How much subsidence is allowed: the introduction of the “effective subsidence capacity” concept in The Netherlands

JAN VAN HERK¹, HANS ROEST¹, INGRID KROON², JAAP BREUNES² & HANS DE WAAL¹

¹ State Supervision of Mines, PO Box 24037, AA The Hague, The Netherlands
m.vanherk@minez.nl

² TNO Built Environment and Geosciences, Geological Survey of the Netherlands, PO Box 80015, 3508 TA Utrecht, The Netherlands

Abstract Subsidence caused by the extraction of hydrocarbons or salt mining is a sensitive environmental and socio-economic issue in the Netherlands. Every company involved in such activities has to submit a Production Plan. The Production Plan fully considers potential land subsidence issues for approval to the authorities. The plan provides contour maps of the subsidence to be expected. It also details the measures that will be undertaken to limit the subsidence and the damage from subsidence as much as possible. The Production Plan is made available to the public as part of a legal consultation process. The legal framework makes it possible for the authorities or the judiciary not to approve the plan when the risk of damage from subsidence is considered too large. A key question for the companies involved is therefore: How much subsidence is allowed? The legal framework itself does not provide detailed answers. To address the issue, the concept of “effective subsidence capacity” has been developed together with an operational procedure based on expectation values of subsidence rate. This has enabled extraction of natural gas from the environmentally very sensitive Wadden Sea area. The approach is supported by environmental experts and provides clarity to mining companies. To determine the effective subsidence capacity for an estuary like the Wadden Sea, the maximum volume rate of subsidence (or relative sea level rise) that can be accommodated in the long term, without environmental harm, is established first. The volume of sediment that can be naturally transported and settled into the tidal basin where the subsidence is expected determines this volume rate or “natural subsidence limit”. The capability of the tidal basins to “capture” sediment over longer time periods (c. 20 years) is the overall rate-determining step. Effective subsidence capacity is the maximum average subsidence rate available for planning human activities. It is obtained by subtracting the subsidence “consumed” by natural subsidence in the area (sea level rise, shallow compaction) from the total long-term natural subsidence limit. In the operational procedure for mining companies, six-year average expectation values of subsidence rates are used to calculate maximum allowed production rates. This is done under the provision that production will be reduced or halted if the expected or actual subsidence rate (natural + man induced) is likely to exceed the natural subsidence limit. Monitoring and management schemes are in place to measure and analyse actual subsidence, to ensure that predicted (6-year average) and actual (19-year average) subsidence stay within the natural subsidence limit and to confirm that no damage is caused to the environment. Regular communication keeps the public and others informed on use of the effective subsidence capacity to demonstrate that the actual average subsidence stays strictly within the defined bounds. The concept of effective-space is generic. It can be customised to manage other subsidence limits if more appropriate.

Key words subsidence management; effective subsidence capacity; natural subsidence limit; Wadden Sea; gas production