Conflicting Perspectives on Water in a Swedish Railway Tunnel Project

ANNELIE SJÖLANDER-LINDQVIST

CEFOS,Göteborgs Universitet/
Avd. Humanekologi, Lunds Universitet
Box 720, 405 30 Göteborg, Sweden
Email: Annelie.Sjolander-Lindqvist@cefos.gu.se

ABSTRACT

The building of a railway tunnel through the Hallandsås ridge in the southwest of Sweden resulted in sinking groundwater levels and a toxic spill for the local community. As a result, this highly technological project expanded from the addressing of technological and economic issues of rail traffic and tunnel building to include issues of environmental harm and how to assess and manage the geology of the ridge. A central concern for local residents as well as for the developer has been how to view and interpret the resource of groundwater. This article focuses on groundwater as a boundary object, bordering the domains of the technologists and the local community. In this situation, technological understanding and knowledge confronts an experience-based understanding and a symbolic interpretation of the water resource.

KEYWORDS

Railway tunnel, water, interpretation, meanings, controversy

1. INTRODUCTION

In some parts of the world, water is recognised as an abundant resource while in other regions and cultures it is associated with droughts and water shortage. Less than one per cent of the water on the planet is potable (Johnston and Donahue 1998). A growing world population implies an increasing number of people without access to safe drinking water. These environmental realities pave the way for controversy and struggle over people's use and management of water. As water is a vital resource for all life, nations throughout the world make considerable efforts to secure their needs for the resource. Dams and canals are built to facilitate supply and storage; irrigation is used to bring water to fields

Environmental Values **14** (2005): 221–39

and crops; water is transferred from rural areas to urban centres to meet the demands of growing city populations.

That water takes no notice of boundaries and frontiers complicates solutions to the problem of a growing demand and need for fresh water. In order to secure sustainable water management unhampered by geographical and political boundaries, policies for collective control and public administration are developed and adopted. Treaties are negotiated between nations, between nations and international communities, and within international communities, as for example, in the new Water Framework Directive adopted in the year 2000 by the European Commission. The background to the prioritisation of water protection in the European Union has been the increasing demand and need to secure water as a resource for future generations: 'Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such' (Directive 2000/60/EC).

Streams, lakes and seas border states and geographical regions, and in so doing, they also border the worlds of people. Issues of water management and use tell 'a story of the tension between danger and opportunity' (Donahue and Johnston 1998: 3), actualising dimensions of power, economy, law and culture. Water, as well as the demand for and supply of water, is embedded in cultural understandings and traditions, power relationships and economic activities (Donahue and Johnston 1998). Water thus may not carry the same meaning to involved actors and interested parties; conflicts may well occur over how to acknowledge and interpret water and water resources. Such controversies can either be disputes over conflicting interests, or may originate from divergent ways of interpreting the world. Conflicts between parties regarding knowledge and how to understand a particular situation or predicament are rooted in a social dimension. Conflicts regarding how to conceive, comprehend and master problems and issues of common interest can also involve other dimensions. One such dimension is the question of contradictions and varied ways of interpreting scientifically-grounded facts and knowledge, and which of these ways should count and hold for accuracy. Another dimension relates to communication, since when social worlds come together in a situation where interests can collide, different knowledge systems deepen discords of interpretation. Conflicts over interests are not merely about concerns, whether originating from economy, politics, law, or a combination of these. Controversies are also influenced by issues of knowledge.

As this article will illustrate, the building of a railway tunnel in the southwest of Sweden came to entail danger to the groundwater resource. As the interested parties discerned the variations of understanding in the local situation, water became a common concern for them all. Groundwater, as a boundary object, borders the domains of the technological community and the local resident community. The tunnel project has involved several actors with views of the project that differ from one another. These different interests and visions are, to use the vocabulary of Star and Griesemer (1989), reflections of the 'social worlds' that are part of the tunnel project, such as the Swedish National Rail Administration, various consultants engaged by the Rail Administration, and the local community above the northern tunnel site. Given that groundwater has such a central place, we must ask how the water in the ground is acknowledged and understood by actors in the 'social worlds' involved. The focus of this article is on how the Rail Administration and the local community interpret and categorise water and its relationship with nature, in the light of the tunnel project and the continuation of the construction efforts that were postponed after a toxic leak in 1997. More specifically, how is 'water' construed and recognised by the two parties involved? Such interpretations originate from different systems of knowledge and, as we shall see, have implications on how the various actors regard the future of the project.

2. THE HALLANDSÅS RAILWAY TUNNEL

The Hallandsås railway tunnel is in an area of natural beauty characterised by magnificent scenery, historical remains, mythic landscape and human use dating back to the Palaeolithic Age when fishers and hunters set up temporary settlements on the peninsula (Hassby 1999). The landscape on the Hallandsås ridge, a significant feature of the Bjäre peninsula, is full of variety. Forest areas with swamps and bogs give way to small-scale cultivated pastoral landscape, arable and pasture land. The northern part of the ridge offers extraordinary views of Laholm Bay, and the vegetation ranges from deciduous forests of beech, alder and hazel to heath and juniper. Throughout this multifaceted landscape the visitor is offered a changing and often magnificent experience of a natural locale characterised by small farms.

