

Health Effects Assessment Tool (HEAT): An Innovative Guide for HIA in Resource Development Projects

Authored by Tania Barron, Marla Orenstein and Ame-Lia Tamburrini

January 2010

Habitat Health Impact Consulting &
Environmental Resources Management



Health Effects Assessment Tool (HEAT): An Innovative Guide for HIA in Resource Development Projects

Table of Contents

ABSTRACT	1
INTRODUCTION	2
HEALTH EFFECTS ASSESSMENT TOOL (HEAT)	4
1. LAND ACQUISITION	7
2. TRANSPORTATION	9
3. WORKFORCE	11
4. LABOUR AND PROCUREMENT	13
5. TAXES / ROYALTIES	15
6. RESOURCE USE	16
7. WASTE	17
8. FUGITIVE DUST AND AIR EMISSIONS	18
9. CHEMICALS AND HAZARDOUS MATERIALS	19
10. PROJECT INFRASTRUCTURE AND EQUIPMENT	20
11. PROJECT SECURITY	22
THINGS TO KEEP IN MIND WHEN ASSESSING HEALTH EFFECTS	24
EVIDENCE ON THE LINKS BETWEEN RD PROJECTS AND HEALTH	25
Industry-Specific Evidence	25
Effects of the Biophysical Environment on Health	27
Effects of the Socio-Economic Environment on Health	29
Factors Associated with Specific Disease Outcomes	31
CONCLUSIONS	33
ABOUT THE AUTHORS	34

ABSTRACT

Resource development projects (RD Projects) (e.g., mining, dams and oil & gas) can have major implications for the physical, biological and human environments in which the projects are located. While environmental impact assessments have been a standard requirement for resource development projects in many countries for several decades, social, and most recently, health impact assessments (HIA), are only now becoming standard practice.

Increasing demand for HIA has generated a need for appropriate guidance to assist project proponents, practitioners and evaluators in commissioning, developing and evaluating robust assessments of the health effects associated with resource development projects. This can be extremely difficult, as multiple components of the project (e.g., workforce, transportation patterns) interact with existing population factors (e.g., local land-use, socio-economic conditions, religious and cultural influences) to generate health effects that vary project by project. Furthermore, HIAs often need to assess a broader set of public health factors than have traditionally been considered in Environmental Impact Assessments, so present new challenges not previously addressed by impact assessment practitioners.

This guidance document introduces the **Health Effects Assessment Tool (HEAT)**, an innovative process for high-value HIA implementation that helps anticipate the types of health effects commonly associated with such developments. For each component of an RD project, this tool presents links to commonly associated health determinants and health outcomes, as well as important contextual and project-specific factors that need to be taken into account. Practical guidance and recommendations are also provided. The guidance document is intended for use by HIA practitioners, and those who need to commission or evaluate HIAs as part of a resource development project.

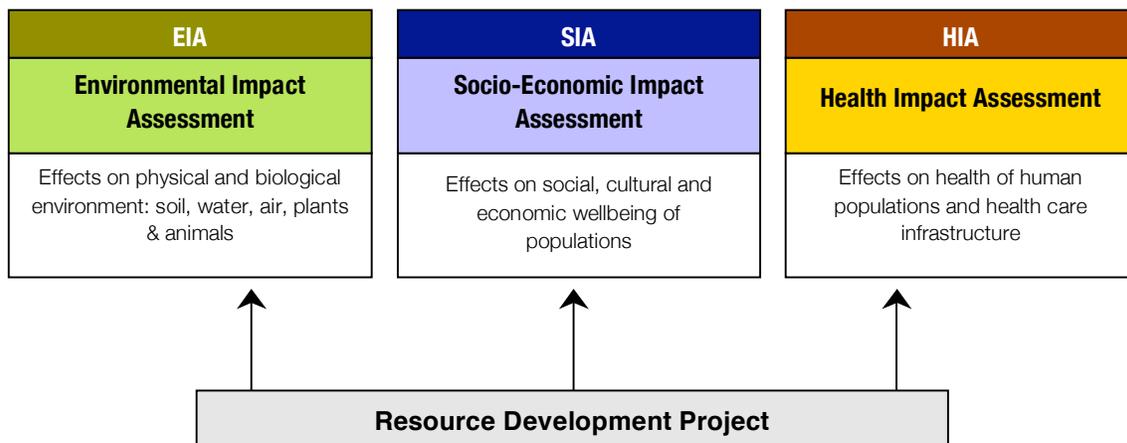
INTRODUCTION

Resource development projects (RD Projects) such as mining, dams, and oil & gas ventures can have major implications both for biophysical environments and for human populations. A natural resources project may cause changes to the physical environment through, for example, the building of roads, the disposal of industrial waste or by causing changes to wildlife habitat. It may also cause changes in a community's social and economic structure by changing the composition or size of the local population, providing jobs in the community, or placing demands on local infrastructure. As a result of the project, human health can similarly be affected in unintended ways. For example, a common long-term effect of RD projects is an increase in sexually transmitted infections (STIs) among workers and the local community, associated with the presence of a large male workforce with disposable income in a socioeconomically depressed area, who are often isolated from their families for long periods of time.

There is an increasing demand for community health issues to be taken into account when RD projects are proposed. This demand arises from several sources. First, many local communities are finding a voice and asking for their concerns around a wide variety of health issues to be addressed. Second, regulators are increasingly integrating public health factors into impact assessment regulatory requirements. Third, international financing institutions (IFIs) are influencing the degree to which public health issues are identified and managed for capital projects globally via lending requirements. For example, the International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability require that community health and safety issues (among others) are appropriately scoped, identified and managed as part of the impact assessment process as a prerequisite for IFC financing. Finally, corporations also increasingly recognize the importance of identifying and managing the effects of their projects on the environment and human health and well-being, to meet internal corporate standards, external regulatory requirements and to ensure the long-term viability of their business.

Health Impact Assessment (HIA) has been developed as a tool to systematically assess and address the direct and indirect community health effects of RD projects. HIA joins Environmental Impact Assessment (EIA) and Socio-Economic Impact Assessment (SIA) as part of an integrated ESHIA (environmental, social and health impact assessment) process, designed to comprehensively assess project impacts on the physical, biological and human environments. HIA in and of itself is an important component within the integrated ESHIA process as it helps to flag the links between the environmental, social and health contexts and the potential knock-on effects that can be generated when any one of these aspects is affected by a project (see Health Effects Assessment Tool tables on pages 7-20).

Figure 1: EIA, SIA and HIA



The increasing demand for HIA has generated a need for appropriate guidance to assist practitioners in developing robust assessments of the health effects associated with resource development. From a practitioner's point of view, determining the health effects associated with large and complex projects can be extremely difficult.

Purpose

In order to develop a thorough and robust assessment of resource development projects, HIA practitioners need a tool to help them a) anticipate the type of community health effects commonly associated with such developments and b) to evaluate these effects in a systematic manner. This paper aims to provide such guidance, helping the user to:

- Identify the different project components commonly found in RD projects;
- Consider the type of health effects most commonly associated with RD projects;
- Appreciate the variety of influencing factors (both context- and project-specific) that influence the link between project components and health effects; and
- Learn from practical guidance and recommendations from practitioners who have conducted RD project HIAs in both developed and developing country contexts.

The Health Effects Assessment Tool focuses on potential community health effects of RD projects. It does not address worker health issues unless these issues also pose a threat to the health of local communities.

Audience

This guidance document can be a useful tool for HIA practitioners, for anyone commissioning, developing and/or evaluating stand alone and/or integrated HIAs (as part of a broader Environmental, Social and Health Impact Assessments (ESHIA)) or for extractive sector companies wanting to understand more about HIA. The document assumes that the reader has a general level of familiarity with environmental, social and/or health impact assessment in the context of capital development projects. For background reading on HIA and other topics relevant to resource development, please see the list of published resources on page 23 of this document.

HEALTH EFFECTS ASSESSMENT TOOL (HEAT)

Purpose of the Tool

The purpose of the Health Effects Assessment Tool is to provide a framework for exploring associations between specific aspects of resource development projects and public health effects.

How the tool works

To make the tool as easy-to-use as possible, we have identified a list of **11 components** common to most resource development projects that are usually associated with health impacts. These 11 components are:

- Land Acquisition
- Transportation (land- or sea-based)
- Workforce
- Labour and Procurement
- Taxes / Royalties
- Resource Use
- Waste (e.g., solid, effluents)
- Fugitive Dust and Air Emissions
- Chemicals and Hazardous Materials
- Project Infrastructure and Equipment
- Project Security

This classification is neither exhaustive, nor the only way that the attributes and outcomes of an RD project may be categorized. The list should therefore be adapted and revised based on the specific project being analyzed. Nonetheless, it provides a practical and informed basis for a framework to link RD projects with subsequent health outcomes.

