Name of the case study	Barents Region - Metal mining for northern communities - Finland [Transformation]	
What about this case makes it interesting? How does this case contribute to understanding of resilience and/or regime shifts in the Arctic?	In the north of Finland, there are immense reserves of diverse raw materials. These include gold, nickel, chrome, iron, zinc and copper (1). The extractive resources industry is related to considerable environmental, social and economic impacts. On the one hand, it can contribute to increasing the prosperity of a region and its population; on the other hand, it might result in negative ecological impacts or have social disadvantages. Ecological impacts include pollution of water, air and soil, as well as loss of biodiversity or destruction of landscapes (9). For the social component, the hard working conditions in the Arctic winter and health issues for workforces are important aspects (1). Especially the Arctic is vulnerable from an ecological perspective and the ecosystem resilience can be generally characterized lower than in southerly latitudes regarding the negative environmental impacts caused by mining operations (3). This case is relevant to many parts of the Arctic where climate change and its associated warming is increasing the accessibility of various minerals (metals, oil, gas, etc.). The institutional measures (laws, regulations, certifications, etc.) being developed in this region show a change in recognizing that mining interacts with the socio-ecological system – it is embedded in and aims to reduce the negative impacts both during and after its operation.	
Template completed by: *Main Contributor	Participants of the 2014 ACCESS course: Adrian Braun*, University of Eastern Finland (LYY-Institute)/ University of Lapland (Arctic Centre) Melanie Flynn, The United Nations University – Institute for Environment and Human Security and The University of Bonn Enoil de Souza Júnior, Centro Polar e Climático	**Key references: Cite in the text using (1), (2), (3) etc. and provide a reference list at the bottom of the template.** (2) Juholin, E. 2004. For business or the good of all? A Finnish approach to corporate social responsibility. *Corporate Governance* 4(3):20-31. (4) Suopajärvi, L. 2013 Social impact assessment in mining projects in Northern Finland: Comparing practice to theory. *Environmental Impact Assessment Review* 42:25-30.

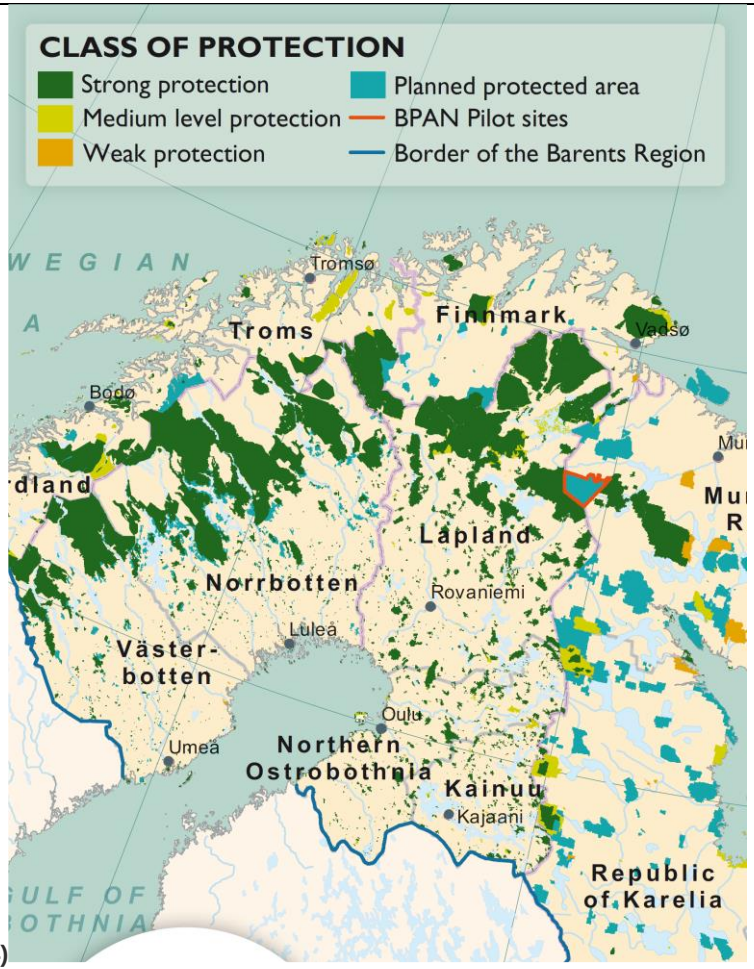
	Instituto de Geociências Universidade Federal do Rio Grande do Sul - UFRGS	(9) Mella, I. 2013. *Environmental impacts of iron ore mine Hannukainen based on the officials` perspective*. BEng. Tampere University of Applied Science, Tampere, Finland.
Reviewed by (name and affiliation)		

