Analysis of the Manitoba – Minnesota Transmission Project Environmental Impact Statement for the Manitoba Clean Environment Commission

Biodiversity, ecosystem services, human health and human well-being in the Manitoba – Minnesota Transmission Project

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Preface

The Manitoba – Minnesota Transmission Project (MMTP) is in the proposal stage of development and in the CEC review stage. We have conducted a review of the MMTP Environmental Impact Statement (EIS) with the intention of informing the Clean Environment Commission (CEC) of Manitoba regarding any potential ecological issues or red flags within the EIS.

As a professional biologist in British Columbia, I have over 15 years of experience conducting environmental assessments (EAs) and related research and monitoring. As the founder of Coldstream Ecology Ltd., I have extensive experience working with First Nation and other Indigenous communities across North America from the high Arctic to the open desert grasslands. I have a broad ecosystem based background, and tend to look at the world with more of a holistic worldview than traditional discipline-specific scientists. I hold a Bachelor's degree in Fisheries and Wildlife Management and a Master's degree in Sustainable Forest Management. I am a Registered Professional Biologist (RPBio) in BC, an Associate Wildlife Biologist in the United States, and a certified Permaculture Designer. I also have extensive experience conducting ecological effectiveness monitoring and participating in an adaptive management framework locally, which conducts annual impact assessments in watersheds dominated by hydroelectric power generation and development.

Ultimately, I am extremely concerned with the rapid degradation of the natural world, which is being witnessed across all biomes. This submission highlights a small but significant number of issues related specifically to the MMTP Environmental Impact Statement; these issues are also generally applicable to the conventional EA processes that guide Manitoba Hydro, provincial and federal assessments. The particular topics of concern that were addressed include:

- the context and overall effectiveness of the MMTP Environmental Impact Assessment process;
- concerns surrounding some of the assumptions regarding the effectiveness of mitigation;
- significant gaps in important information relating to biodiversity, ecosystem services, human health and human well-being; and most importantly,
- a failure to link relevant ecological information to human health and human well-being in current and future contexts.

Some portions of this submission further the ideas, concepts and recommendations presented in my submission to the CEC proceedings in 2013 (Alyson McHugh, The Need to Monitor and Report Ecosystem Service Change for the Keeyask Generation Project).

This report is intended to encourage forward, future thinking regarding hydroelectric development projects and facilitate the implementation of regenerative sustainability practices. In my professional opinion, it is essential to bring integrity back to environmental assessments and employ strategies that will enhance the environment that we all depend on, rather than degrade it. To this end, we engaged in an examination of the relationship that was adopted in the EIS approach, assessment and conclusions and we asked an overarching question: Did the MMTP EIS reinforce healthy relationships between human beings and the environment? The following submission details our examination of that relationship.

1. Examination of the effectiveness of Environmental Assessment processes: Is the EA process failing?

To attempt to answer our question, it is first necessary to examine the integrity of natural systems around us at global, national and local scales. Second, the interactions and interdependencies of social, economic and ecological systems, within the development of projects such as the Manitoba – Minnesota Transmission Project, need to be assessed with the ultimate goal of determining how proposed project and development impacts would contribute to, or degrade the integrity of those interactive systems, and consequently the environment, human health and human well-being. We then extend lessons from these examinations to our review of the MMTP EIS.

The structure and functions of earth's natural systems are rapidly changing from global to local scales. Human development is a major threat to the diversity of life on earth, which is known as biodiversity. As of 2005, two-thirds of all the fresh water flowing into the oceans was obstructed by approximately 800,000 hydropower projects (i.e., more than 45,000 large dams; 750,000 small dams) (Giller 2005, Myers et al 2013). Every hydropower project requires transmission systems, and converter stations like the MMTP. In some areas up to 95% of wetlands have been lost or severely impaired; consequently freshwater species declines are higher than any other biome in the world (Romanelli et al 2015). In the last 17 years alone, humans have deforested more than 2-3 million square kilometers of primary forest (Hansen et al 2013). The 2016 Living Planet Report estimated that the global

populations of vertebrates: birds, fish, mammals, and amphibian and reptiles have cut in half; they've declined by 58% in the last half century and are predicted to decline by 67% by 2020 (WWF 2016).