The railway tunnel project, involving construction of two parallel 8.6 kilometre-long tunnels to allow for high-speed trains, was commissioned by the Swedish government and commenced in 1992. The tunnel is part of a larger project to improve and extend the West Coast Main Line between Göteborg and Malmö. From its early planning in the mid-1980s, the construction of a railway tunnel through the Hallandsås ridge has been described as necessary for the provision of efficient, safe and modern railway transportation of goods and people to the European continent. The project has also been backed by regional policy arguments that a tunnel would promote employment and local tourism (Banverket 1990). After a toxic leak in September 1997, the main argument deployed in support of continuing the tunnel excavation was instead that a completed tunnel would reduce the emission of carbon dioxide, thereby reducing contributions to global warming (Banverket 2000a; Boholm 2004).

A dominant issue in the project is the groundwater situation. Right from the start, the abundance of groundwater in the ridge has been a difficult problem for the building contractor and the Swedish National Rail Administration (Banverket). Leaking groundwater emerged as an acute problem in 1996 when the contractor, Skanska, had severe difficulties with limiting the out-leakage of groundwater and consequent lowering of the ridge's groundwater table. The extremely high water pressure made it difficult to seal the tunnel walls using traditional blasting and injections of concrete. The chemical blend Rhoca Gil, consisting of acrylamide and N-metylolacrylamide, was therefore used in an attempt to stem the heavy leakage, but it turned out that the chemical components of the sealant could not harden in the presence of water. Instead of sealing the tunnel walls, the component leaked into and contaminated the groundwater, which in turn transferred into surface waters and soils through waste water from the tunnel site.

It has been argued by geologists that the Rail Administration and the contractor failed to take all geological knowledge of the ridge into consideration (Bergström 1997; Bergström 1998; Eriksson and Wentzel 1998). Research indicates that the contractor and the responsible authority, the Rail Administration, neglected available research and knowledge of the geology (Falkemark 1998; Hydén and Baier 1998; Mårald and Sörlin 1998; Löfstedt 1999). The results of geological assessments have failed to override the political visions and aims of the tunnel project (Bergström 1997). It has been argued that this disregard largely explains the problems that have occurred (Hydén and Baier 1998). The reputation of Swedish technological know-how has been questioned (Mårald and Sörlin 1998; Falkemark 1998), and the Hallandsås tunnel, which was supposed to be ready by 1996, is still unfinished. Construction work stopped in October 1997 because of the toxic leak, with less than half the length of the tunnel completed.

This toxic spill had severe consequences for the local community. Farmers in the area could not deliver their agricultural products for a period of 60 days, and they could not use water from contaminated water sources. The Rail Administration delivered water daily to affected households and drilled new wells. After the discovery of the toxic spill and the cessation of construction, security and protection work has carried on continuously in the two main tunnels and in the working tunnel at the central access shaft. Leak-proofing works have also been carried out in the years following the project's suspension.

In May 1999, an order from the Swedish government commissioned the Rail Administration to comprehensively assess the environmental consequences of a resumprtion of the tunnel project. The Rail Administration began its process of assessing environmental impacts by means of modelling methods and scrutinising three future options for the tunnel project: tunnel drilling using a tunnel drill machine; blasting and drilling – a rather conventional and typically Swedish method; and the 'zero option' – discontinuing the project and reverting to operating rail traffic on the old line.

In June 2001, the government mandated the Rail Administration to continue the project, but before resuming the work, the Environmental Court had to approve a continued discharge of groundwater during construction operations. The Environmental Court approved the application, but the execution permit was withdrawn by the Environmental Court of Appeal in June 2003 as the court urged further investigations into the Rail Administration's planned measures for protecting the biological environment. After court proceedings in September 2003, the Environmental Court of Appeal decided in October to approve the additional release of groundwater, and suggested measures for the protection of the environment.

3. METHODOLOGY

This article builds on anthropological field-work carried out intermittently in the vicinity of the tunnel site in Båstad municipality – located on the Bjäre Peninsula next to the Laholm Bay and having approximately 14,000 residents – in two periods: 1999–2000 and 2001–2003. In addition to making participant observation at public consultation and information meetings, I have conducted in-depth interviews with local residents. I have also collected data on local perceptions of nature and the environment through collaborative photography, accompanied by follow-up photo interviews and 'nature walks' during which informants guided me through the natural landscape of Hallandsås (Sjölander-Lindqvist 2004A; 2004B). In order to understand and disclose local views and perceptions of the local environment and the tunnel project I chose a combination of methods. Interviews, lasting between two and six hours, were carried out with people who had been affected by the consequences of the tunnel project. In these interviews, the informants expressed sentiments, worries, ideas and understandings of the tunnel project and insight was gained into how they, their families and the local community had responded to the problems of the sinking water table and the toxic leak. Among the informants were small-scale dairy farmers, single households and small local business owners. They were of varying background with respect to education, age, sex and family status. To further capture the meanings and values related to the local environment, the method of collaborative photography was chosen since photographs could be seen to represent the 'real world'. Visual images are in this sense, representations of collective understandings and meanings of the social and cultural contexts of the local community. As such they illustrate and give information about what the photographer sees as significant in the local environment (Pink 2001; Sontag 1973; Johnson and Griffith 1998). The photographs were subsequently discussed in follow-up interviews in which the photographer was given the opportunity to verbally explain the motif and his or her reasoning behind the choice of the motif.