Category (mark with X)	**Resilience/ Adaptability**		**Loss of resilience**		**Transformation**	
					X	
Case study details:	**Country**	**Place**	**Scale – space**	**Scale – time**	**Sector(s)**	**Other (e.g. disturbance)**
	Finland	Lapland		1950s-present	Mining, reindeer herding	Socio-ecological impacts of mining

Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other: *state here***
		X	x (demand for minerals)					

	Biophysical	**Social**
1. Basic description of coupled social-ecological	**a) What types of ecosystem(s) and other major biophysical features are present?** (3) - forests (boreal forest – mainly pine, spruce, birch), - inshore waters (lakes, rivers, ponds) - swamps	**c) Who are the key groups of people in this case?** (1, 2, 3, 6, 7) - mining companies - local politicians - scientists - communities

system in focus (What are the key components and stake holders) If possible draw a systems diagram or conceptual map of the case – this can be a series of diagrams to capture different periods in the case and the drivers/ actors/ events that characterize the period.	- in general wetlands **b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics?** The Barents Protected Area Network (BPAN) is working to protect the most important and vulnerable ecosystems in the Barents region. Forests and wetlands are especially considered in that approach. The map below includes three relevant Finnish regions for this case study (Lapland Province, Northern Ostrobothnia, Kainuu) to underpin the established class of protection and subsequently the importance of the ecosystem (5). The majority of strongly protected areas are north of the Arctic Circle (in the province of Finnish Lapland). (3, 5) Finland has mining projects, mining production or deposits for a large number of materials considered critical, very important and important by the EU. Therefore, Finland's policy places a focus on the Finnish mineral sector which covers: mining of metallic ores and industrial minerals, industries that extract and process aggregates and natural stones, industries that produce and supply machinery, equipment, technology and services for mining operations, and various institutions including research organisations and agencies, universities and technical and trade schools.	- NGOs - indigenous people - investors - other business sector-related actors - European Union - transportation companies - UN bodies (e.g. UNFCCC, UNEP) **d) What kinds of livelihoods are important in the system?** Employment/livelihoods in (1, 2, 3): - mining sector - forestry sector - tourism - reindeer herding - transportation - mining equipment and services sector (often separated from mining) Mining is related to all three dimensions of sustainability (environment, social, economy). Mining might result in negative environmental impacts (e.g. water pollution, land destruction). In a social perspective mining could improve the well-being of a community (e.g. job creation, infrastructure development) but could simultaneously interfere the businesses of the indigenous people (e.g. reindeer herding, tourism). In the economic context, the mining companies primarily set up these operations to gain profits. **What institutions are key to this case? If possible define what scale it addresses.** The majority of exploration and mining companies in Finland are small or medium sized mining companies mostly owned by foreign



(14)
BPAN – Excerpt of protected areas in northern regions of Finland – separated into different classes of protection (5)

investments (14).

> Global reporting standards/frameworks (11):
- Global reporting initiative guidelines with performance indicators
- UN Global Compact
- OECD guidelines for multinational enterprises

> Environmental Management Systems:
- ISO 14001
- EMAS

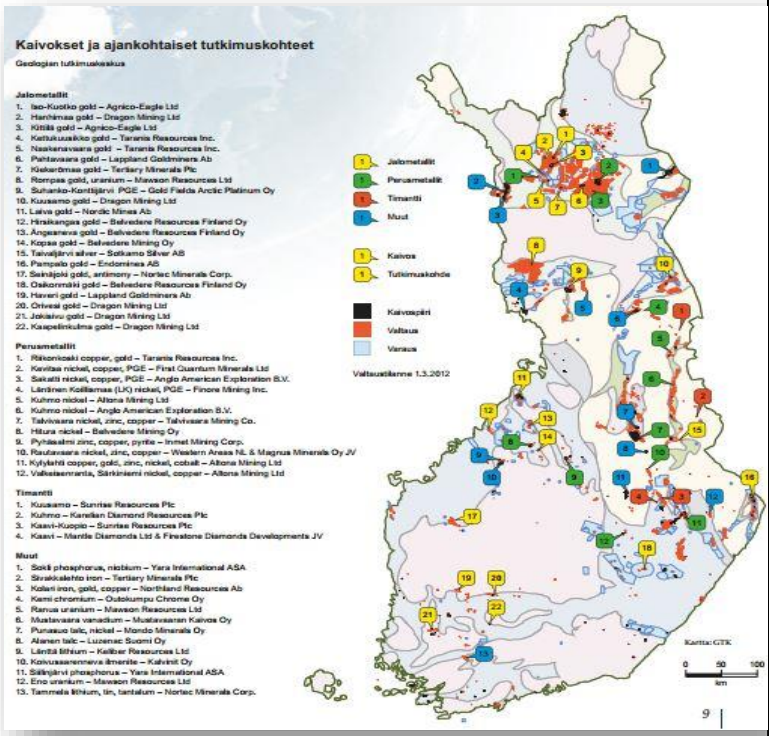
> Social Standards:
- AA 1000
- SA 8000

> CSR standard:
- ISO 26000 (no certification possible)

> Laws and prescriptions (e.g. environmental security laws)
- developed by Finnish legislation
- developed by EU (European Commission)
- in force in neighbouring states and subsequently rising pressure regarding international relations

How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries?