Note: It is important to note that the type of health effects generated by these project components can differ greatly depending on the lifecycle of the project. Therefore, the potential health effects generated by project components should be considered separately for each of the major project phases including construction, operations, and decommissioning. Specific impacts can also be generated by the transition between project phases. Therefore special attention is required during transition phases to ensure that all potential public health effects are identified and managed. For example, the change in the skills, quantity and type of labour required between the construction and operations phases may lead to a high number of unemployed workers during this transition, which will need to be addressed by project proponents and regulatory authorities.

For each of the 11 project components, we present a number of **context- and project-specific factors** that may influence the likelihood and degree of the impacts that are generated.

- **Context-specific factors** comprise pre-existing local conditions such as the local socio-economic conditions, religious and cultural influences, the capacity of the existing health care infrastructure, and the health status of the local population.
- **Project-specific factors** are factors directly related to the development and/or existence of the project and the way it is managed, such as the level of engagement with affected groups, the extent to which a safety culture is fostered, or the willingness to source goods and labour locally.

The likelihood that a project will generate particular health impacts, positive or negative, depends on these influencing factors.

For each of the 11 project components, we then consider **intermediate risks and outcomes**. These are usually social, economic or environmental changes that take place as a direct or indirect result of the project, and that often, of themselves, impact community health. For example, if the project results in loss of social support networks, vulnerable individuals who were reliant on those networks for meeting some of their health needs may find that their quality of life is compromised as a result of losing access to those social networks.

Finally, the tool presents potential health effects or measurable health outcomes that stem either directly from the project or from changes to the intermediate risks and outcomes. It also provides commentary on factors that could influence the way in which health effects are manifested.

Each RD project is different, as is each HIA. The reader will need to decide for himself/herself which project components, and which contextual and specific factors apply to the particular situation under consideration.

Common Health Issues faced by RD Projects

There are a number of common health issues that are particularly relevant for RD projects, and that are important to take into account in an RD project HIA. These health issues, presented below, are identified in a number of recognized standards and guidelines, including publications by the World Health Organization and the International Finance Corporation.

- Minor physical injuries to debilitating injury and/or death
- Effects to respiratory health
- Spread of sexually transmitted diseases
- Unwanted pregnancies
- Spread of vector-related diseases (zoonotic diseases such as malaria or yellow fever)
- Spread of communicable diseases (TB)
- Spread of water- and food-borne diseases
- Acute and/or chronic poisonings
- Dietary changes and malnutrition
- Chronic diseases (non-communicable diseases)
- Effects on health care capacity and access

- Deterioration in living conditions and increase in poverty levels
- Lifestyle changes
- Effect to cultural health practices
- Mental stress
- Increase in alcohol and drug use/abuse
- Decrease in safety of local community
- Impact to overall quality of life

A last note about the health assessment framework: when considering the effect of project components on health, it is important to note that impacts will differ depending on which segment of the population is being considered, and some segments of the population will be much more vulnerable to potential health effects of projects than others. (e.g., children living close to a source of fugitive dust and emissions may be more vulnerable to respiratory health effects than adults living in that same location). In order to complete an accurate assessment it is necessary to clearly identify the scope and boundaries of the assessment as well as specific vulnerable groups who are more likely to be affected by a project.

Note: As project proponents, impact assessment practitioners and evaluators, we are usually most concerned with how a project will affect those living in closest proximity to the project and those most vulnerable to the likely project effects. Therefore, a useful exercise before conducting any assessment of health effects is to identify the area of influence (Aoi) of the project, including the communities located within this area. The assessment then will focus on the Aoi.

1. LAND ACQUISITION

Land acquisition is a common aspect of resource development projects. The effects of land acquisition are highly dependent on the types of communities that live on the land to be acquired, how people in these communities use the land, the social, cultural and livelihood links that they have to the land, and whether they have legal titles to their property. Other important factors to consider include the socioeconomic and health conditions of the affected population as this will influence their ability to adapt to the livelihood changes brought on by the land acquisition. The degree to which affected groups are engaged in the land acquisition process, how the land value is assessed and how compensation is structured will greatly influence the health outcomes generated by land acquisition.

In some countries, the land acquisition process is governed by national regulations. In some, it is not. Notice that the potential health effects generated greatly depend on the intermediate socio-economic and environmental effects created (see table below). The groups most vulnerable to health effects are likely to be those with high dependence on their land for their livelihoods, but without land titles and limited access to legal recourse.

Note: When considering the health effects from land acquisition, take into account not only the effects on the population to be resettled, but the effects to the “receiving community”, if the resettled population will be integrated into an existing community.

Project Component: LAND ACQUISITION

Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects <small>*(potential effects assuming a worst / best case scenario; actual impacts may differ in severity)</small>
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Presence of existing populations on land to be acquired • Land use in area to be acquired and whether these activities comprise a significant portion of settlers' income/livelihood • Whether the displaced have land titles • Socio-economic conditions of people to be resettled • Ability for resettled population to adapt (keep similar level of income/sustenance) to maintain level of pre-impact livelihoods • Existing health conditions of human receptors most likely to be affected and their ability to adapt to the effects generated 	<ul style="list-style-type: none"> • Acreage to be acquired • Process undertaken to acquire and compensate for land-take • Level of engagement of affected groups in this process • Whether project puts in place an International Standards Resettlement Action Plan to address physical and economic displacement 	<ul style="list-style-type: none"> • Economic and/or physical displacement leading to potential: <ul style="list-style-type: none"> ○ partial and/or total loss of income and/or sustenance ○ change in physical/social environment ○ disruption to local practices/ways of living ○ loss of social/support networks and isolation • Change in access to important local sites (water wells, school, religious sites, markets etc) • Potential competition for employment, resources and services with "receiving" community 	<ul style="list-style-type: none"> • Mental stress (linked to loss of income/livelihood, uncertainty, social conflict etc) • Dietary changes and malnutrition • Health problems associated with increased levels of poverty and deterioration of living conditions (poor access to water, sanitation and electricity, overcrowding, respiratory disease,) • Decrease in access to health care and services • Decrease in quality of life for both resettled community and "receiving community" • Effect to cultural health practices <p style="margin-top: 10px;"><i>Those most affected will likely include displaced populations without legal titles to their lands in addition to other vulnerable groups</i></p>

2. TRANSPORTATION

Changes generated by project traffic (trucks, other road vehicles, trains and boats) and/or road or rail infrastructure can impact the local community both positively and negatively. The relative increase in project traffic and type of vehicles used—generally heavy trucks—compared to baseline levels can have a significant effect on the quality of life and overall health of local communities, and particularly of individuals within them. Local factors, such as the existing use of local roads, the community's level of experience manoeuvring in heavy traffic, the level of reliance on small boats for fishing, and the presence of a local culture that respects road signage and safety, will influence the local community impacts.

Although traffic accidents may not occur frequently, the devastation for individuals, families and communities can be significant, and the effects long lasting or permanent. Rural and peri-urban areas with limited economic resources are often less able to absorb large increases in heavy truck traffic presenting unique risks to the local population. For communities that rely on subsistence food sources, changes in traffic patterns or road infrastructure may change the location or number of animals in the local area, or access to those animals both for community members and for outside hunters. On the other hand, improvements in the local road network can provide greater access for emergency response vehicles, and greater access to markets, hunting grounds, jobs, or social support networks. However, increased access can also result in the devastation of natural resources such as forests (opened up for logging), hunting grounds, etc.

Note: The risk of accidents is likely greater on roads with high levels of local, mixed-use traffic (e.g., pedestrian, bicycle, motorcycle, animals etc) in existing accident hotspots (intersections etc), as well as in high traffic areas of social importance to the local community (schools, markets, bus depots etc). The effects from train traffic (if applicable to the project in question) should also be considered.