Public meetings were held in Båstad, organised by the Rail Administration and by the Environmental Monitoring Group, an independent expert group appointed by the building contractor and the Rail Administration shortly after the discovery of the toxic spill. Seventeen public consultation and information meetings were held between 17 January 2000 and 30 June 2003, fifteen of which I attended and tape-recorded. At these meetings, the Rail Administration informed the public about the tunnel project. Meeting attendees were given the opportunity to raise questions and express their concerns and worries about the project and the technologies used or planned to be used in fulfilment of the governmental mandate to construct a railway tunnel through the ridge. Observations and note-taking from these meetings, written protocols and tape recordings, together with material from fieldwork, constitute the basis for this article.

4. WATER – A BOUNDARY OBJECT

Water is regarded here as an object having diverse meanings for different actors. Such objects can serve to form a boundary between concerned 'social worlds' (Star and Griesemer 1989). These social worlds, which are based upon knowledge and experience from (for example) a local point of view, from a political interest, from an industrial interest, or from a more generalised or specialised technological viewpoint, can collide when the object in question is understood differently. Certain objects or situations in the world can thus become issues of conflicting interests and values and of how the object of shared interest should be understood. In such cases, technological scientifically-based knowledge, *techne*, often confronts local communities' skills and understandings, *mētis* (Scott 1998).

Objects bordering the interest of various stakeholders raise questions of translation and mediation between such different worlds of understanding. Star and Griesemer (1989) argue that a boundary object can serve as a mediator between social worlds; in other words, that the boundary object is an anchor or a bridge between the social worlds involved. A congruent encounter between *mētis* and *techne* is, however, not always the case. Brian Wynne's study of the encounter between local farmers and the responses and management actions of radiation safety experts with respect to the radioactive fallout from the 1986 Chernobyl accident in Cumbria in the UK, illustrates some of the difficulties. In northern England, sheep farmers' understandings and experiences of the effects of the radioactive contamination cloud were in conflict with scientists' and experts' understandings and knowledge of how to handle sheep farming and radioactivity (Wynne 1989). For example, the assertion that the 21-day ban on moving and slaughtering sheep from areas affected by the radioactive cloud would not have any effect in practice on the sheep farmers, since the levels of radiation would have decreased within that period, proved to be wrong. Instead of decreasing, radioactivity increased and the official ban was extended indefinitely. Scientists' assumption that the radioactivity would decrease was derived from a model on caesium distribution in clay mineral soils. Since the soils in the contaminated area were mainly acidic, caesium remained mobile and available for uptake in vegetation. Scientists' advice to pursue a wait-and-see policy contradicted farming practices, based on local circumstances. Since pastures are limited, lamb breeding is highly time-scheduled to adjust to pasture conditions, sheep stocks, market values and need for money. Farmers felt desperate and frustrated when urged to comply with scientists' advice to sell the lambs later, and when officials failed to understand the local complexity of sheep farming (ibid. 1989). When *mētis* is removed, or simply ignored, from the agenda of the encounter between concerned social worlds, *techne* rules (Scott 1998). While the UK case is an example of differing perspectives, the encounter between local realities and scientific, specialised, or generalised knowledge can also run in parallel, without either actor directly confronting the other with conflicting interpretations.

Struggles to solve problems of too much or too little water can be found throughout the world. Farmers, local residents, industry, politicians, indigenous people, governments and environmentalists all take an interest in the management of water resources. Often these interests diverge drastically. In his discussion of 'maps of activity', Scott (1998) notes that while one map serves to acknowledge the reflection and a representation of the planned vision of an area, another activity map may record all the unplanned movements that take place (Scott 1998: 347). While the politician sees an improved transportation system, the environmentalist sees vanishing fauna and flora. The farmer fears declining harvests, while industry hopes for improved logistics.

In the case of the Hallandsås railway tunnel, it was visions of trains going faster, the railway becoming more competitive, decreasing carbon dioxide emissions, and increasing cost- efficiency that paved the way for this technological project. Locally, voices were raised concerning the geological difficulties that the builder would face when trying to excavate the tunnel. Local knowledge and experiences, however, were disregarded in the efforts of the scientific technological community to assess the complexities of the ridge. Through a process of *inscription* – a term referring to the activities of coding, listing, and characterisation aiming for order (Latour and Woolgar 1986) – contracted experts developed strategies to manage the geological difficulties posed by the ridge and to make possible the building of the tunnel. Through the enrolment of experts and consultants, facts were constructed.

5. WATER AS A PROBLEM

The Hallandsås ridge has a complex geology, deriving from remains of primitive rock and sedimentary bedrock, formed 70 to 100 million years ago when extensive long-term movements caused deformations of the bedrock composition, creating an auriferous and fractured granite rock partly converted into clay. These zones of cracks hold huge deposits of groundwater, forming a plentiful groundwater resource in the ridge (SOU 1998).[1] The groundwaters in the area are of two kinds: near-surface groundwater (found in earth layers) and bedrock groundwater.

This geological circumstance makes it technically difficult to build a tunnel through the ridge without causing 'unacceptable'[2] environmental degradation. As a result of the toxic spill in 1997, there was a shortage of fresh and potable water, and the issue of water supply for residents and farmers came into prominence for both the project-owner and the local community. Following the toxic accident, various measures have been taken in order to minimise the consequences of the environmental crisis. These activities, however, have not always been satisfactory. For example, delivery of water to tanks installed on private property and the drilling of new pipe-wells raised water-quality issues when tanks, unsatisfactorily cleaned during the delivery process, developed fungal growth, and when filters put on the new pipes failed to filter iron and manganese out of the water.