Municipalities close to mines need to ensure that mining operations do not hamper the ecosystem services provided to those in the area: Provisioning ecosystem services:



Mines in Finland (19) (Source: GTK – Geological survey of Finland)

- Food (for instance fish, berries)
- Fresh water
- Fuel

Regulating ecosystem services:
- Water purification

Cultural ecosystem services:
- Aesthetic
- Spiritual
- Educational
- Recreational

Supporting services:
- Nutrient cycling
- Soil formation
- Primary production

(18)

2. Timeline

Draw a timeline of *key* events/ developments to the case. Points to include:

Make clear the period of time over which the change is being considered.

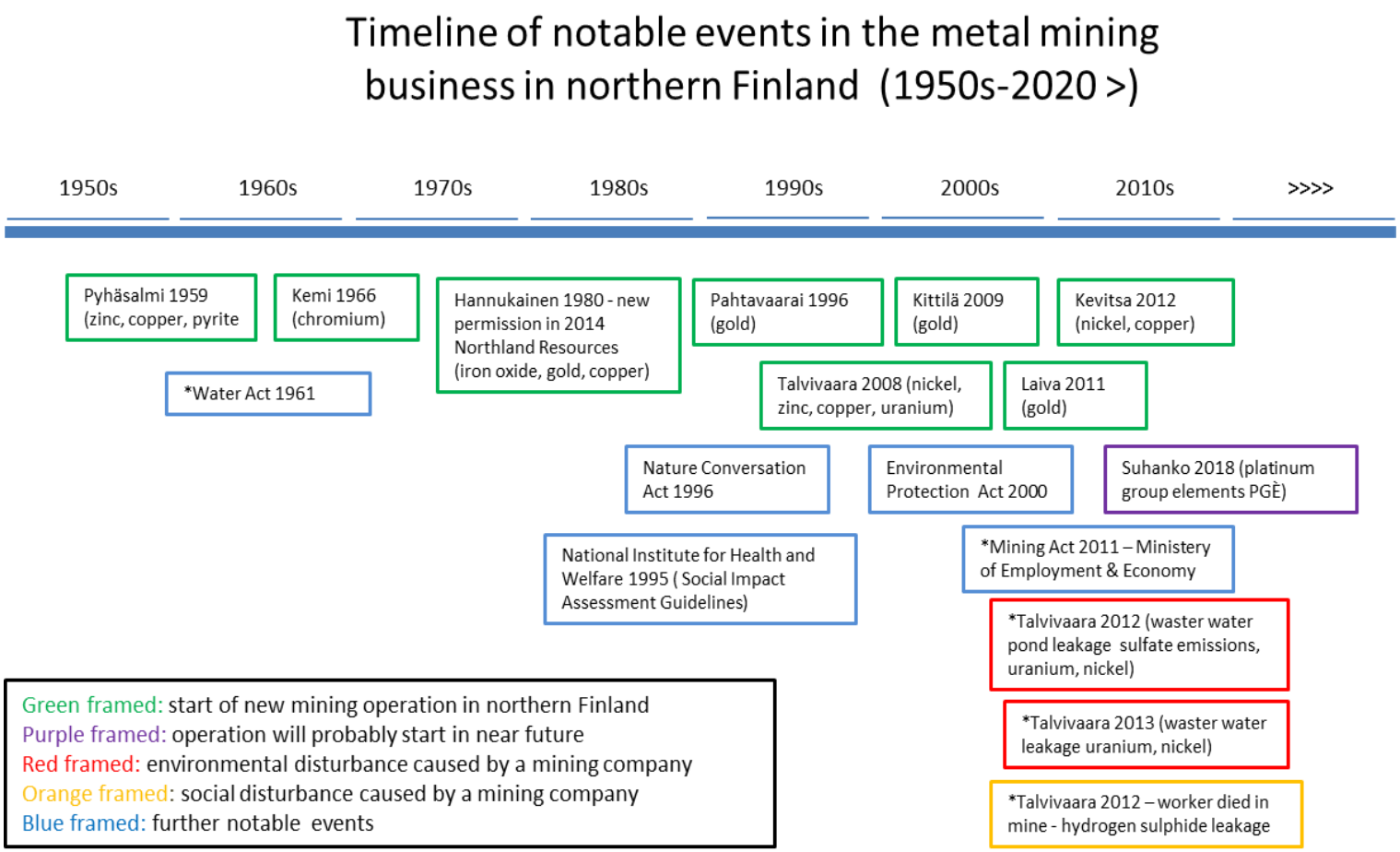
Provide a brief description of event/ actors, and ecological impacts. Mark particularly significant events with *.