Project Component: TRANSPORTATION (LAND-BASED OR SEA)			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> Type and frequency of existing local traffic (foot, bicycle, motorcycle, vehicle, boat etc) Existing high danger areas/accident hotspots or presence of areas where project traffic would intersect local high traffic areas (e.g., intersection of railway and local road, schools, etc.) State of road infrastructure and signage Local experience with type and level of traffic brought by project Existing local access to emergency response and health care services Presence of a safety culture Existing health conditions of human receptors most likely to be affected and their ability to adapt to the effects generated 	<ul style="list-style-type: none"> % increase in traffic compared to existing levels Type of vehicles/vessel used Hours and frequency of transport Type of skills and safety training provided to drivers Changes created to road infrastructure 	<ul style="list-style-type: none"> Traffic accidents (land or sea) between project vehicles/boats and local users using the same travel route (including pedestrians, cyclists, motor vehicle users, boats etc) Damage to road infrastructure Noise and fugitive dust Economic displacement/loss of income, especially in situations where local fishing/farming sites/activities are disturbed by traffic (boat or otherwise) and associated exclusion zones Disruption to subsistence food availability Depletion of local natural resource 	<ul style="list-style-type: none"> Ranging from minor physical injuries to debilitating injury and/or death <p><i>Particularly in situations where access to EMS services and health care are limited or unavailable to the local population</i></p> <ul style="list-style-type: none"> Dietary changes and malnutrition <p><i>Health effects from economic displacement highly dependant on locals' reliance on fishing/farming etc as their main source of income/livelihood</i></p> <ul style="list-style-type: none"> Respiratory effects -ranging from acute effects (e.g., minor irritation of eyes, throat, lungs) to chronic effects <p><u>Potential positive effects:</u></p> <ul style="list-style-type: none"> Increase in access to services <ul style="list-style-type: none"> Health care Education Infrastructure and Services Markets Improvement in overall quality of life

3. WORKFORCE

One of the project factors most often linked with community health effects, and often among the most challenging to manage, is the mobilization and presence of project workforces, which include the management of workers and worker camps. There are several different health effects that can be linked to this project component including the introduction and spread of disease, worker-community conflict and decrease in safety of local community, and an increase in use of and pressure on existing infrastructure and services.

From a project perspective, a large number of workers with disposable income in impoverished areas has been frequently associated with population influx, an increase in or introduction of prostitution, an increase in the availability of alcohol/drugs and overall decrease in safety of the local community. Project factors that affect the type and degree of health effects generated can include the number of workers required, where they are sourced from, the length and nature of their contracts and the type of training and management measures (e.g. code of conduct, camp requirements) put in place to ensure the safety of workers and local communities. Relevant baseline conditions to consider when assessing the potential health effects from workforces include: the size and relative location of local communities to the project and worker camps, local socioeconomic conditions, availability of employment opportunities for women, the disease profile of the local population, the culture of the local population, the capacity of local health care system to address a potential increase in communicable diseases, and the access that affected populations have to these services.

It is important to note that the health effects associated with project workforces are highly dependant on the intermediate impacts that may be generated. For example, an unintended consequence of large workforces in impoverished areas can be population influx – outsiders who travel to, and often settle in, the project area in search of jobs and other income generating opportunities. The side effects of population influx can include pressure on local services, overcrowding, creation of squatter settlements, prostitution, pressure on waste management and sanitation, which in turn can affect health via an increase in the risk of food- and water-borne illnesses, and the spread of sexually transmitted and other communicable diseases.

Note: It is important to separately analyze the effects of project employees versus contractors since the profile, treatment and management of the two workforces tend to be quite different. This creates different conditions for the two workforces, resulting in different risks for the local community. For example, contractors, who are often on short work contracts (a few years), are less likely to be from the local community, have comprehensive health care, or to be recipients of preventative health care and education measures. Thus contractors are more likely to use the local health care system (especially for non-work related conditions), display risky behaviours and present greater risks to their health and the health of local communities.

Project Component: WORKFORCE			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Size of local community within the project's area of influence • Experience among local community with the presence of foreign or outside workers • Socioeconomic conditions among local community (e.g., income, poverty levels) • Existing disease profile among the local population • Presence of sexually transmitted diseases (e.g., HIV/AIDS, Syphilis etc) • Presence of other communicable diseases (e.g., TB) • Availability of information and programs on the prevention of sexually transmitted diseases among the local population • Religious and cultural influence on family structure, and sexual health (e.g., STD prevention and contraceptive use), and presence of existing risky behaviours • Existing capacity of local health care system (including with the support of NGOs and other organizations) to manage current and new STI infections and other communicable diseases and manage the associated long term treatment for these diseases. • Existing health conditions of human receptors most likely to be affected and their ability to adapt to the effects generated 	<ul style="list-style-type: none"> • Direct employees (# of workers, sourcing location, type of contract, years they will work on the project) • Contractors (# of workers, sourcing location, type of contract, years they will work on the project) • Worker employment health and safety screening criteria • Worker health care provided (this usually differs between direct employees and contractors) • Entertainment and leisure activities provided during workers' time-off • Location and type of housing provided to workers (may differ between direct employees and contractors) • Whether worker housing is closed access, open access or hybrid • Worker employment health and safety screening criteria • Worker health care provided (may differ between direct employees and contractors) • Extent to which STI education and cultural sensitivity training is provided to employees and contractors • Presence and enforcement of worker conduct clauses in Code of Conduct • Worker-community sexual interaction and other social or economic interactions • Restrictions against hunting, fishing and use of natural resources by workers 	<ul style="list-style-type: none"> • Population influx • Pressure on existing local services and infrastructure (water, electricity, waste, sanitation, health services) • Increase in the cost of living regionally • Depletion of natural resources important to local communities • Increase in prostitution resulting from the presence of a large number of male workers with disposable income within a socioeconomically depressed area • Sexual interaction between workers and community members • Increase in the demand for and use of alcohol and/or drugs 	<ul style="list-style-type: none"> • Spread of sexually transmitted diseases • Unwanted pregnancies • Spread of communicable diseases • Pressure on existing health infrastructure / services, affecting the level of care available for local communities • Increase in alcohol and/or drug use/abuse • Decrease in safety of local community • Mental stress/impact to overall quality of life

4. LABOUR AND PROCUREMENT

The creation of labour and procurement opportunities can result in significant health benefits for local communities. However, factors such as the level of education and skills of local community members and the project's willingness and commitment to ensure local content (e.g., provide training) greatly influence the realization of benefits generated by this project aspect. Those least likely to benefit from job provision are women, the uneducated/illiterate, untrained youth, the elderly, and those with pre-existing debilitating health problems. The issue of substance abuse is often closely linked with RD-project related jobs and income, but the direction of effect may be complex. Alcohol and substance abuse may be linked with hopelessness and despair, and may be high in communities with high unemployment rates. Increasing prosperity in these cases may improve conditions. However, substance abuse often increases among those who suddenly have relatively high amounts of disposable income from RD jobs. Workers from outside may also import alcohol, drugs or a "party culture" into a community.

Note: The long-term positive benefits to health from employment and procurement opportunities highly depend on the length of the work opportunity and the nature of the contract (wage, benefits etc). While short-term work contracts are likely to lead to short-term economic benefits for a local worker and his/her family, its unlikely that short-term work will lead to significant improvement in overall quality of life and health status.

Project Component: LABOUR AND PROCUREMENT

Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Existing level of education, skills, work experience among the local population • Language(s) spoken by the general population • Willingness among local population to relocate for work opportunities • Any national/local government requirement for local hiring as part of the project 	<ul style="list-style-type: none"> • Number of employees and contractors hired AND the length and nature of their contract • Level of skills and experience required for employment • Project willingness to source labour and goods locally (e.g., commitment to source a certain percentage of jobs locally) • Project's willingness to provide training to local communities to help them meet basic hiring requirements 	<ul style="list-style-type: none"> • Increase in income and purchasing power of community members working on the project • Higher level of local spending, leading to an infusion of cash into the local economy • Increase in skills of local workers and therefore their future employability <p><u>Potential negative effects</u></p> <ul style="list-style-type: none"> • Effect to family structure if worker must move away for employment purposes, particularly following initial period of local employment 	<ul style="list-style-type: none"> • Dietary changes – Increase in quantity and diversity of food consumed • Increase in access to services <ul style="list-style-type: none"> ○ Health care ○ Education ○ Infrastructure and Services • Lifestyle changes <i>Highly dependant on type of work, length of contract, location of employment, wage, etc.</i> <ul style="list-style-type: none"> ○ Weakening of intra-family relationships ○ Substance abuse, domestic violence, etc. ○ Improved living conditions

5. TAXES / ROYALTIES

Taxes and royalties paid by the project to the government of the host country can represent a significant transfer over the life of a project. The extent to which taxes and royalties benefit local communities and the regional population around the project highly depends on how the national, regional and local government reinvest and use the funds.