Consequently, we are witness to and a part of widespread and global ecological degradation of many of the ways nature contributes to our health and well-being. As nature's life support systems decline at an accelerating rate, people, too are increasingly victims of the deteriorating state of nature. Substantial human health effects are now evident, and increasingly the health of not only our generation, but future generations as well, is being compromised. Health effects from changes to the environment are predicted to become widespread within a few decades, and dominant in the second part of this century (Whitmee et al 2015). Humans have been recognized as a powerful force behind the environmental change and a new geological epoch called the Anthropocene (Hamilton 2016) has been recognized. This is the first Era where humans, and their activities arguably dominate global cycles within the natural world. The overall exploitation of natural resources is directly contributing to the declining trends. The top threats to species are directly linked to human activities, including habitat loss, degradation, and overexploitation of wildlife (WWF 2016).

A change in the functioning of the Earth system, as a whole, is evident. As a professional biologist engaged in environmental impact assessment research and adaptive management on a daily basis in Canada, the changes are apparent here at home as well. Unfortunately, this leads me to question if we, as professionals, partly caused this. It forces me to ask myself some very tough questions: How may I have contributed to this? Have the Environmental Assessment (EA) processes in Canada, both at a provincial and federal level possibly contributed to this accelerating decrease in ecosystem function and services? In the end, how effective is the EA process? Bradshaw et al (2010) examined the effectiveness of the EA process around the world. They assessed 228 counties and ranked them by their relative environmental impact. Metrics assessed included natural forest cover loss, habitat conversion, marine captures, fertilizer use, water pollution, carbon emissions and proportion of threatened species. Among the 20 countries in the world with the greatest impact on their environments Canada ranked 12th for overall environmental impact (Figure 1). Canada was also ranked in the top ten counties for environmental impact on individual metrics such as natural habitat conversion, fertilizer use and carbon emissions.