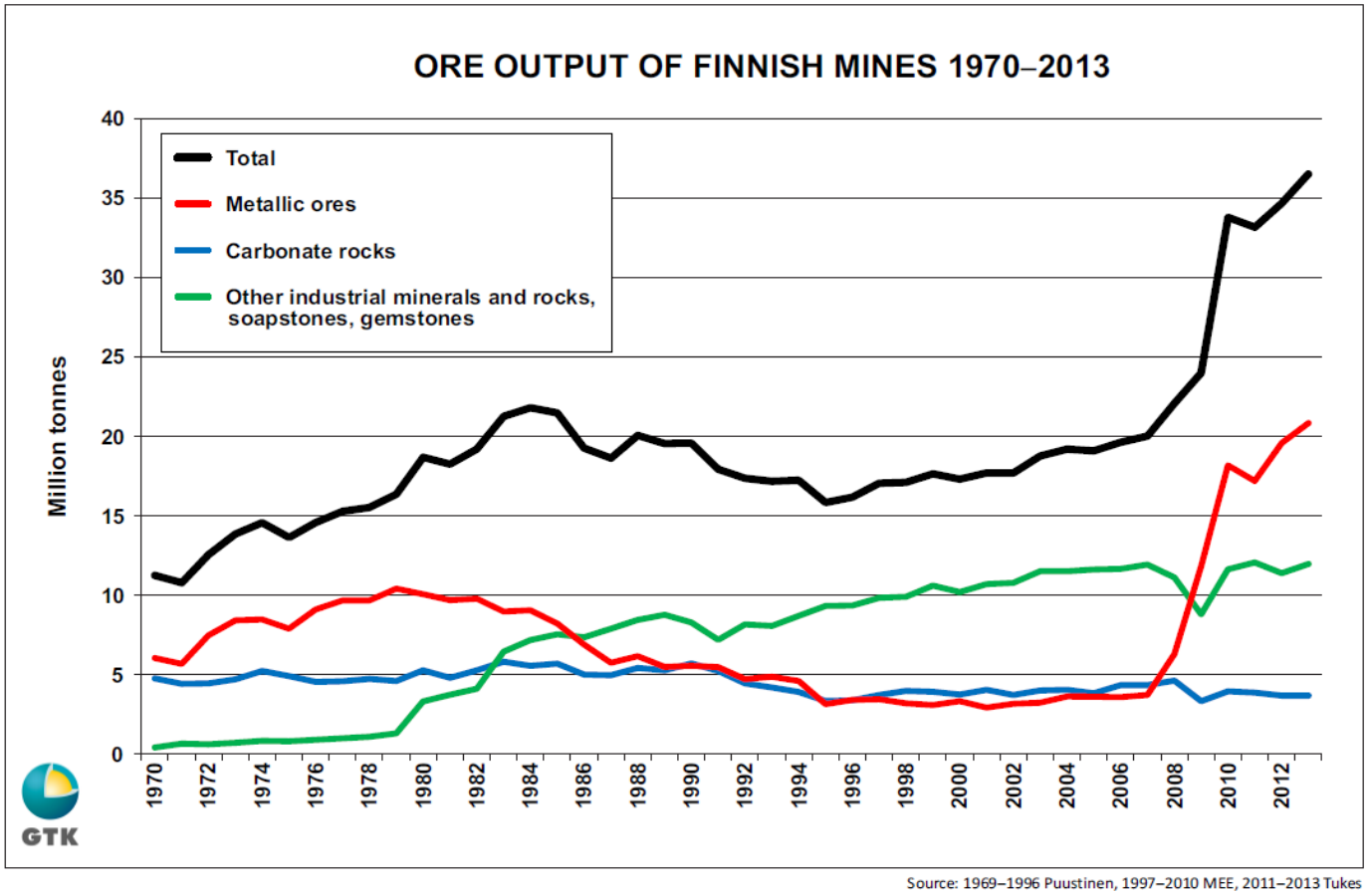
Consider both biophysical and social dimensions.

Additional points that can be considered:

Is it possible to identify periods of change from one type of system to another, transformations?