The Rail Administration has taken a number of initiatives that go beyond issues of water supply (and water quality) for the local community. They have carried out a clean-up of amides, controlled wells, and mapped both toxic leakage and the lowering of groundwater levels. The Environmental Monitoring Group was commissioned to investigate the environmental consequences of the completed tunnel parts and the toxic spill, as well as the clearing of groundwater, surface water, and soil. The group was additionally commissioned to look into a possible continuation of the tunnel project.[3] Later on, an ecological programme for control was launched in 1999 to investigate the effects of the lowered water table on near-surface groundwater and whether nature, farming, and forestry had been affected as a result of the environmental consequences of the tunnel project.

Apart from these measures, the Rail Administration has looked into the conditions for a continuation of the work to build a tunnel through the ridge as stipulated by the government in 1999.[4] To fulfil this goal, various measures have been employed to acquire knowledge about the complexity of the ridge and to assess the constraints of nature on the project. A major obstacle for the continuation of work is the abundance of groundwater in the ridge and the geological complexity of the latter, and this has been confronted using different assessment methodologies.[5] The results of the three modelling methods used prognosticate the effects of sinking groundwater levels in soil and rock (Banverket 2000a). The models themselves and the results of the models have been contested, primarily in the local community but also among experts. Consequently, the Rail Administration has expended much effort on the development of convincing models. At a public consultation meeting held on 25 May 2000, an expert on water modelling who was also a member of the Environmental Monitoring Group described how these modelling efforts should be perceived: 'When we speak of models we have to be constantly aware that a model is a representation of reality, not reality itself.'

In the environmental impact assessment, the Rail Administration concluded that the complexity of the bedrock can cause differences in the results of the modelling and the real effects of the tunnel (ibid.). Nevertheless, there seems to be a great belief in the models,[6] as expressed at a public consultation meeting in March 2000:

> I don't know if any better models exist in the world than those we have been using. We've tried to choose the best available technology … We can't do more. I believe in it … I have no better tools to use when I model, so I have full respect for the accuracy of the outcome of the models. (Environmental expert, Rail Administration)

To assess the obstacles the groundwater resource seems to offer to a successful outcome of the tunnel project, a classification of the environment has been carried out using external *techne* categories. Through the establishment of climate stations, measurements of water flow, earth layer drillings, and the establishment of control programmes for the natural environment, farming and forestry, the Rail Administration has been conducting a mapping of the natural environment: the groundwater and the geology of the ridge, that with its complex bedrock structure and pervious soils and rock is highly permeable. In the realm of the tunnel project, this is perceived as a problem rather than a resource. The Rail Administration's investigation and assessment of the local environment builds on the collection of data from nature. Through these 'input data' to the models in use, testing is carried out of 'what the ridge can bear' (Environmental expert, Rail Administration, 22 March 2000). Although the Rail Administration admits that this mapping builds on a simplified version of reality, it nevertheless argues that by modelling the groundwater it can determine the effects of the tunnel on groundwater and the characteristics of the groundwater during both the building and the operational phases. The data are thus transformed and presented as diagrams or tables during meetings organised by the Rail Administration. These *inscriptions*, the end results of the modelling, are interpreted in terms of their significance as evidence (Latour and Woolgar 1986: 50). This process of developing inscriptions started after the environmental crisis of autumn 1997; through its inscriptions of the 'presumed' flow and nature of the groundwater resource, the Rail Administration argues that it has gained adequate and reliable data to be used in the realm of the future of the tunnel project.

The what and where of the water in the ridge has thus become a central aspect of the assessment of the environmental consequences of a resumed tunnel project. The project manager for the Hallandsås tunnel project between October 1997 and October 2000 framed the work on its impact assessment in this way: 'We shall increase our knowledge and verify the statements … We want to be able to say that "this is how it is"' (17 January 2000). Referring to the future prospects of the tunnel project, the same project manager said, 'We shall acquire knowledge about the value of nature in order to be able to prioritise' (Environmental Debate, Stockholm, November 2000). While certainty and verification ostensibly underpin assessments made of the environmental characteristics of the area, the technological knowledge acquired is also used politically. By arguing that the Rail Administration has the technological competence to assess what nature's circumstances are, local understandings and meanings of nature are if not neglected, depreciated. *Techne* rules and *mētis* is ignored.

For the Rail Administration, the groundwater situation during the building and operational phases of the railway tunnel has made the project gradually assume additional aspects that were not included initially. Not only did the flow of groundwater hinder the building of the tunnel; it also brought to the agenda the actual meaning of 'water' for the local community. The abundant groundwater resource of the Hallandsås has thus become a major concern for the parties involved. Without a greater knowledge of the resource, the future of the project is very much at stake. This knowledge, understanding and interpretation of the natural resource, as claimed by experts, are equally questioned by the local community.

6. WATER AS A RESOURCE

People living in the area above the northern tunnel site recognised that something odd was going on with the groundwater on the ridge when private wells, dams and streams began to dry out in areas next to where the newly formed tunnels ran beneath their homes and estates. These problems began to arise as early as in the fall of 1995, when local residents observed that something strange was happening to wells that had provided the community in the area with water on a regular basis for generations. Concerns were raised, which became more acute as time passed by. An interest group, called the *Three Villages*, was established to focus on what a lowered water table would mean for farming, household water supplies and local flora and fauna.