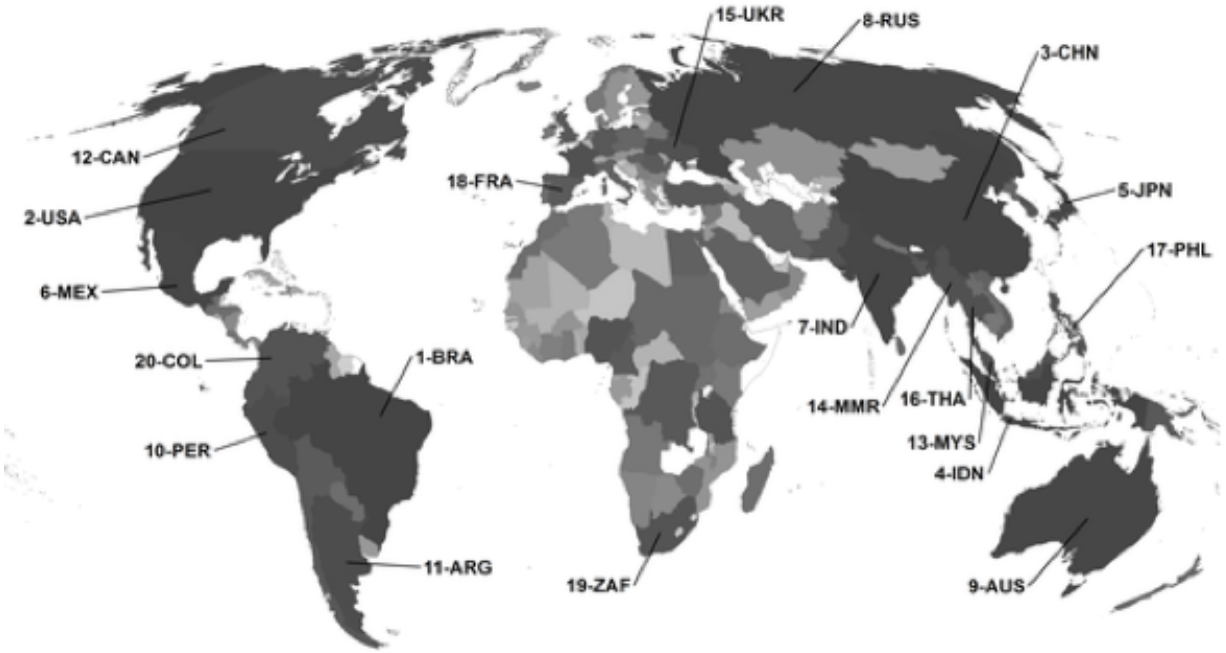

Figure 1. Environmental impact of nations expressed as a combination of their ranks for natural forest lost, habitat conversion, marine captures, fertilizer use, water pollution, carbon emissions, and proportion of threatened species. [Reproduced from Bradshaw and colleagues, 2010 and The Lancet Commission on Planetary Health, Whitmee 2015]

Canada ranks among the worst in the world for environmental impact of nations, giving us some insight into the effectiveness of the EA processes in Canada. Ball et al. (2013) conducted an analysis of 35 Environmental Impact Assessments in the South Saskatchewan River Watershed, reviewing the indicators (including VCs) used in the EIAs. They illustrated that current indicators, in general do not assess the VCs in the correct context. Furthermore, current EIAs do not facilitate scaling up from the project level to a watershed, or cumulative effects assessment. Thus, it cannot be determined that the projects will have no significant adverse environmental effects to the project area or region. Similarly, a study in the United States assessed several case studies in a special issue of Science of the Total Environment. Again, the results of the extensive review revealed the same problem (Schafer, 2012). Current EIA (Environmental Impact Assessment) guidelines do not capture the stress placed on watersheds and rivers (Noble et. al 2011).

It is apparent the process is also failing in BC- as evidenced by work I am engaged in through my business, as well as the general public pushback on several proposed major development projects, such as Site-C Dam and the Transmountain Pipeline. I find myself questioning if we, as professional biologists, are asking the right questions, and if those questions are asked in the correct context. What are we missing? My colleagues and I care about the environment very much, and we work extremely hard to conduct EIAs and facilitate the reduction of environmental impacts. The questions of where, why and how the process is failing are becoming increasingly important in our field. Manitoba currently

follows similar, and in some cases, the exact same environmental assessment processes as the federal government, BC and Saskatchewan. Therefore it is unlikely that the MMTP will add to or ensure the sustainability of the ecosystems being further impacted by this project. The EA processes in Canada, in BC, Saskatchewan, the USA and in Manitoba are failing. The MMTP EIS demonstrates that environmental assessments such as this are largely ineffective. Collectively, we need to reconsider the relationship between human actions, human health and well-being, environmental quality and ecological integrity. The current societal approach we take in interacting with the planet, including the way we exploit natural resources and assess the consequential environmental impacts, needs to change.

2. Evolution of environmental assessments

Prior to the late 1960s, there was no public participation in environmental decision-making with regards to resource development projects; therefore there were no official environmental assessments, as regulated by legislation, in Canada. In the early 1970s tools such as environmental impact assessment were introduced to help resolve conflicts over the distribution of the risks and benefits associated with project development. A decade of civil society, government, and scientific work plus several Supreme Court decisions resulted in CEAA 1992, and the Canadian Environment Assessment agency, with offices across Canada. With the focus placed chiefly on the mitigation of adverse biophysical effects, the new tools ultimately led to improvement in the quality of environmental decision-making, but to a limited extent (Winfield 2016).

However in the last two decades, government and corporate efforts to streamline the EA process resulted in the reformation of the Canadian Environmental Assessment Act (CEAA) in 2012. However rather than facilitating project approvals, it appears to have had the exact opposite effect (Winfield 2016). Changes to CEAA have compounded already existing issues, further complicated the process, and seem to be impeding the successful navigation through the process from project inception to approval. The erosion of public confidence in the process is evident as social, political and legal opposition to major development projects across Canada has been growing, resulting in lengthy delays, legal actions, and uncertainties surrounding approvals. Consequently, during the most recent federal election campaign, the reformation of federal environmental assessment law was highlighted, with both leading parties promising to make changes as soon as possible if elected.