Identify disturbances



or events that challenged, built, or reduced resilience or adaptive capacity in the system.	In the following: Supporting graph from GTK to underline the rising significance of mining businesses with respect to the three dimensions of sustainability (8):  **Geological survey of Finland – ore output of Finnish mines 1970-2013 (8)**

3. Disturbances What are the key disturbances in the system (present and past)	**a) Have there been major biophysical disturbances that are relevant for the case?** Talvivaara mining company (1): - continuously: sulphate emissions - pollution in the water course - 2012 leak from the gypsum waste pond – contamination of water with nickel and uranium - 2013 another major leak in Talvivaara´s waste water pond – contamination of surrounding environment with nickel and uranium > Talvivaara mining company receives enormous criticism due to the caused environmental damages (3) - several cases under investigation - several penalty payments for insufficient waste water management Negative environmental impacts might have effects on (9): - water quality - soil - food security - wildlife animals (habitat) - biodiversity - forest regions and plants - air quality - greenhouse gas emissions (climate change debate) - destruction of landscape (open-pit-mining) - noise and vibrations > cutting of forest areas results in deforestation and loss of biodiversity (1/3/9)	**b) Have there been major social disturbances that are relevant for the case?** Indigenous people and mining (1, 3): Since 1991 the parliament as a whole has had to give the Sami an opportunity to voice their opinion. This implies no veto power, but the formal power to make the parliament listen to the demands of the Sami. Since 1996 Finnish authorities must negotiate with the Sami Parliament on all decisions that will affect the Sami as indigenous peoples, including mining (17). Sami people live in Finnish Lapland – livelihoods based on reindeer herding and tourism. Both businesses might be disturbed by mining operations. Reindeer herding migration routes may be affected particularly by open pit mining. Reindeer herding requires a large geographical area. The reindeer move depending on season and it is important that routes and passages between different grazing areas are not blocked. New land use can make the old grazing areas unusable, smaller or difficult to reach. Reindeer herding needs continuous grazing areas with different graze and functions. Reindeer herding is therefore sensitive to changes in use of land and needs a comprehensive perspective on the impact of new land use (17). Direct effects: e.g. core areas, grazing lands, calving areas, etc. - Lost grazing areas due to mining facilities - Affected or blocked moving routes and alternative routes - The mine's effect on connectivity between different areas

		-Effects of increased noise, traffic or other human activity. Indirect effects: - More pressure on other grazing areas and the risk for overexploitation - Risk that reindeer herding is pushed into other important areas such as farming, forestry, living areas, etc. - Risk for overgrazing among boarders between Sami villages and near fences - Risk for smaller grazing areas and thus a need for a decrease in number of reindeers to avoid the risk of overgrazing. This could also mean a decrease in the number of reindeer herders. - A need for more active movement activities between grazing areas and boarder controls in-between Sami villages. - An increased need for technique support such as helicopters, trucks, etc. (17) “Sapmi is rich in precious metals, oil, and natural gas. Mining activities in Arctic Sapmi cause controversy when they are in grazing and calving areas. Mining projects are rejected by the Sami Parliament in the Finnmark area. The Sami Parliament demands that resources and mineral exploration should benefit mainly the local Sami communities and population, as the proposed mines are in Sami lands and will affect their ability to maintain their traditional livelihood,” (15). Sami sacred sights: Mining locations even include ancient Sami spaces that are designated as ecologically protected areas, such as the Vindelfjällen (which is located in

		Sweden) (16). Although people are no longer living in the area, it is still their childhood landscape and the site of their home town, with all the associated memories, meanings and family ties. People carry the places in their identities, a fact which is expressed for example in the popular saying in Lapland: 'A man [sic] may leave Lapland, but Lapland never leaves the man' (4) Sami Tourism is based on both traditional and ecotourism approaches, which does not fit in with a mining environment. A mine could hinder the operational precondition of tourism and the attractiveness of the area. This is a matter that the Sami parliament in recent times is dealing with more frequently (17) Controversial issue: Can mining and tourism coexist? Pro: Mining is an attraction. Tourists could visit the mining site and watch the production processes. Contra: Mining is destroying the environment (e.g. contaminating lakes, rivers, ponds and tourists avoid visiting these spots anymore). Open-pit mining (3) - challenging and cost-intensive to close the mine properly - municipality could be involved into the social disturbances - security of workforce (3, 6, 7) - Health and Safety regulations and policies in the mining businesses. Accidents happen, corporate behaviour in these

		situations. Communities generally respond positively to new mines opening in the area as this creates jobs for the community. It is reported that for every one job created directly from a mining activity a further three or four are created indirectly. Additionally, jobs created by the mining industry are considered to be long-term employment (14).
4. Drivers of change Clarify what impacts these drivers have on the SES and if these are direct or indirect	**a) What are the key biophysical drivers of change?** > Climate change/global warming (1) - a warming climate might allow for easier access to ores in the Arctic - Barents Sea might be accessible longer during the year, allowing for transportation during the winter season A warming climate could result in more cost-efficient mining operations in the Arctic in the future. The length of the Arctic winter might be shorter and the annual output could be increased as a result of the extended work period during the year.	**b) What are the key social drivers of change?** > Continuously high demand for metals and rare earth minerals – from a Finnish and global perspective: (1, 3) - Several extracted resources could continuously achieve a high global market price - Rare earth minerals needed for production of new, highly demanded technologies, such as wind turbines. Demand is increasing in these sectors (13). China has gone from exporting 75% of raw products to shipping just 25%, so new mining demand pressures are increasing in Europe (14). > Transportation - goods have to be allocated to remote markets (1, 3) > Finnish government and European Union set up laws and prescriptions with respect to social issues (1, 2, 3, 4) - The Finnish Mining Act (3, 9) from 2011 provides, for example, the following rules to protect health and safety of the involved actors: "*The mining operator shall place and, if necessary, protect the mining machinery and equipment such that*