Above the northern part of the tunnel, which had been completed before the toxic leak became known to the public, is a community of three small villages. Here in the villages of Lya, Finsbo and Mäshult, informants described life as moving on without any major interruptions until the environmental crisis of the acrylamide leak. When this was discovered it became an event of substantial influence on daily life. The area is one of small farms, with narrow and steep roads winding through an open landscape and offering dramatic views of the Laholm Bay and the town of Båstad, located some three kilometres away. The pastoral landscape on top of the ridge also speaks of an historical heritage of agriculture and village community life, from the Old Stone Age to the Middle Ages (Hassby 1999). Today, families who have lived there for generations intermix with people who have moved there because of the natural beauty of the area. Over the years that have passed since the first well dried up as a result of the the tunnel project, people have come to realise the importance of the environment on the Hallandsås ridge for their local community (Sjölander-Lindqvist 2004 B). People are worried about the future of their community.

In 1997 one of the farmers, who was a member of the interest group, living in the northern area of the tunnel stretch, took the initiative to investigate the water situation in the area around the villages. A survey was distributed to all households in the area in order to assess the effects of the tunnel project on water resources around the northern tunnel site. The result of the survey was worrying. It was found that in an area of 6 square kilometres, 70 wells, 17 springs, 7 dams and 7 streams had run dry. Nearly two years later, in the early summer of 1999, an inventory of ecological effects of the tunnel project was made by the independent Environmental Monitoring Group.[7] The results of the inventory indicate changes in groundwater and surface water. Farmers noted reduced harvests as well as changes in the flora. In September 1997, a second survey was distributed by the farmer who had taken the first initiative. The results had not changed to any noticeable extent, except for the fact that twelve wetlands were now additionally affected by the lowered groundwater table.[8]

During interviews, informants spoke in highly emotional terms about how ponds and streams near their homes had dried up. Members of the local community started to question what was happening to their environment and their place of living, a process in which they also attached values to what they saw as fundamental to community life and community ideals. As well as expressing a growing concern for the future of the local environment; informants also framed their thoughts from an ontological[9] point of view. Groundwater and water resources were perceived as assets of vitality, fundamental for the existence of the local community. In the interviews and in informants' photographs,[10] water resources in the area and on the ridge were recurrently mentioned and depicted. Springs 'here, there, and everywhere' provided examples of the abundant water resources on the ridge. *Älemossen*, a rather extensive bog,[11] was commonly mentioned in the interviews along with allusions to its wealth of fauna and flora. It is said that all streams and surface water on the Hallandsås originate here. Streams are associated with memories of how people as children used to go fishing in the woods. Brooks in the yards of two of the informants, once a source of joy for their families, have dried up as a consequence of the lowered water table. The *Lya Branddamm*, a pond associated with memories of how people used to ice skate and how it served as a backup resource in case of fire, was more or less emptied of water as a consequence of the massive groundwater leakage. Although today much of its water has returned, people's understanding of the pond is now different from what it was in previous years. Instead of being associated with childhood memories, joy and pleasure, the pond is now seen as an index of the uncertainties of water supply as well as of the very future of the farming community itself (Sjölander-Lindqvist 2004A). *Borror*, local dialect for pipes tapping into groundwater, are found almost everywhere on the ridge. Dug or drilled wells, which were also rather prevalent before the tunnel project, indicate the abundance of water in the ridge. It was said that, earlier, people could more or less put a spade into the ground and water would gush from the hole. The abundance of groundwater is also reflected in the narrative of a spring that appeared inside the earth-floored cellar of a house right after it had been dug; the hole in the earth floor was turned into a well and supported the farm and the family living in the house with fresh, good-tasting water for generations. One day the well dramatically dried up, according to the woman living in the house – a clear indication of the tunnel below.

Plummeting groundwater levels are understood to seriously challenge the unique environment of the area. It is generally understood that farming depends upon the characteristic property of the ridge to hold large supplies of water in the vast systems of cracks in the decomposed primary rocks of the ridge. The survival of agriculture, small-scale and rather labour intensive as a result of the hilly landscape, is intimately associated with this exceptional environment. While the Rail Administration argues that the near-surface groundwater, found in earth-layers, is replenished by snow and rainfall, the local community takes a different view and contends that the two groundwater types communicate. Local residents agree that supplies of near surface groundwater are replenished through precipitation, but argue that groundwater springs are fed by bedrock groundwater. The abundance of groundwater is of vital concern to farmers, as it makes it possible to have good harvests even in very dry summers (Sjölander-Lindqvist 2004A; 2004B).

The understanding that water is a basic foundation for the local farming community suggests that the community perceives the groundwater resource – or as some would say, the *lack* of that resource – differently from the Rail Administration. While the Rail Administration interprets water as something to be catalogued and coded, the local community understands water and nature on the Hallandsås in a quite different vein. When discussing water, people refer to the 'new' water – that is, the water that they now run from their water-taps – as 'empty' and 'neutral'. The processes of clarifying poor quality water to eliminate manganese and iron have created a water with no taste, and have transformed water into something different from what it used to be. The savour and freshness of the water is gone, taken away by the Rail Administration: 'It was a fresh and good-tasting water. It's all gone!' (Woman, Three Villages).

The uniqueness of the water has vanished, and so has the value of a water that used to be authentic, fresh and good tasting. What once was their own, pure and unprocessed water has been exchanged for the less desirable 'equally good' water. Water is not just water, as a local participant argued in one of the public meetings addressing future solutions of water supply (in September 2001). Water is acknowledged as holding an essential value. The water that people can run from their water-taps does not hold this quality of essentiality.