Less than two years later, the Federal Environment Minister Catherine McKenna just released her Expert Panel's report on reforming Canada's environmental assessment processes: *Building Common Ground: A New Vision for Impact Assessment in Canada* (published April 5, 2017). Dr. Gibson, a Canadian leading Sustainability academic from The University of Waterloo in Ontario, who was an expert witness for the CEC during the 2014 Keeyask hearings, has conducted an analysis and review of *Building Common Ground* (Gibson 2017). We utilize his review and expertize to put the EIS in the current EA context while we conduct our own review of MMTP.

Dr. Gibson focuses on the development and application of sustainability-based next generation environmental assessment law and policy for Canada at the federal and

provincial/territorial levels. The main premise of his research, Next Generation Environmental Assessment Project, is that projects should be required to enhance prospects for lasting well-being. His analysis and review assessed how next generation environmental assessment components were included in the Expert Panel's report. In general, he applauded the Expert Panel's report for one of the most important recommendations that was made: *ensure that the core objective of assessment law and processes, and all relevant assessments, make positive contributions to sustainability.*

In the review, Dr. Gibson outlines the demands of an assessment regime with a sustainability focus. They would require:

1) that every undertaking to make a positive contribution to sustainability;
2) discouragement of trade-offs;
3) application of explicit, context-specified sustainability criteria;
4) identification of best options; and,
5) seeking multiple, mutually reinforcing, fairly distributed and lasting *gains*, while avoiding significant adverse effects.

In addition, Dr. Gibson noted four principles that underlie the vision and implementation guidelines in the Expert Panel's report. The principles require that the assessment process be:

1) transparent;
2) informed;
3) inclusive; and
4) meaningful.

These requirements and principles outlined in The Expert Panel's report should drive the Scope and discourse in EAs and EISs, and set the tone for hearings conducted by the CEC. Because of the imminent changes to EA law in Canada, which will affect Manitoba regulatory situations also, I used this to guide part of my review criteria in this assessment.

The Manitoba Hydro MMTP utilized a conventional approach in the EIS. The following sections of this submission demonstrate that the focus of the current EA Scope and subsequent EIS for MMTP was on reducing significant adverse effects of the project using mitigation, rather than on enhancement of the environment and human health and well-being. Given the Expert Panel's recommendations, it is possible, that the approach used in the assessment of this project will become obsolete at the National level; provincial approaches will likely, and should, follow suit. The following sections aim to explore and demonstrate where the MMTP EIS falls short of achieving positive contributions to sustainability through lasting gains, while avoiding significant adverse effects.

3. Environmental externalities

Externalities can be defined as unintentional, unpaid, impacts that result from land use development; essentially a side effect that is unaccounted for. Environmental externalities are broad, can be positive or negative, and are not borne equally. Manitoba Wildlands (2014) defined environmental externalities in a submission report to the CEC on the Keeyask Generation Station Project as unintentional and uncompensated side effects imposed on society and the environment that are not accounted for by the producers or consumers of energy. "Environmental externalities" are those that impact the environment or people, as an effect of the development of projects such as the proposed MMTP. They are mostly outside the mechanisms of pricing; so therefore there is technically no cost to pay for the utilization of the common good, that is ecosystems. Figure 2 depicts some common examples. These unaccounted for side effects are estimated to be worth over $7 trillion globally. Ecological degradation is happening in part, because it is rare that the goods and services that ecosystems provide have been accounted for or fully valued in today's economic paradigm and environmental decision making frameworks (Maberly and Elliot 2011, Healthwaite 2010, TEEB 2010). It appears that this is consistent for MMTP as well.