Project Component: TAXES / ROYALTIES			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • % of taxes and royalties that are reinvested in the region where the project is built • Whether government reinvests taxes/royalties for the public good (e.g., infrastructure, services, education, training etc) in the locality of the project • Capacity and will of local governance structure 	<ul style="list-style-type: none"> • Taxes and royalties paid to the host government 	<ul style="list-style-type: none"> • Investment in local infrastructure and services • Investment to develop and or support other public goods <p><i>Highly dependant 1) on whether taxes and royalties trickle down to region where project is built and specifically how the funds are reinvested, 2) level of corruption</i></p>	<ul style="list-style-type: none"> • Increase in availability of and access to services <ul style="list-style-type: none"> ○ Health care ○ Education ○ Infrastructure and Services • Improvement in overall quality of life • Lifestyle changes <p><i>Highly dependant on whether taxes and royalties trickle down to region where project is built and specifically how the funds are reinvested</i></p>

6. RESOURCE USE

RD projects require a variety of resources, most frequently water and energy. Water in particular is a contentious issue, as the project's use of water can compete with or affect community use of water for personal necessities, recreation, or livelihoods. When assessing potential health effects from the project's use of water, it is important to have a thorough understanding of where and how communities access water (e.g., shallow ground water wells) in order to conduct appropriate assessment and modelling that will help determine if water sources could be affected. Other potential ways that the project could impact water sources include: blocking access or making it more difficult for communities to access water sites (e.g., train tracks constructed between community and their water source, or inadvertently blocking water well with project boundary, etc). Conversely, projects may build water and/or electrical infrastructure that also bring benefits to the local community. If this is the case then the potential intermediate and long-term benefits must be considered.

Project Component: RESOURCE USE			
Influencing Factors		Intermediate Risks/Outcomes (<i>Socio-Economic and Environmental</i>)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Source of water (ground water, surface water) used by communities • Existing water quality and quantity • Current uses of water (recreation, livelihoods, etc.) • Main source of energy and uses • Existing health conditions of human receptors most likely to be affected and their ability to adapt to the effects generated 	<ul style="list-style-type: none"> • Source of water for project and quantity used relative to availability • Energy needs of the project • Whether project will build infrastructure to bring water and/or energy to the project and whether it will allow and facilitate the surplus to be accessed by local communities 	<ul style="list-style-type: none"> • Decrease in the availability of water for local communities either due to: <ul style="list-style-type: none"> ○ Effect to ground water wells ○ Surface water • Decrease in water quality and/or in access to water • Decrease or increase in the availability of energy sources/ for local communities • Cost of water/energy to community 	<p>Decrease or increase in quality of life due to</p> <ul style="list-style-type: none"> • Decrease or increase in access to clean, safe water • Decrease or increase in access to energy sources • Health changes related to change in livelihoods • Dietary changes • Mental stress due to perceptions of water contamination or suitability

7. WASTE

RD projects inevitably result in waste production, the size of which is highly dependent on the project type and relative scale. Project waste and effluents can represent a significant challenge depending on the level of waste generated, the management of the waste and the capacity of local infrastructure and services to absorb and treat the additional quantities. When assessing the impacts of waste it is important to assess the local/regional capacity to manage project-specific waste/effluents in order to understand what human impact the waste may generate once it is transported out of the project zone. The risks to public health range from affecting the level of waste and sanitation services received by local communities to—in more severe cases—contamination of surface and/ or ground water and soil and an increase in food and water-borne disease.

Note: Special attention to project waste management is required in contexts where there is no formal waste management system resulting in the indiscriminate dumping in open-land fills. Not only could project waste contribute to the existing likelihood that waste is contaminating water and affecting the physical and biological environment, but it could present direct health risks to any locals who either live in or near the land-fill or who rummage the area in search of articles to use/sell.

Project Component: WASTE (SOLID, EFFLUENTS, ETC.)			
Influencing Factors		Intermediate Risks/Outcomes (<i>Socio-Economic and Environmental</i>)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Regional capacity to receive and safely manage waste generated by project and worker camps • Whether human receptors either live in or frequent local landfills • Existing health conditions of human receptors most likely to be affected and their ability to adapt to the effects generated • Endemic diseases 	<ul style="list-style-type: none"> • Type and quantity of waste generated • Waste management plans implemented by project (including whether project will be responsible for the containment and management of its own waste or whether it will depend on the local system) 	<ul style="list-style-type: none"> • Dumping of waste in local landfills • Contamination of local water sources and soil due to sewage/waste • Contamination of surface and or ground water, or soil leading to: <ul style="list-style-type: none"> ○ Human contact and/or consumption of traces of waste generated ○ Physical and biological environmental degradation 	<ul style="list-style-type: none"> • Spread of: <ul style="list-style-type: none"> ○ Food and water-borne diseases ○ Zoonotic diseases • Decrease in quality of life

8. FUGITIVE DUST AND AIR EMISSIONS

Dust is usually associated with construction activities and traffic on unpaved roads. Other air emissions may arise from machinery used in construction or operations of the project, or from venting, flaring or fugitive leaks that occur during operation of the project facilities. Substances of concern include: particulate matter; benzene, diesel fuel and polycyclic aromatic hydrocarbons (PAHs); CO₂; nitrous oxides; sulfur oxides; volatile organic compounds (VOCs); methane; hydrogen sulphide; and carbon monoxide. The assessment of respiratory inhalation of air emissions is often done as part of a human health risk assessment in an EIA. In these assessments, it is important to keep in mind that different segments of the population have different vulnerabilities to respiratory challenges. In addition, air emissions can have other health effects, including irritation and stress (from real or perceived risk); and health effects arising from changes to subsistence activities affected by deposition of air emissions or dust (for example, dust covering grown or harvested food or changes to fish populations).

Project Component: FUGITIVE DUST AND AIR EMISSIONS			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Direction of prevailing winds relative to source of emission and human receptors • Proximity of human receptors to source of dust/emissions • Existing health conditions (e.g., respiratory health) of human receptors most likely to be affected and their ability to adapt to the effects generated • Existing local access to health care services 	<ul style="list-style-type: none"> • Project's ability to keep emissions and dust generated by project below internationally recognized limits to protect human health • PM2.5 and PM10 • Emissions (VOCs, CO₂ etc) • Emissions and dust management plans put in place by the project 	<ul style="list-style-type: none"> • Dust • Emissions • Perceived risk to health from project emissions on behalf of communities • Changes to subsistence food sources 	<ul style="list-style-type: none"> • Nuisance due to dust and odours • Respiratory effects - ranging from acute effects (e.g., headaches, eye and lung irritation) to chronic effects (damage to respiratory system, cancer) • Dietary changes • Mental stress <p><i>Highly dependant on level of emissions, communities' existing state of health and their ability to access care.</i></p>

9. CHEMICALS AND HAZARDOUS MATERIALS

This section examines the use, transportation (loading and offloading), storage and disposal of chemicals and hazardous materials. As with dust and air emissions, the potential for human contact with and subsequent disease development from hazardous chemicals is often examined through a Human Health Risk Assessment (HHRA) performed as part of an Environmental Impact Assessment. For a thorough HIA, however, it is necessary to ensure that all potential routes of chemical and hazardous material exposure are fully captured. An adequate HHRA performed either within the HIA or separately should be sure to examine: potential worker exposure (relevant especially for community-based workers), scenarios that involve accidental release or spillage that could lead to very high acute levels of exposure, and also non-sanctioned uses of hazardous materials or containers that previously stored hazardous materials by members of the local community. In addition to the disease consequences of chemical exposure (e.g. cancer or respiratory disease), the HIA should also consider impacts to local health care capacity as well as economic or other consequences.

Project Component: CHEMICALS AND HAZARDOUS MATERIALS (including medical waste- biohazards)			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> Proximity of human receptors to areas where chemicals/hazardous materials are used, stored, transported and/or disposed Regional capacity for safe disposal of hazardous materials/chemicals 	<ul style="list-style-type: none"> Type, concentration and quantity of chemicals/hazardous materials used Plan to contain and dispose of materials Presence of contingency planning for the project Presence of spill prevention management plans Extent to which project communicates risks to local emergency responders and local community and collaborates with them on emergency response and planning (build capacity) 	<ul style="list-style-type: none"> Use of chemical / hazardous material containers by local community Accidental spills contaminating surface and or ground water, or soil leading to: <ul style="list-style-type: none"> Human contact and/or consumption of traces of chemicals and hazardous materials Physical and biological environmental degradation 	<ul style="list-style-type: none"> Ranging from acute cases of poisoning (e.g., nausea, headaches, eye and lung irritation) to chronic poisoning and associated long-term consequences <p><i>Highly dependant on chemical process, hazardous materials used, concentration of release and exposure time</i></p>

10. PROJECT INFRASTRUCTURE AND EQUIPMENT

Project infrastructure and equipment includes structural elements of the project (industrial plants, storage areas, port, project boundary etc), heavy machinery, associated construction activities (land clearing, dredging) and other processes where failure could pose a risk to local communities (loading and offloading, etc). These factors may vary greatly depending on the specific project in question. However, most of them are physically located either within or near the project boundary.