		these are safe in ordinary use and in potential foreseeable exceptional situations and such that they will not endanger the health or safety of any party," (9). > The Finnish federal ministries brought into force several "Acts" that influence the ecosystems at least indirectly in several ways. (3, 9) - Mining Act (621/2011) - Nature Conservation Act (1096/1996) - Environmental Protection Act (86/2000), - Act on the Protection of Wilderness Reserves (62/1991) - Land Use and Building Act (132/1999) - Water Act (264/1961) - Reindeer Husbandry Act (848/1990) - Radiation Act (592/1991) - Nuclear Energy Act (990/1987) - Off-Road Traffic Act (1710/1995) - Dam Safety Act (494/2009). Since 1987 reindeer herding is considered a national value. Reindeer herding is hence protected against any activity that could obstruct it in an obvious way (17).
5. Sources of adaptive capacity: What factors allow(ed) the system to adapt to disturbances in the past and present? Give a brief assessment of recent	**a) Within the ecosystem?** (-) Climate Change reduces the duration of frozen grounds during the year. That might result in rising efforts of companies' operations and subsequently in more emissions and pollution (1).	**b) Within society (e.g. people, social capital, management, institutions, infrastructure):** (+) Implementation of corporate social responsibility (CSR) policies and reporting on environmental performances (11). (+) The Finish government is working on strategies to improve the material and energy efficiency of machinery, equipment and processing technologies used in the mineral

or on-going changes (+/-/0 = increasing/ reducing/ not affecting adaptive capacity)		sector. Create incentives for the recycling and reuse of stockpiled waste, tailings and mineral products. Encourage through an annual award for excellence in resource efficiency (14). The mining industry intends to decrease their emissions by using new technologies. That has been recently successful. (-) Nevertheless, new mining operations remain sources of emissions (1, 3, 9). (+) Finnish government and European Union: establishment of laws and prescription with respect to fair working conditions, health and safety for workers, compensation guidelines in case of accidents, health insurance support, etc. (1, 4). (+) increasing work safety - new technologies allow, to some extent, that dangerous tasks previously conducted by humans are now done by machines (1). (-) with respect to the previous point: machines are replacing humans and consequently jobs vanish. Results in less employment and disadvantages for the society (1). (+) mining companies can earn a social license, awarded by local communities – useful approach to improve the individual social performance of a company (3). Sami reindeer herding: (-) There are no alternative areas to be used for reindeer herding because all areas are all ready used. Therefore, reindeer herding can only adjust slightly to the mine. However, during the 10 years the mine is planned the

		reindeer could be kept more on other grazing areas than near the pit (17). (+) Female reindeer can be marked with reflectors so the risk for traffic accident will be minimized (17). (-) Males and calves cannot be given reflectors as their neck size grows too fast (17).
The next two sections break down the information in Section I. While it is not necessary to fill these sections, if you have additional information pertinent to specific rows below feel free to enter the material.		
II.1-8 SES, resilience and adaptive capacity		
	Biophysical	**Social**
II.1. Where do we find changes and resilience in the face of change?	a) Within nature	b) Within society
II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou)	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.?
II.3. What are the key linkages?	a) From nature to society (e.g. ecosystem services)	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution)

E.g. ecosystem services, resource extraction. These linkages should exist. If there are not mutual links between social and ecological components the case is not a social-ecological system.		
II.4. What are key interactions?	a) What are the key ecological interactions within the case? b) What are the most important biophysical tele-connections to distant systems?	c) What collaborations, conflicts, or other key linkages exist between actors? **d) Between local actors and distant actors?** Rare earth minerals needed for production of new, highly demanded technologies, such wind turbines, and demand is increasing in these sectors (13). China has gone from exporting 75% of raw products to shipping just 25%, so new mining demand pressures are increasing in Europe (14).
II.5. Culture	a) How is the relationship between society and nature viewed? b) What meanings are attributed to nature and to interactions with nature?	c) What are key cultural features of relevance for the case? d) What are key cultural practices and beliefs related to nature?
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc).	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc)
II.7. What are key	a) What types of ecological processes (e.g. loss of	b) What types of slow social processes (e.g. aging,