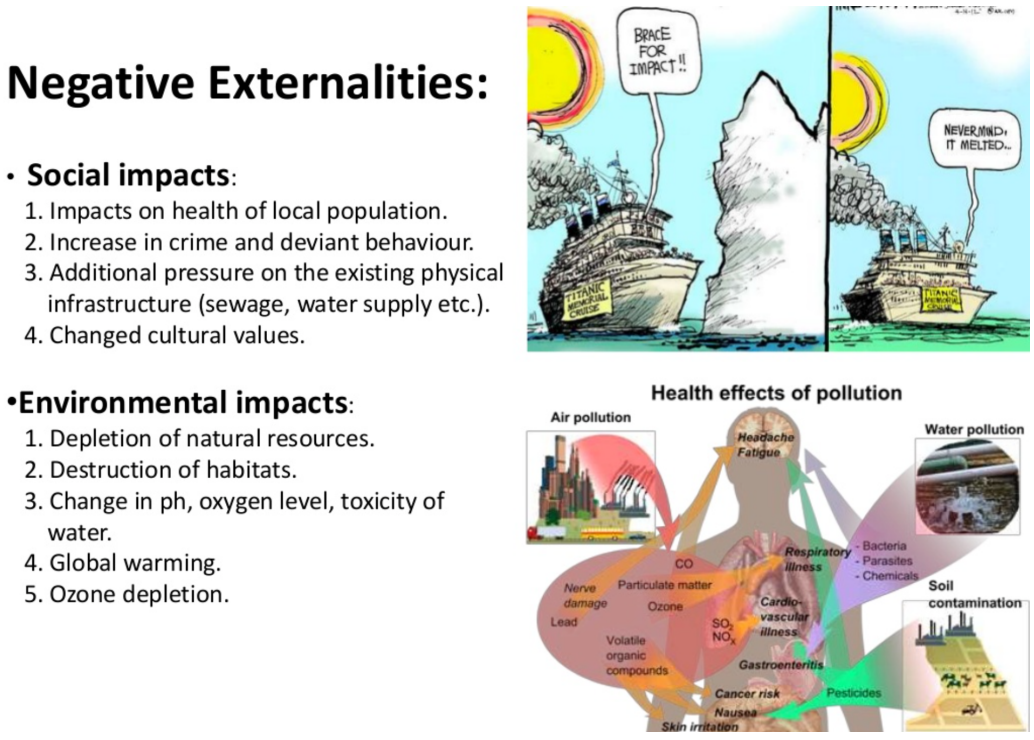

Figure 2. A depiction of common environmental externalities that are often not accounted for in decision-making frameworks and environmental assessments such as MMTP (reproduced from Bonsal 2015).

Manitoba Hydro does not define environmental externalities or explicitly recognize, discuss or assess them within the EIS. As a result, there is no analysis within the Environmental

Impact Statement of several of the externalities of the proposed project's potential impacts on some important environmental resources within the Environmental Impact Statement. While these types of analysis are inherently difficult due to uncertainties and incomplete information regarding values, with the omission of many environmental externalities, Manitoba Hydro is potentially not addressing the degradation of natural resources during the project. Consider the forest potentially lost to the preferred ROW as one example where numerous environmental externalities will occur. As the habitat is degraded or lost, the values and benefits that come from that particular forest area, like water and air purification, carbon sequestration and nutrient cycling, and cultural connections like a sense of place, for example, are also lost, for that particular place. These losses ultimately cost society money, and should be valued. Valuing environmental externalities (monetarily or not) provides major contributions to the formulation of sustainable development policies which are often integrated approaches that lend themselves to qualities that are not immediately and reliably quantifiable (Ricci ND).

We recognize that the explicit study of environmental externalities was not within the scope of the assessment; but this is based on a false premise of the separation of economics and ecology. Ecosystem services contribute to human welfare and their economic value is essential to the global economy (Costanza & Folke 1997; Costanza, et al. 1997; Hooper et al. 2005; Millennium Ecosystem Assessment Program 2005). Why does Manitoba Hydro appear to avoid many ecosystem services, natural capital, and externalities in its various environmental statements for future projects? Due to the formula Manitoba Hydro uses for determining the significance of their residual effects, it is apparent the impacts that create negative externalities on the environment have little weight in their Environmental Impact Statement. However, changes to the environment during the construction, operations and maintenance of the proposed project will likely cause negative environmental impacts and externalities, both now and in the future, and this depreciation needs to be recognized and accounted for in the MMTP EIS process. As such, the repeated conclusion of low magnitude of declared residual and cumulative effects in the EIS is questionable. Valuation of externalities in the EIS process is long overdue. There is a strong connection between the environment and human health (see evidence below), therefore environmental externalities should have been assessed within the scope of MMTP, and should be integrated in all decision-making and recommendations that come through the CEC.