Health effects related to project infrastructure and equipment will depend greatly on the relative location of these activities to human receptors and the likelihood that community members cross into the industrial complex. The latter frequently occurs, for example, when good grazing areas are limited and are located within the project boundary or if the project footprint overlaps with traditional grazing grounds. In economically deprived areas, the RD project may also attract individuals interested in acquiring project materials for resale. Appropriate signage, keeping the project boundary intact and appropriate communication and engagement on safety issues with workers and the local community can be important factors in protecting the health of local community members by distancing them from potentially hazardous conditions.

Health effects in relation to injury will also depend on the overall safety culture of the operating organization.

In areas with endemic diseases such as malaria, yellow fever or other vector-related diseases, special attention should be paid to ensure that still-water environments that create breeding grounds for mosquitoes (and other vectors) are not created by either project construction activities or industrial processes.

Note: Water management ponds, empty containers and areas with poor drainage could all create breeding grounds for mosquitoes. Depending on the local context, this could present a risk ranging from minor nuisance from mosquito bites for workers and the local community to a more severe outcome such as the spread of diseases like malaria and yellow fever. In situations where health services are limited to local communities, these conditions can be fatal.

Project Component: PROJECT INFRASTRUCTURE AND EQUIPMENT			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Proximity of human settlements to industrial site • Likelihood that local settlers will respect boundary of industrial site • Existing local access to emergency response and health care services • Existing health conditions of human receptors most likely to be affected and their ability to adapt to the effects generated • Presence of endemic diseases such as malaria and yellow-fever 	<ul style="list-style-type: none"> • The specific physical infrastructure, equipment and industrial process carried out by the project • Presence and effectiveness of project boundary • Whether H&S education outreach regarding the rules and risks of the industrial complex are communicated broadly (workers and community) • Whether project directly or indirectly through its activities creates still-water environments that could become breeding grounds for mosquitoes • Whether awareness/training and prevention is provided to workers/ contractors to ensure still water environments are not created and to protect workers' health. • Overall safety culture of the organization 	<ul style="list-style-type: none"> • Decreased access to grazing grounds or other common lands and potential loss or injury of animals who cross project boundary • Conflict between the project and the community • Structural failures and accidents • Proliferation of mosquitoes 	<ul style="list-style-type: none"> • Ranging from minor physical injuries to debilitating injury and/or death – highly dependant on specific infrastructure and equipment used for project and whether project and community activities overlap • Mental stress (from new safety risk or potential effect to livelihoods) • Spread of malaria or yellow fever

11. PROJECT SECURITY

The presence and conduct of project security can affect the livelihoods of local communities living in the project's area of influence. The likelihood that communities' livelihoods and quality of life could be affected highly depends on past and current conduct of the security staff (e.g., whether staff has been implicated in past human rights abuses etc), the rules of conduct for security staff outlined by the project and the mitigation measures put in place to monitor and ensure that staff is securing the project infrastructure in a way that does not violate the rights of the local community and/or compromise their safety. Special attention should be paid in contexts where a third-party security force (e.g., government security) is required to protect project infrastructure, as the conduct of a third-party security force is more difficult to monitor and manage, presenting unique risks to the livelihoods of local communities.

Note: The degree of conflict and/or security risk present in the project area will influence the degree of security required for the resource development project. Areas of high conflict will likely require the use of heavy security in order to protect the project infrastructure and staff and are likely to see a higher level of force/aggression by security personnel leading to a heightened level of risk to the livelihoods and safety of local communities.

Project Component: PROJECT SECURITY			
Influencing Factors		Intermediate Risks/Outcomes (Socio-Economic and Environmental)	Potential Health Effects*
Contextual Factors	Project Factors		
<ul style="list-style-type: none"> • Proximity of human settlements to industrial complex and project infrastructure • Traditional land-use in and around industrial complex and project infrastructure • The extent to which local settlers' livelihoods depend on activities in and around the project site (e.g., grazing animals, gathering resources, fishing, farming, etc) and whether alternative areas for them to carry out these activities exist • Likelihood that local settlers will respect project boundaries • Socioeconomic conditions among local community (e.g., income, poverty levels) • Degree to which area is/ or has in the past been a conflict zone, or area of existing local conflict • Likelihood that members of the local community via organized groups or other are involved in illicit activities that may pose a threat to the project (e.g., involvement in illicit drug trade, etc) 	<ul style="list-style-type: none"> • Type and effectiveness of physical border separating industrial site • Assessment of risk posed to project based on the local/regional context • Type of security personnel hired by the project • Whether government security personnel are also providing security to project • Whether human rights and cultural sensitivity training is provided to security personnel (both company and government) and reinforced by project • Clauses in Code of Conduct regarding appropriate behaviour for security personnel 	<ul style="list-style-type: none"> • Conflict between project security and local settlers • Growing resentment of local community towards the project • Economic displacement leading to potential: <ul style="list-style-type: none"> ○ partial and/or total loss of income and/or sustenance ○ disruption to local practices/ways of living • Risk of excessive force by project security towards local community 	<ul style="list-style-type: none"> • Mental stress • Effect to overall quality of life of local community • Deterioration of living conditions and increase in poverty • Decrease in safety of local community <p><i>Effects are highly variable depending on the level of conflict risk in the area and whether the presence of project security alleviates some of that risk or actually heightens the level of conflict /risk.</i></p>

THINGS TO KEEP IN MIND WHEN ASSESSING HEALTH EFFECTS

- The Health Effects Assessment Tool presents many possible effects that could be generated by RD projects – that is, the tables reflect a worst-case (or best-case) scenario of the effects that could be generated by an RD project. Therefore, practitioners should use this framework only as a guide and should exercise discretion and professional judgement to ensure that they have appropriately scoped the health effects and causal pathways relevant to the specific RD project and the context within which it is located.
- Health effects from resource development projects are highly dependent on how the project is implemented and what management measures are put in place to mitigate potential effects. Thus we want to emphasize the importance of thoroughly exploring mitigation and management measures when conducting impact assessments. A common mistake in HIA is to invest too much time and effort up-front in the identification of impacts and not enough on developing mitigation measures and management plans to address the effects. If the goal of an HIA or other impact assessment is to prevent or manage negative effects (and enhance benefits) then it is necessary that the assessment focus on tangible mitigation and management measures for the project to implement. This emphasis on mitigations/management measures is also the reason why this Health Effects Assessment Tool groups impacts by project component. Grouping impacts in this manner facilitates the process of identifying management measures for each project component.
- Stakeholder engagement is a fundamental process within any impact assessment not only to ensure that all impacts are appropriately scoped and viable mitigations are identified, but also to ensure that the impact assessment focuses on addressing the interests/concerns of the people most likely to be affected by the RD project. Furthermore, stakeholder engagement can generate many side benefits such as better communication and long-term relationships between the project and local communities which can be to the benefit of both parties.

PUBLISHED EVIDENCE ON THE LINKS BETWEEN RD PROJECTS AND HEALTH

This section provides the reader with references to primary research, systematic reviews, meta-analyses and other materials that support the links between resource development projects and health determinants or health outcomes.

The references are organized into four sections:

- Industry-Specific Evidence (evidence for links between specific project types--such as mining or oil & gas--and health)
- Effects of the Biophysical Environment on Health
- Effects of the Socio-Economic Environment on Health
- Factors Associated with Specific Disease Outcomes

Each reference has been selected because it provides valuable information that documents the existence of the link, provides evidence to quantify or characterize the link, or suggests evidence-based mitigation strategies. Not all references will be relevant for all RD projects, and the reader is urged to select from among them as appropriate.

It should also be noted that this list is not exhaustive, and that new information is continually becoming available. The reader should therefore consider additional resources beyond those presented below to complete the HIA.

Readers are also urged to contact the authors with suggestions for additional resources for inclusion in future versions of this report.