slow variables Changes that occur over decadal or longer time scales	permafrost, shifts in species composition) are driving important long-term changes in ecological structures and processes?	population growth, loss of language) are driving important changes in social institutions and behaviours?
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)?	c) Can social stresses or major changes be attributed to ecological regime shifts? d) Are there specific social practices that might be contributing to ecological regime shifts
II.8 Regime shifts	**If a regime shift exists and is important to this case describe it below.** Please indicate whether the regime dynamics are well-established, contested, or speculative.	
II.8.a. Detailed description of alternate regime shifts A case study can contain more than one type of regime shift	Briefly describe the structure of each regime. What does each regime look like? What are differences in ecosystem structure and function? (e.g. permafrost loss, vegetation change)? How do the properties and behaviours of regimes differ? e.g. collapse of subsistence food sources, fundamental change in types of livelihoods, change in governance institutions, new actors with significant political power who transform decision making)	
II.8.b. Feedback mechanisms within the system that maintain each regime	Ecological feedback mechanisms	Social feedback mechanisms

II.8.c. What key changes drive regime shifts? Describe how these changes alter the state of the system or feedback processes.	a) Drivers of ecological regime shifts (either social or ecological). b) How do these changes alter biophysical feedback processes?	c) Drivers of social regime shifts (either social or ecological). d) How do these changes alter the social feedback processes?
II.8.d. Ecosystem services substantially impacted by regime shift	a) Changes in ecological processes that produce ecosystem services	b) Changes in demand for ecosystem services (market and non-market) c) Changes in the institutional context of ecosystem services e.g. changes in access and changes in how ecosystem services are valued as expressed by rules and regulations.
II.8.e. What is (+/-) impacted by changes in ecosystem services directly or indirectly	a) Impacts from regime shift on ecological components	b) Impacts from regime shift on social actors
II.8.f. Potential cascading effects	Describe, if any, the likelihood of potential ecological cascading effects to other SES	Describe, if any, the likelihood of potential social cascading effects to other SES
II.8.g. Where do actors intervene to alter regime shift dynamics and who can do the intervening?	Ecological oriented interventions	Socially oriented interventions

REFERENCES/ SOURCES CITED: (Key References highlighted in YELLOW)

(1)	TeamNord 2014:501. 2014. *Best Environmental Practices in the Mining Sector in the Barents Region - International Conference*. Rovaniemi, Finland, 23-25 April 2013. Copenhagen: Nordic Council of Ministers.
(2)	Juholin, E. 2004. For business or the good of all? A Finnish approach to corporate social responsibility. *Corporate Governance* 4(3):20-31.

(3)	Kokko, K., A. Oksanen, S. Hast, H.I. Heikkinen, H. Hentilä, M. Jokinen, T. Komu, M. Kunnari, E. Lépy, L. Soudunsaari, A. Suikkanen, and L. Suopajärvi. 2014. *Sound Mining in the North - A Guide to Environmental Regulation and Best Practices Supporting Social Sustainability. Different Land-Uses and Local Communities in Mining Projects (DILACOMI)*. Finland: Oulu University, Finnish Forest Research Institute (Metla) and University of Lapland. [online] URL: <https://lauda.ulapland.fi/bitstream/handle/10024/59503/Sound%20minig%20in%20the%20North.pdf?sequence=2>
(4)	Suopajärvi, L. 2013 Social impact assessment in mining projects in Northern Finland: Comparing practice to theory. *Environmental Impact Assessment Review* 42:25-30.
(5)	Finnish Environment Institute. 2013. Appendices: Regional evaluations: Finland. Pages 114-139 *in* Juvonen and Kuhmonen, editors. *Evaluation of the Barents Protected Area Network using PoWPA as a tool*. Finnish Environment Institute, Helsinki, Finland. [online] URL: http://www.bpan.fi/en/powpa-reports/
(6)	Carroll, A. B. 1999. Corporate social responsibility: Evolution of a definitional construct. *Business and Society* 38(3):268-295.
(7)	Dunne, S. 2007. What is Corporate Social Responsibility Now?. *Ephemera* 7(2):372-380.
(8)	GTK Geologian Tutkimuskeskus. *Geological survey of Finland*. 2014. [online] URL: http://en.gtk.fi/informationservices/mineralproduction/ [Accessed 28 August 2014].
(9)	Mella, I. 2013. *Environmental impacts of iron ore mine Hannukainen based on the officials` perspective*. BEng. Tampere University of Applied Science, Tampere, Finland.
(10)	*Mining Act 2011. (621/2011).* Finland: Ministry of Employment and the Economy.
(11)	Rasche, A. 2009. Toward a model to compare and analyze accountability standards - The case of the UN Global Compact. *Corporate Social Responsibility and Environmental Management* 16(4):192-205
(12)	World Business Council for Sustainable Development. 2000. *Corporate social responsibility: Making good business sense*. World Business Council for Sustainable Development, Geneva, Switzerland. [online] URL: http://www.wbcsd.org/work-program/business-role/previous-work/corporate-social-responsibility.aspx
(13)	Collins, G., A. S. Erickson, Y. Hao, M. E. Herberg, L. Hughes, W. Liu, and J. Nakano. 2011. *Asia's rising energy and resource nationalism: Implications for the United States, China, and the Asia-Pacific region*. The National Bureau of Asian Research, Chicago, USA.
(14)	Department for Environment, Food and Rural Affairs. 2012. *Review of national resource strategies and research*. Department for Environment, Food and Rural Affairs, London, UK. [online] URL: <https://www.gov.uk/government/publications/review-of-national-resource-strategies-and-research>
(15)	NRK. 2010. Mining prospects in arctic Norway also causing controversy. *Sami voices* blog, [blog] 25 April 2010. URL: <http://saamivoices.blogspot.se/2010/04/mining-prospects-in-arctic-norway-also.html> [Accessed 23 September 2014].
(16)	Stéphane Lombard. *Vindelkroken*. [video online]. URL: http://icr.arcticportal.org/video/viewvideo/73/news-a-politics/blackstone-to-mine-reindeer-pastures-sweden [Accessed 23 September 2014]