7. BORDER DISSONANCE

Along with the problems described above, the Rail Administration has also had to face other issues in its role as developer and as executor of a government initiative. At the borders of the tunnel project, different visions, understandings, hopes and 'social worlds' meet and interact. The Rail Administration confronts stakeholders on a daily basis, meeting and engaging with local residents in various settings. Both informal and formal meetings are held, telephone calls are made, and employees of the Rail Administration and consultants go out on investigations of soils, wells and pipes on affected estates, and in some cases compensation is discussed or a new pipe is drilled into the ground. The conditions have change from what had been a relatively non-contact relationship. As time passes by, there are a growing number of occasions for encounters between members of the three most concerned villages and the Rail Administration.

The launching of the environmental impact assessment in late summer 1999 gave rise to several public consultation meetings, which, according to the Rail Administration were organised in part to obtain local views on the assessment work.[12] At these meetings, the Rail Administration presented data and results from their operations in order to 'achieve a correct picture of the future', as one of the environmental experts in the Rail Administration formulated it at the first public consultation meeting (January 2000). Activities like, for example, mollusc inventories and measurements of the flow of surface waters confronted the worries and concerns of the local community. At the consultation meetings, local residents were informed about the estimated environmental consequences during both the building phase and the proposed operational phase. At these meetings, the concerned and interested public had a chance to raise questions and express their worries. Residents affected by the problems with the groundwater frequently insisted that the Rail Administration must handle the water issue carefully. The lowering of the groundwater level, they stated, has not only resulted in a loss of water in wells, dams and streams, it has also brought a loss of essential values. As such, this feeling and experience of loss of the groundwater has violated the foundations of the community. Constantly, people demand and pray for a recovery of the groundwater.

Why doesn't the Rail Administration do anything about the 'bleeding of the ridge', as both informants and meeting participants have described the situation? Why can't the leaking water be led back to the ridge? These questions, asked numerous times, indicate how strongly people feel about their local environment, and about nature and the ridge. The questions also express the sentiment that the ridge and the state of the groundwater are seen as matters of ill-health that need to be addressed properly; the ridge is in this sense perceived as a body.[13] Such metaphorical descriptions of the ridge as a living being convey the local understanding that nature on the Hallandsås ridge cannot heal itself from wounds caused by the building of the railway tunnel. The bleeding metaphor, together with similar expressions like that the ridge 'vomits' chemicals that have been injected into it, convey that the ridge and its nature are experienced as vulnerable. There is simply a limit to how much nature can bear. The ridge needs human help in order to heal. Informants feel that returning drained water back on to the ridge will help the ridge and its biological environment recover its original healthy state.

Local people acknowledge that what will happen in the future is surrounded by a high degree of uncertainty, resulting from what they see as both a lack of competence and a lack of understanding of the complexity of the geological conditions of the ridge. There is a perception of a 'missing link' in society, as when high-modernist planning and *techne* confronts *mētis* (Scott 1998).

During the years that have passed since the groundwater level began to fall and the toxic leak that followed, residents in the villages above the northern tunnel parts have come to acquire extensive knowledge about the situation. They have made sure that they are as well informed as possible about the work commissioned by the Rail Administration. Besides this, they bring an additional dimension to the groundwater issues of the tunnel project. This is the question of morality. How much is nature worth when such an important resource as water can be wasted, as is the groundwater of the Hallandsås? The tunnel project entails more than the business of making trains go faster and reducing carbon dioxide emissions. The latter aspect is another side of the environmental coin: the risks of road traffic versus the risk of emptying the Hallandsås ridge of a resource that in many other parts of the world is considered a scarcity.

8. DISCUSSION

In the local community on the Hallandsås, water has been a resource that has been more or less taken for granted. The abundance of what locally has been regarded as fresh and good-tasting water has turned into a situation of scarcity. What once was a community with abundant water supplies is now instead a community where problems with water supply and quality are being perpetuated.

The case of the tunnel venture at Hallandsås illustrates the multiple meanings associated with a technological endeavour in an environment that locally is experienced as significant in terms of meanings, values and beliefs. The planned vision that a parallel train tunnel through the Hallandsås ridge would entail a decrease in greenhouse gases interferes with local fears that the surrounding environment will be seriously damaged. Locally, uncertainty prevails regarding the effects of the tunnel project on the biological environment, and ultimately, on the future of the local farming community. Local residents stress the importance of a high groundwater table for agriculture, and for the local ecology. Through their experience of farming activities in the area, farmers argue that the geological structure and the flow of the groundwater in the area, are of crucial importance for the natural environment, and consequently also for the entire social community. Without a relatively stable and high level of the groundwater in the ridge, the future of the farming community is understood to be jeopardised.

The laboratory gathers facts, but what happens when the 'black box', the social unquestioning of technologically reproduced knowledge, is opened? This question, raised by Latour and Wolgar (1986), can in a similar vein be applied to the Hallandsås case. For the developer, the Rail Administration, the effort to build a tunnel turned into a venture encompassing more than geological facts and engineering principles. The geological condition of the ridge is only one side of the coin. The other is the importance of maintaining a high groundwater table, generally understood among members of the local community as a prerequisite for the survival of the farming community. The Rail Administration uses the 'modelling' of nature as a means to retrieve data that will help them execute a government initiative that will bring a lowering of the water table, if only for a limited period. Residents in the area crave for the return of the groundwater to ensure a future for the environment, nature, the local community, and therefore also for the values, the beliefs and the meanings to which the community clings. Water is much more than a resource giving life in a physical sense. Similarly, the recently adopted EU directive acknowledges the cultural value of water.