Industry-Specific Evidence

Oil and Gas

- Balint, J., Boelens, P., & Debello, M. (2003). *Health Impact Assessment: SEIC Phase 2, Development: Sakhalin Energy Investment Company*. Available at: <http://www.who.int/hia/examples/energy/whohia062/en/index.html>.
- Bush, K., & Medd, L. M. (2007). *Population Health and Oil and Gas Activities: A Preliminary Assessment of the Situation in North Eastern BC*. Board of Northern Health. Available at: http://www.northernhealth.ca/about/nh_reports/documents/OilandGasreport.pdf.
- Environmental Health Assessment Services, Health Canada (2004). *Canadian Handbook on Health Impact Assessment, Volume 4: Health Impacts by Industry Sector*. Ottawa: Health Canada. Available from <http://www.apho.org.uk/resource/item.aspx?RID=47704>.
- Goodland, R., editor (2005). *Oil and Gas Pipelines: Social and Environmental Impact Assessment - State of the Art*. Virginia: International Association of Impact Assessment. Available at: <http://www.amazonia.org.br/arquivos/166360.pdf>.
- Jobin, W. (2003). Health and equity impacts of a large oil project in Africa. *Bull World Health Organ*, 81(6): 420-426.
- Krieger, G., & Balge, M. (2005). *A Guide to Health Impact Assessments in the oil and gas industry*. London: International Petroleum Industry Environmental Conservation Association and International Association of Oil & Gas Producers. Available at <http://www.ipieca.org/activities/health/downloads/publications/hia.pdf>.
- Leonard, L. (2003). Possible illnesses: assessing the health impacts of the Chad Pipeline Project. *Bull World Health Organ*, 81(6): 427-433.
- Singer, B., Bell, E., Choi, H., Nguyen, C., Nouri, A., Reddy, R., et al. (2004). Big Oil and Health: Lessons from the Chad-Cameroon Pipeline Project. Princeton University, Woodrow Wilson School of Public Health and International Affairs. Available at: http://www.princeton.edu/research/final_reports/www591b_f03.pdf
- Utzinger, J., Wyss, K., Moto, D. D., Yémadji, N. D., Tanner, M., & Singer, B. H. (2005). Assessing health

impacts of the Chad–Cameroon petroleum development and pipeline project: challenges and a way forward. *Environmental Impact Assessment Review*, 25(1): 63-93.

- Wernham, A. (2007). Inupiat Health and Proposed Alaskan Oil Development: Results of the First Integrated Health Impact Assessment/Environmental Impact Statement for Proposed Oil Development on Alaska's North Slope. *EcoHealth*, 4(4): 500-513

Mining

- Boyle, S. (2000). Resource Development and Health in Papua New Guinean Ok Tedi Mines. *Journal of Rural and Tropical Public Health*, 50-54. Available at: http://www.tropmed.org/rreh/vol1_8.htm.
- Environmental Health Assessment Services, Health Canada (2004). *Canadian Handbook on Health Impact Assessment, Volume 4: Health Impacts by Industry Sector*. Ottawa: Health Canada. Available from <http://www.apho.org.uk/resource/item.aspx?RID=47704>.
- Government of the Northwest Territories. (2008). Communities and Diamonds: Socio-economic Impacts in the Communities of Behchokö, Gamèti, Whati, Wekweèti, Detah, N'dilo, Áutselk'e, and Yellowknife. . 2007 Annual Report of the Government of the Northwest Territories Under the BHP Billiton, Diavik and De Beers Socio-economic Agreements. Available at: <http://www.iti.gov.nt.ca/publications/#miningoilgas>.
- Lockiea, S., Franettovichb, M., Petkova-Timmerb, V., Rolfec, J., and Ivanovad, G. (2009) Coal mining and the resource community cycle: A longitudinal assessment of the social impacts of the Coppabella coal mine. *Environmental Impact Assessment Review*. 29(5): 330-339.
- Noble, B. F., & Bronson, J. E. (2005). Integrating Human Health into Environmental Impact Assessment: Case Studies of Canada's Northern Mining Resource Sector. *Arctic*, 58(4): 395-405.
- Stephens, C., & Ahern, M. (2001) *Worker and Community Health Impacts Related to Mining Operations Internationally: A Rapid Review of the Literature*. London, Mining and Minerals for Sustainable Development Project. Available at: www.iied.org/pubs/pdfs/G01051.pdf.

Dams

- Braun, Y.A. (2005). Selling the River: Gendered Experiences of Resource Extraction and Development in Lesotho, *Research in Rural Sociology and Development*. 10: 373-396.
- Environmental Health Assessment Services, Health Canada (2004). *Canadian Handbook on Health Impact Assessment, Volume 4: Health Impacts by Industry Sector*. Ottawa: Health Canada. Available from <http://www.apho.org.uk/resource/item.aspx?RID=47704>.
- Lerer, L. B., & Scudder, T. (1999). Health impacts of large dams. *Environmental Impact Assessment Review*, 19(2): 113-123.
- Nam Theun 2 Project - Social Development Plan, Chapter 5 - *Health Impact Assessment and Public Action Plan*. 1(5). (2005). Available at: <http://www.namtheun2.com/images/stories/SDP/Volume1/Chapter 5 Health Resettler Regional cf.pdf>.
- Parent, G., Ouedraogo, A., Zagre, N. M., Compaore, I., Kambire, R., & Poda, J. N. (1997). Large dams, health and nutrition in Africa: beyond the controversy. *Sante*, 7(6): 417-422.
- Tetteh, I. K., Frempong, E., & Awuah, E. (2004). An analysis of the environmental health impact of the Barekese Dam in Kumasi, Ghana. *J Environ Management*, 72(3): 189-194.
- World Health Organization, Sustainable Development and Healthy Environments. (1999). *Human Health and Dams: The World Health Organization's submission to the World Commission on Dams (WCD)*. Protection of the Human Environment: Water, Sanitation and Health Series. Available at: <http://www.who.int/hia/examples/energy/whohia052/en/index.html>

Wind Energy

- Ison, E. (2009). *Rapid Review of Health Impacts of Wind Energy*. Available at: www.apho.org.uk/resource/view.aspx?RID=83200.
- Pedersen, E., & Persson Waye, K. (2007). Wind turbine noise, annoyance and self-reported health and well-being in different living environments. *Occup Environ Med*, 64(7): 480-486.
- Pedersen, E., van den Berg, F., Bakker, R., & Bouma, J. (2009). Response to noise from modern wind farms in The Netherlands. *J Acoust Soc Am*, 126(2): 634-643.

Multiple Project Types

- Birley, M. H. (1995). *The Health Impact Assessment of Development Projects*. London: Her Majesty's Stationary Office. Available at: <http://www.birleyhia.co.uk/publications.htm>.
- Birley, M. H., & Lock, K. (1998). Health and peri-urban natural resource production. *Environment And Urbanization*, 10(1): 89-106
- Bouvier de Candia, AL. (2007). Canadian Natural Resources Large-Scale Projects: Social, Cultural and Economic Impacts. Annotated Bibliography of Post-Project Studies. Environmental Health Assessment Services, Health Canada. Available at: http://sdeir1.uqac.ca/document_030096195.html#doc.
- Environmental Health Assessment Services, Health Canada (2004). *Canadian Handbook on Health Impact Assessment, Volume 4: Health Impacts by Industry Sector*. Ottawa: Health Canada. Available from <http://www.apho.org.uk/resource/item.aspx?RID=47704>.
- Hassan, A., Birley, M., Giroult, E., Zghondi, R., Khan, M., & Bos, R. (2005). Environmental health impact assessment of development projects: a practical guide for the WHO Eastern Mediterranean Region. Cairo, Egypt: World Health Organization. Available at: http://www.who.int/water_sanitation_health/resources/emroehiabook.pdf
- Mercier, J.R. (2003). Health impact assessment in international development assistance: the World Bank experience. *Bull World Health Organ*, 81(6): 2.
- Summers, Gene F. and Arne Selvik (1982). *Energy Resource Communities*. Madison, Wisconsin: MJM Publishing Co.
- University of Alberta (2008, March 13). Five Factors Of Social Ills In Energy, Mining And Logging Communities. *ScienceDaily*. Retrieved from <http://www.sciencedaily.com/releases/2008/03/080313124412.htm>.

Effects of the Biophysical Environment on Health

Please note that there is a large and well-developed body of knowledge and methodology to link environmental changes with human health outcomes. The reader is strongly advised to consult with a specialist in Human Health Risk Assessment (HHRA) when conducting a health impact assessment on a resource development project. The references below are intended to supplement the HIA with characteristics of the environment not normally considered in an HHRA.