(17)	Ekenberg, S. 2008. *A baseline study of socio-economic effects of Northland Resources ore establishment in northern Sweden and Finland: Indigenous peoples and rights*. Department of Human Work Sciences, Luleå University of Technology, Luleå, Sweden. [online] URL: http://pure.ltu.se/portal/files/4717921/Indigenous_Peoples_final.pdf
(18)	The Economics of Ecosystems and Biodiversity. *Ecosystem Services*. [online] URL: http://www.teebweb.org/resources/ecosystem-services/ [Accessed 23 September 2014].
(19)	GTK – Geological survey of Finland

GLOSSARY OF TERMS IN THE TEMPLATE

Actor	We use this term generally to look for individuals, groups, organisations, and so on that structure actions and/ or are stakeholders.
Adaptive capacity	Is the capacity of actors in the system to manage resilience in order to stay within a desired state during periods of change. This is related to the diversity in the system behind the provision of a function.
Disturbance	This refers to any disturbance to the system, regardless of scale, duration, intensity and frequency. See shock and stress.
Driver	Actor or process that directly or indirectly affects change in a social-ecological system. External means that the system in question (the scale being looked at) is unable to affect the driver in question – there is no feedback from the system to the driver.
Ecosystem services	The goods and services humans derive from ecosystems. These include: provisioning, regulating, cultural ecosystem services respectively.
Feedbacks	A change within a system that occurs in response to a driver, and that loops back to control the system. A feedback can help to maintain stability in a system (negative or balancing feedback), or it can speed up processes and change within the system (positive or enhancing feedback). Feedback processes play a very important role in determining system thresholds and in maintaining system resilience.
Institution	Here we refer to the humanly devised constraints that shape human interactions, such as rules, norms and laws. These can be formal or informal. Note that we are not referring here to institutions as organisations.
Regime shift	For complex systems, a substantial and enduring reorganization of the system, where the internal dynamics and the extent of feedbacks undergo change.
Resilience	This is a property, in this context of social-ecological systems. It relates to the capacity of a system to cope with disturbances and recover in such a way that they maintain their core function and identity. It also relates to the capacity to learn from and adapt to changing conditions, and when necessary, transform.
Shock	A sudden, unexpected disturbance. This kind of disturbance is often punctual, and has important impacts on large parts of the system.
Slow variable	When analysing complex system is often useful separating “fast” and “slow” variables. Fast variables often represent the primary concern of ecosystem users, for instance game or crop production. Slow variables shape the behaviour of fast ones but change slowly with respect to the overall dynamics of the system. Examples of slow variables might include permafrost thawing for a social-ecological system of Arctic hunters where the fast variable is game, or soil organic matter for an agricultural system where the fast variable is crop production.
Stress	This is a disturbance that has long persistence and often low intensity in impact.
Social-ecological system	This is an interwoven system of human societies and ecosystems. This concept emphasises that humans are part of nature and that these components function in interdependent ways. In the template identifying these interactions between the components aims to identify the processes and actors/ components that interact and particularly the feedbacks between the human-related

	components and the ecosystems/ biophysical components.
Stakeholder	See “actor”
Systems Diagram	This is using a diagram to illustrate the configuration of a system. This is done by defining its structure, function, and feedbacks. For a case there may be more than one diagram if the system changes in character (actors, processes, drivers, disturbances, feedbacks etc.) over time.
Timeline	The goal with the timeline is to capture important events – both punctual and over longer periods of time, identifying the causes of these events and the actors/ processes involved. This should be done chronologically and distinguishing events.