing sheet piling. Consider including installed mitigative measures in as-built drawings.

(c) The following guidelines and references may assist the operator when identifying geological forces which might impose stresses on a pipeline and designing mitigative measures.

(1) INGAA Foundation Report 2015-03, “Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lessons Learned from Constructing Pipelines in West Virginia.”

(2) National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information “National Maps” at: www.ncei.noaa.gov/access/monitoring/us-maps.

(3) USGS, “Landslide Hazards” maps and supporting materials at: www.usgs.gov/programs/landslide-hazards/maps.

(4) The Nature Conservancy, “Improving Steep-Slope Pipeline Construction to Reduce Impacts to Natural Resources”.

(5) PRCI PR-000-18COMP – R04, “Geohazards Compendium”.

2.4 Landfills and unstable soil.

(a) Special consideration should be given when placing pipelines over landfill areas where the supporting fill might decompose. Mitigation measures include extra excavation and soil replacement or additional pipe support, such as slabs or casings.

(b) Long-wall or other mining underneath a pipeline might also lead to pipeline undermining or lack of support. Additional pipeline thickness, support bridging or slabs, or casings are all methods for consideration to mitigate these conditions.

(c) Areas subject to salt mining or sinkholes also deserve special consideration and might warrant one or more of the above solutions.

2.5 ~~Navigable w~~ Waterways.

(a) Where facilities will be installed in navigable and non-navigable waterways, the following should be considered.

(1) Dynamic interaction between the water and bottom.

(2) Flotation.

(3) Scouring.

(4) Erosion.

(5) Impacts of major storms

(6) Potential dredging or anchoring activities.

(b) The use of models, such as hydrologic or land mass movement, might be beneficial.

(c) For information about work in harbors, see the National Research Council report, “Improving the Safety of Marine Pipelines” (1994), available ~~online~~ from National Academies Press (NAP) at www.nap.edu/read/2347.

3 MARKERS

...