Link between road building and health outcomes

- Egan, M., Petticrew, M., & Hamilton, V. (2001). *Assessing the Health Impact of Road Building* (August 2001). ESRC Centre for Evidence Based Public Health Policy, Social and Public Health Sciences Unit, University of Glasgow.
- Egan, M., Petticrew, M., Ogilvie, D., & Hamilton, V. (2003). New Roads and Human Health: A Systematic Review, *American Journal of Public Health* 93: 1463-1471.

Link between noise and health outcomes

- Babisch, W. (2005). Noise and health. *Environmental Health Perspectives*, 113(1): A14-A15.
- Berglund, B., Lindvall, T., & Schwela, D. H. (1999). *Guidelines for Community Noise*. World Health Organization. Available at: <http://whqlibdoc.who.int/hq/1999/a68672.pdf>.
- Shield, B. M., & Dockrell, J. E. (2003). The Effects of Noise on Children at School: A Review. *Journal of Building Acoustics*, 10(2): 97-106.
- Stansfeld, S. A., & Matheson, M. P. (2003). Noise pollution: non-auditory effects on health. *Br Med Bull*, 68: 243-257.

Link between environmental contaminants and health outcomes

- de Hollander, A.E.M. *A framework for assessing the significance of health impacts of environmental exposures: Deaths, DALYs or Dollars?*, University of Utrecht Institute for Risk Assessment Sciences. Available at: igitur-archive.library.uu.nl/dissertations/2004-0511-152200/full.pdf
- Van Oostdam, J., Donaldson, S. G., Feeley, M., Arnold, D., Ayotte, P., Bondy, G., et al. (2005). Human health implications of environmental contaminants in Arctic Canada: a review. *Sci Total Environ*, 351-352: 165-246.

Links between environmental change and health outcomes

- Commers, M. J., Gottlieb, N., & Kok, G. (2007). How to change environmental conditions for health. *Health Promotion International*, 22(1): 80.
- Health Scotland, Greenspace Scotland, Scottish National Heritage & Institute of National Medicine (2008). *Health Impact Assessment of Greenspace: A Guide*. Greenspace Scotland: Stirling, Scotland. Available at: <http://www.greenspacescotland.org.uk/default.asp?page=475>.
- Mouchet, J., & Carnevale, P. (1997). Impact of changes in the environment on vector-transmitted diseases. *Sante*, 7(4): 263-269.

Link between deforestation and vector-borne disease

- Walsh, J. F., Molyneux, D. H., & Birley, M. H. (1993). Deforestation: effects on vector-borne disease. *Parasitology*, 106(Suppl): S55-75.

Links between resource development and subsistence food sources

- Kuhnlein, H. V., & Chan, H. M. (2000). Environment and contaminants in traditional food systems of northern indigenous peoples. *Annu Rev Nutr*, 20: 595-626.
- Milburn, M. P. (2004). Indigenous Nutrition: Using Traditional Food Knowledge to Solve Contemporary Health Problems. *American Indian Quarterly*, 28(3 & 4): 411-434.
- Nelson, M., Natcher, D. C., & Hickey, C. G. (2005). Social and economic barriers to subsistence harvesting in a northern Alberta aboriginal community. *Anthropologica (Ottawa)*, 47(2): 289-301.

Effects of the Socio-Economic Environment on Health

Link between imported workforce and sexually transmitted infections

- Goldenberg, S. M., Shoveller, J. A., Ostry, A. C., & Koehoorn, M. (2008). Sexually transmitted infection (STI) testing among young oil and gas workers: the need for innovative, place-based approaches to STI control. *Can J Public Health*, 99(4): 350-354.
- Goldenberg, S., Shoveller, J., Koehoorn, M., & Ostry, A. (2007). *Sexual Behaviour and Sexually Transmitted Infection (STI) Prevention among Youth in Northeastern BC*. Vancouver: Vancouver Foundation. Available at: <http://sexualhealth.ubc.ca/Research/Publications.aspx>.
- Goldenberg, S., Shoveller, J., Ostry, A., & Koehoorn, M. (2008). Youth sexual behaviour in a boomtown: implications for the control of sexually transmitted infections. *Sex Transm Infect*, 84(3): 220-223.
- Ndhlovu, L., Searle, C., van Dam, J., Mzaidume, Y., Rasego, B., & Moema, S. (2005). *Reducing the transmission of HIV and sexually transmitted infections in a mining community: Findings from the Carletonville: Mothusimpilo intervention project: 1998 to 2001. Horizons Final Report*. Washington DC: The Population Council, Inc. Available at: www.popcouncil.org/pdfs/horizons/crtnvll.pdf.

Link between RD employment income and alcohol misuse

- Dunn, C. (2007). Health Canada Report on Income Increase and Alcohol Abuse. Health Canada. Available at: http://www.ngps.nt.ca/Uploads/Intervenors/HealthCanada/070622_HC_rep_income-alcohol-abuse.pdf.

Link between resource development and poverty

- Aaron, K. K. (2005). Perspective: big oil, rural poverty, and environmental degradation in the Niger Delta region of Nigeria. *J Agric Saf Health*, 11(2): 127-134.
- Pegg, S. Mining and poverty reduction: Transforming rhetoric into reality (2006). *Journal of Cleaner Production*. 14(3-4): 376-387.

Link between resource development and equity

- Jobin, W. (2003). Health and equity impacts of a large oil project in Africa. *Bull World Health Organ*, 81(6): 420-426.

Link between equity and health outcomes

- Commission on Social Determinants of Health. (2008). *Closing the Gap in a Generation: Healthy Equity Through Action on the Social Determinants of Health. Final Report of the Commission on Social Determinants of Health*. Geneva, World Health Organization, 256. Available at: www.who.int/social_determinants/final_report/en/.
- Starfield, B. (2007). Pathways of influence on equity in health. *Soc Sci Med*, 64(7): 1355-1362.

Link between resource development and crime

- Covey, H.C. (1983). Crime in the Region of Colorado Affected By Energy Resource Development. *Journal of Research in Crime and Delinquency*, 20(1): 110-125.

- Luthra, A. D. (2006). *The Relationship of Crime and Oil Development in the Coastal Regions of Louisiana*. A dissertation submitted for partial fulfillment of PhD at Louisiana State University and Agricultural and Mechanical College. Available at: <http://en.scientificcommons.org/12989931>.

Link between energy projects and boom and bust cycles

- Ministry of Municipal and Community Affairs, Government of the Northwest Territories (2005). *Northern Communities: Boom, Bust and the Role Of Infrastructure (Workshop Report)*. Research and Analysis Division, Infrastructure Canada. Available at: <http://www.infc.gc.ca/research-recherche/results-resultats/wr-at/maca-mamc/nc-cn-eng.html>.
- Research and Analysis Division, I. C. (2005). *Planning for a Soft Landing: Non-Renewable Resource Development And Community Infrastructure In The Northwest Territories*. Infrastructure Canada. Available at: <http://www.infc.gc.ca/altformats/pdf/rs-rr-2006-02-eng.pdf>.
- Rodrigues, A. S., Ewers, R. M., Parry, L., Souza, C., Jr., Verissimo, A., & Balmford, A. (2009). Boom-and-bust development patterns across the Amazon deforestation frontier. *Science*, 324(5933): 1435-1437.

Link between boom and bust cycles and social/health outcomes

- Cortese, C. F., & Cortese, J. A. (1978). *The Social Effects of Energy Boomtowns in the West: A Partially Annotated Bibliography*. Council of Planning Librarians, Exchange bibliography #1557.
- Seydlitz, R., & Laska, S.B. (1994). *Social and economic impacts of petroleum 'boom and bust' cycles*. U.S. Department of Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. Available at: www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3441.pdf.

Link between resource development and local economic conditions

- Halstead, J.M. and Liestritz, F.L. (1983). *Impacts of Energy Development on Secondary Labour Markets: A Study of Seven Western Counties*. Department of Agricultural Economics. Agricultural Experiment Station North Dakota State University. Available at: <http://ideas.repec.org/p/ags/nddaer/23260.html>.

Links between employment and health outcomes

- Doyle, C., Kavanagh, P., Metcalfe, O., & Lavin, T. (2005). *Health Impacts of Employment: A Review*. Dublin: The Institute of Public Health in Ireland. Available at: <http://www.publichealth.ie/publications/healthimpactsofemploymentareview>.

Link between resource development and health systems structures

- Calain, P. (2008). Oil for health in sub-Saharan Africa: health systems in a 'resource curse' environment. *Global Health*, 4: 10.
- Utzinger, J., Wyss, K., Moto, D. D., Tanner, M., & Singer, B. H. (2004). Community health outreach program of the Chad-Cameroon petroleum development and pipeline project. *Clin Occup Environ Med*, 4(1): 9-26.