During all the meetings that have been held, from public consultations and information meetings to specific meetings focusing on particular problems and issues, the quality and quantity of water have generally been emphasised in the discussions. Groundwater, surface water, recipients, watersheds, outflow areas, saturated and unsaturated zones and percolation – terms exemplifying the string of projects making use of advanced technology – have been central in the discussion of the area's water situation. A technical vocabulary confronts water as a lived reality. Controversy is manifested when agreement is lacking on how to represent the object of the problem (Callon 1986). The Rail Administration transforms the water into something calculable and measurable, while the local community is striving for another representation of groundwater and nature in the area. they ask for what is led away to be returned. Leading seepage water into the ocean entails more than the leading away of a transformed groundwater. As seepage water is conducted away, a locally appreciated asset of great importance to the community and its members vanishes.

Although considerable effort and money is being spent on investigations and mapping directed towards knowing and understanding the complexity of the geological conditions of the ridge, uncertainty prevails regarding the models that are used. While admitting that a simplified picture of reality is depicted, the

Rail Administration argues that advanced models of the environment and the groundwater have been used. They argue for accuracy in the models and claim that the model estimation and calibration is based upon a set of data, though they also admit that the ridge holds rich complexity in geological terms. The Environmental Monitoring Group also accepts that models and estimates always entail a generalisation of reality.[14] The model is to be seen as a simplified representation of a complex reality. As Scott argues, an application of general rules and techniques is always situational and dependent upon the context, and can be '… an invitation to practical failure, social disillusionment, or most likely both' (Scott 1998: 318). Space, time, and ends should be understood through particularities of the situation; they are always unique and delimited (ibid.).

9. CONCLUSION

The borders of the tunnel project are laced with controversy. Life and a way of living confronts a governmental mission. Groundwater, found below the surface of the natural landscape, filling the pores and cavities in soil and rock, borders several worlds of understanding and interpretation. There is a collision of ideas about water and what the building of railway tunnel will entail locally. The building of technological facilities concerns various interests, local communities and stakeholders. Different ways of understanding what is happening, how work is carried out, what the planned facility might entail – will meet. In this case, the meetings held have been a forum for the encounter between technological skills and know-how, experience-based knowledge and the implicit bearing that the ridge's water has on local community values and meanings. In such situations of incongruity, where people feel that their concerns, their experiences and their knowledge are overruled, conflict might arise. While the developer models nature to reduce the uncertainty issue in the construction of the tunnel and its effects on the biological environment, local residents perceive the issue of uncertainty differently. In arguing that local knowledge is overlooked they fear that the future of the farming community is threatened. Differences in opinions on the what, where, and wherefore of objects of shared interests, have the potential to aggravate and intensify controversies, as with the groundwater in the Hallandsås ridge. Local understandings and experiences of the natural environment and the land dispute confront other knowledge. The tunnel project has been a meeting point for competing knowledge as well as conflicting interests, and illustrates the multidimensionality of conflicts. Interests are in this sense intimately connected to issues of knowledge, whether techno-scientific (Latour and Wolgar 1986; Latour 1987) or framed by more 'immediate' ways of understanding and interpreting local circumstances.

NOTES

The research on which this paper is based derives from funding provided by the Bank of Sweden Tercentenary Foundation (Riksbankens Jubiluemsfond) and the Swedish National Rail Administration (Banverket). I would like to express my appreciation to Åsa Boholm and the anonymous reviewers for invaluable comments on earlier versions of this paper.

[1] Even so, when the Swedish State Railways investigated the possibility of building a railway tunnel through the Hallandsås ridge in 1975, it was concluded that the geological quality of the rock structure in the area allowed for construction of a tunnel.

[2] What constitutes 'acceptable' effects on nature has been ardently discussed at public meetings. The Rail Administration has referred the question of how to decide on what is acceptable or not to the Swedish government and the Environmental Court.

[3] The Environmental Monitoring Group consisted of qualified expertise from a wide range of branches, such as law, chemistry, hydrogeology, soil mechanics, and foundation engineering. A number of experts have also been engaged by the group and the work of the group has been quality checked by a reference group.

[4] Guaranteeing a future sustainable water supply for households and farmsteads along the tunnel stretch has, according to the Rail Administration, been one of the major premises for a continuation of the tunnel project. In order to fulfil this requirement, the Rail Administration in 2001 held public consultations where solutions for future water supply were discussed. These public consultations have been carried out, according to the Rail Administration, with people living in 'the area of influence', and have addressed the issue of future water supply in the event of a resumption of tunnel building. Two alternative solutions were suggested at the meetings: new drilled pipes, or the possibility of being connected with proposed water mains. Three hundred properties are in question. In June 2003, the first households were joined up to the new water main.

[5] Three different methods have been in use to calculate affects on the groundwater: the MIKE SHE model for groundwater flows in soil in the operational phase of the project, applied however only on bored wells and not dug wells (Päiviö and Wallentinus, 2001), and the VISUAL MODFLOW model as a means of studying how leakage of groundwater into the tunnel affects groundwater levels in surrounding rock. The third method, the Risk Variable model, shows the relative vulnerability of different areas in the case of a lowered groundwater table.

[6] As an organisation and a workplace, the Rail Administration includes different professions. These professions might, of course, hold different understandings of the groundwater in the ridge and of the project as a whole. However, the emphasis in this article has been on the views of the Rail Administration as made clear in the public dialogues at the consultation and information meetings, and in official documents.