Link between housing and health outcomes

- Brealey, T.B and Neil, C.C. (1988). *Resource Communities: Settlement and Workforce Issues*. Editor: P. W. Newton. SCIRO Publishing.
- Bonnefoy, X., Annesi-Maesano, I., Aznar, L. M., Braubach, M., Croxford, B., Davidson, M., et al. (2004). *Review of evidence on housing and health*. Paper presented at the Background document to the Fourth Ministerial Conference on Environment and Health, Budapest, Hungary, June 23-25, 2004. Available at:

www.euro.who.int/Document/HOH/ebackdoc01.pdf.

- Moloughney, B. (2004). *Housing and Population Health--the State of Current Research Knowledge*. Ottawa: Canadian Population Health Initiative - Canadian Institute for Health Information. Available at: http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=PG_284_E&cw_topic=284&cw_rel=AR_1129_E.
- Rauh, V. A., Landrigan, P. J., & Claudio, L. (2008). Housing and health: intersection of poverty and environmental exposures. *Ann N Y Acad Sci*, 1136: 276-288.
- Taske, N., Taylor, L., Mulvihill, C., Doyle, N., Goodrich, J., & Killoran, A. (2005). *Housing and public health: a review of reviews of interventions for improving health: Evidence briefing summary* (1st edition). National Institute for Health and Clinical Excellence. Available at: http://www.nice.org.uk/niceMedia/docs/housing_summary_word.doc.
- Thomson, H., Petticrew, M., & Morrison, D. (2001). Health effects of housing improvement: systematic review of intervention studies. *BMJ*, 323(7306): 187-190.

Factors Associated with Specific Disease Outcomes

Link between resource communities and mental health

- Bacigalupi, L. M., & Freudenberg, W. R. (1983). Increased mental health caseloads in an energy boomtown. *Administration and Policy in Mental Health*, 10(4): 306-322.
- Bougsty, T., Marshall, P., & Chavez, E. (1983). Prevalence and prevention of mental health problems in an energy-affected community. *Administration and Policy in Mental Health*, 10(4): 272-287.
- Neil, C. C., & Jones, J. A. (1988). Environmental Stressors and Mental Health in Remote Resource Boom Communities. *Journal of Sociology*, 24(3): 437.
- Park, J., & Nelson, C. H. (1998). The investigation of stress in resource-dependent communities: the effect of rapid socioeconomic changes on mental health service use. *Int J Circumpolar Health*, 57(Suppl 1): 432-438.

Link between water resource development and infectious disease

- Erlanger, T.E., Keiser, J., Caldas de Castro, M., Bos, R., Singer, B.H., Tanner, M. and Utzinger, J. (2005) Effect of water resource development and management on lymphatic filariasis, and estimates of populations at risk. *Am J Trop Med Hyg*. 73: 523-533.
- Ghebreyesus, T.A., Haile, M., Witten, K.H., Getachew, A., Yohannes, A.M., Yoahannes, M., Teklehaimanot, H.D., Lindsay, S.W. and Byass, P. (1999) Incidence of malaria among children living near dams in northern Ethiopia: community based incidence survey. *BMJ* 319: 663-666.
- Health Impact Assessment (HIA) of Development Projects with Reference to Mosquito-borne Diseases, 2nd edition. (2009). Chapter in: *A Profile of the National Institute of Malaria Research*. Delhi: Indian Council of Medical Research.
- Keiser, J., Caldas de Castro, M., Maltese, M., Bos, R., Tanner, M., Singer, B.H., Utzinger, J. (2005) Effect of irrigation and large dams on the burden of malaria on a global and regional scale. *Am J Trop Med Hyg* 72: 392-406.
- Sharma, S. K., Tyagi, P. K., Upadhyay, A. K., Haque, M. A., Adak, T., & Dash, A. P. (2008). Building small dams can decrease malaria: a comparative study from Sundargarh District, Orissa, India. *Acta Trop*, 107(2): 174-178.
- Steinmann, P., Keiser, J., Bos, R., Tanner, M. and Utzinger, J. (2006) Schistosomiasis and water resources

development: systematic review, meta-analysis, and estimates of people at risk. *Lancet Infectious Diseases* 6: 411-425.

- Yewhalaw, D., Legesse, W., Van Bortel, W., Gebre-Selassie, S., Kloos, H., Duchateau, L., et al. (2009). Malaria and water resource development: the case of Gilgel-Gibe hydroelectric dam in Ethiopia. *Malar J*, 8:21.
- Zimmerman, R. H. (2001). Wetlands and infectious diseases. *Cad Saude Publica*, 17(Suppl): 127-131.

Link between resource development and HIV/AIDS

- Golder Associates (2004). HIV/AIDS Guide for the Mining Sector. Completed for the International Finance Corporation. Available at:
[http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/ref_HIVAIDS_section1/\\$FILE/Section+1b.pdf](http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/ref_HIVAIDS_section1/$FILE/Section+1b.pdf).
- Kigotho, A. W. (1997). World Bank oil-pipeline project designed to prevent HIV transmission. *Lancet*, 350(9091): 1608.

Link between resource development and traffic safety

- WorkSafeBC. *Resource Road Safety Practices*. Accessed at:
<http://www2.worksafebc.com/Portals/Petroleum/ResourceRoads.asp?reportID=34972>

Links between resource development and indigenous population health

- Gibson, G., & Klinck, J. (2005). Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health*, 3(1): 115-139.
- Wernham, A. (2007). Inupiat Health and Proposed Alaskan Oil Development: Results of the First Integrated Health Impact Assessment/Environmental Impact Statement for Proposed Oil Development on Alaska's North Slope. *EcoHealth*, 4(4): 500-513.

CONCLUSIONS

This guidance document has provided a framework for HIA practitioners to systematically address the potential health impacts arising from resource development projects. These types of projects are generally large and complex, and there is no one approach or process that can anticipate all or the exact community health effects that will occur, as each context will present new situations, vulnerabilities and thus outcomes. Every situation must therefore be examined individually, and appropriate adjustments made to the HIA approach.

The evidence that links RD project components to changes in health is diverse. For some associations explicit models have been developed (e.g. for respiratory effects associated with air emissions, or for increases in traffic-related injuries and fatalities associated with increased vehicular movement). For many other areas, the evidence is less prescriptive, and provides only a general indication of likelihood and direction of effect. It is the responsibility of the HIA practitioner to use the best evidence available and to ensure that the concerns of all stakeholders are addressed fairly and accurately.

As a last note, in conducting the HIA the role of the local community must not be forgotten. The community will continue to experience the effects of the RD project long after the HIA consultants have packed up and returned home. They should be engaged and involved at every point in the HIA process, from the scoping of health concerns, to the gathering of evidence, through to the development of appropriate mitigation strategies. Their voice should be clearly heard by the HIA practitioners, the project proponents and the regulators who oversee the process.

ABOUT THE AUTHORS

Readers are encouraged to contact the authors with comments or suggestions about this document.

Tania Barron is a senior consultant with ERM's Corporate Social Strategies team. Tania's expertise lies in providing strategic advice and training to private sector clients on managing the social and sustainability risks of their operations. Her areas of focus include leading health and social impact assessments (HIA / SIA) and supporting clients with stakeholder engagement processes. Tania has experience working in a variety of sectors including in oil and gas, mining, manufacturing and agriculture as well as with international development banks such as the World Bank, the IFC and the IDB.

Tania Barron
Environmental Resources Management
Email: Tania.Barron@erm.com
Tel: +1 (202) 255-7965

Marla Orenstein is a founding partner of Habitat Health Impact Consulting, located in Calgary, Canada. From her background as an epidemiologist, she consults on population health issues for business, government and academia, with particular attention to lifestyle and environmental risk factors for chronic disease and injury. Through Habitat, she has worked to develop Health Impact Assessment in North America, through HIA-related projects, teaching and training, and activities focused on growing the field professionally.

Marla Orenstein
Habitat Health Impact Consulting Corp.
Email: marla@habitatcorp.com
Tel: +1 (403) 451-0097

Ame-Lia Tamburrini is a Research Associate with Habitat Health Impact Consulting, and has been involved in a broad range of projects that assess community wellbeing, often among marginalized or disadvantaged populations, including seniors, people in low socio-economic brackets, and underserved communities.

Ame-Lia Tamburrini
Habitat Health Impact Consulting Corp.
Email: ame-lia@habitatcorp.com
Tel: +1 (403) 451-0097