[7] MGG PM 217

[8] MGG PM 234

[9] Bruce Kapferer argue that ontology is '… assuredly part of the realities through which human beings move as it may be ingrained in their person, in their being, and is vital in their self-constitution' (Kapferer, B. (1988). *Legends of People, Myths of State: Violence,*

Intolerance, and Political Culture in Sri Lanka and Australia. Washington, Smithsonian Institution Press.

[10] Photographs yielded during the second part of fieldwork when the informants were engaged in collaborative photographing (see Sjölander-Lindqvist, 2004B for further discussion on this).

[11] Approx. 140 hectares.

[12] This first consultation meeting in the impact assessment process would serve as a new start for the project. All effort should be made to acquire an independent basis for decision-making on the future of the project.

[13] 'Nature' is a word that has been applied to procreative dimensions as well as secretions of menstrual blood and semen (Olwig, 1993).

[14] MGG 140

REFERENCES

Banverket (1990). Tunnel genom Hallandsåsen. Banutredning. Huvudtext. Borlänge.

Banverket (2000a). En fortsättning av projekt Hallandsås? Borlänge, Regeringsrapport.

Banverket (2000b). Projektutredning Hallandsås. Miljökonsekvensbeskriving. Borlänge.

Bergström, J. (1997). 'Järnväg genom Hallandsås?' *Geologiskt Forum* **16**: 3–4.

Bergström, J. (1998). 'Tunnelfiaskot i Hallandsås - Orsakat av okunnighet eller illistighet?' *Geologiskt Forum* **17**: 3.

Boholm, Å. (2004). '"Greater good" in transit: The unwieldy career of a Swedish rail tunnel project', *Focaal*.

Callon, M. (1986). 'Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay'. In J. Law (ed.), *Power, Action and Belief: A new sociology of knowledge?* London: Routledge & Kegan Paul.

Donahue, J. M. and B. R. Johnston (1998). 'Introduction'. In J. M. Donahue and B. R. Johnston (eds), *Water, Culture, and Power: Local Struggles in a Global Context*. Washington, DC: Island Press.

Eriksson, K. and K. Wentzel (1998). 'Hallandsåsen är ett söndervittrat berg', *Forskning och Framsteg* **1**.

Falkemark, G. (1998). Hallandsåsen och höghastighetens pris. *Miljö i grund och botten - erfarenheter från Hallandsåsen*. Stockholm, Fritzes. SOU 1998:137.

Hassby, R. (1999). *Båstads Historia*. Båstad: Föreningen Gamla Båstad.

Hydén, H. and M. Baier (1998). När kunskapen blir onödig – om normativ assymetri i fallet Hallandsåsen. *Miljö i grund och botten – erfarenheter från Hallandsåsen*. Stockholm: Fritzes. SOU 1998: 137.

Johnson, J. C. and D. C. Griffith (1998). 'Visual data: collection, analysis, and representation'. In V. C. de Munck and E. J. Sobo (eds), *Using Methods in the Field: A Practical Introduction and Casebook*. Walnut Creek: AltaMira Press.

Kapferer, B. (1988). *Legends of People, Myths of State: Violence, intolerance, and political culture in Sri LAnka and Australia*. Washington: Smithsonian Institution Press.

Latour, B. and S. Woolgar (1986). *Laboratory Life: The Construction of Scientific Facts*. Princeton, New Jersey: Princeton University Press.

Latour, B. (1987).*Science in Action*. Cambridge, MA: Harvard University Press.

Löfstedt, R. a. Å. B. (1999). 'Off track in Sweden', *Environment* **41**(4): 16–44.

Mårald, E. and S. Sörlin (1998). Vad är 'det andra' värt? En studie av natur- och miljösyn hos Banverket och Skanska i Projekt Hallandsås. *Miljö i grund och botten – erfarenheter från Hallandsåsen*. Stockholm, Fritzes. SOU 1998:137.

Olwig, K. R. (1993). 'Sexual cosmology: nation and landscape at the conceptual interstices of nature and culture; or, what does landscdape really mean?' In B. Bender (ed.), *Landscape: Politics and Perspectives*. Oxford: Berg Publishers Ltd.

Pink, S. (2001). *Doing Visual Ethnography: Images, media and representation in research*. London: SAGE Publications.

Päiviö, J. and H.-G. Wallentinus (2001). 'The Hallandsås railway tunnel project', *Nordregio Report*(6): 55–94.

Scott, J. C. (1998). *Seeing Like a State*. New Haven: Yale University Press.

Sjölander-Lindqvist, A. (2004A). 'The effects of environmental uncertainty on farmers' sense of locality and futurity: a Swedish case study', *Journal of Risk Research* **7**(2): 185–197.

Sjölander-Lindqvist, A. (2004B). 'Visualising place and belonging: Landscape redefined in a Swedish farming community'. In Å. Boholm and R. Löfstedt (eds), *Facility Siting: Risk, Power and Identity in Land-use Planning*. London: Earthscan.

Sontag, S. (1973). *On Photography*. New York: Ferrar, Straus and Giroux.

SOU (1998). *Kring Hallandsåsen: Delrapport från Tunnelkommissionen*. Stockholm: Fritzes.

Star, S. L. and J. R. Griesemer (1989). 'Institutional ecology, "translations" and boundary objects: amateurs and professionals in berkeley's museum of vertebrate zoology, 1907–39', *Social Studies of Science* **19**: 387–420.

Wynne, B. (1989). 'Sheep farming after Chernobyl: A case study in communicating scientific information', *Environment* **31**: 10–15, 33–39.