4. Mitigation of significant adverse effects – does it work?

Manitoba Hydro's statement of environmental impacts that may potentially occur as a result of the proposed MMTP makes the assumption that mitigation measures are effective, most or all of the time. Mitigation is the attempt to avoid, minimize, restore or compensate a potentially adverse impact (and enhance beneficial impacts). MH defines mitigation in their Glossary of Terms (MMTP EIS, Chapter 22) as "measures for the elimination, reduction or control of the adverse environmental effects of a project, and includes restitution for damages to the environment caused by those effects through replacement, restoration, compensation or other means". The analysis of "residual' effects within the EIS is equivalent to the formula Potential Impact + Mitigation (100% effectiveness) = Residual Effect (MMTP EIS, Chapter 7, Table 7-1). There are some concerns with this assumption.

The outcome of mitigation efforts and restoration projects regarding externalities and adverse effects is influenced by a number of variables such as site and landscape conditions, hydrological regime, the rate of development of ecosystem attributes, nutrient supply rates, disturbance regimes, seed bank conditions, invasive species and life-history traits (Zedler 2000). The conditions at each site, or for each project, are a unique combination of these factors. Consequently, mitigation and restoration projects are often hampered by imperfect knowledge surrounding these biotic and abiotic (i.e., living and non-living) interactions. These uncertainties often lead to unintended consequences (i.e., environmental externalities). For example, numerous studies on wetland mitigation have concluded that created wetlands rarely perform as intended, and they do not often replace the ecosystem structures and functions that were lost (MEA 2005). The World Commission on Dams (WCD) found that large dams have more negative than positive environmental impacts, and that there is a widespread failure to account for downstream consequences on the environment (i.e., environmental externalities). In their global assessment, the Commission found that only 20% of the ecosystem impacts were mitigated effectively (WCD, 2000). A review of the literature on environmental mitigation implies that such measures are not monitored or analyzed extensively enough to conclude scientifically that environmental mitigation practices such as bird diversion, reduced risk timing windows, country food substitution, restoration and rehabilitation are effective (Fedy et al 2015; Hill & Arnold 2012). In conclusion, there is not sufficient evidence to support the assumption within the MMTP EIS that the mitigation efforts proposed by the proponent are effective and will, with certainty, reduce or eliminate identified adverse effects.

5. Self-assessments

Currently in Manitoba, proponents for proposals seeking a license under Manitoba's Environment Act prepare Environmental Impact Statements. These self-prepared EAs comprise the primary tool for environmental assessment. Self-assessment means the proponent is assessing its own plan, its intended project, based on the data and information that the proponent holds or gathers. Self-assessment in Canada and Manitoba's EA systems is reviewed, re assessed, and informed through independent experts and information brought to the regulatory process by interveners or participants, like myself. Where a proponent has a significant number of existing licensing for infrastructure, such as Manitoba Hydro, the outcomes from self assessment of intended projects requires thorough review and independent, knowledgeable experts who contribute their assessment and questions to the review of the project, including during CEC hearings. The public reviews, scoping document, EIS, TAC comments, public comments, and the transcript, presentations, expert witnesses, submissions, cross examination during CEC hearings are all in response to the dynamic of self assessment by the proponent. Based on evidence of the ineffectiveness of EA processes in general, and the conclusions in the MMTP EIS, it is unlikely that self-assessment, in its current form as exemplified by the Manitoba Hydro MMTP EIS, is appropriate. Independent assessments are recommended.

6. Informed decision-making, Adaptive Management and Structured Decision-Making within MMTP

In Manitoba Hydro's EIS, Adaptive Management (AM) is defined as a systematic process with the goal of continually improving environmental management based on outcomes and is established within the Environmental Protection Program (EPP) for the Project (MMTP EIS, Chapter 22, p. 22-2). Manitoba Hydro states that their intention is to "[allow] for flexibility in the mitigation of adverse environmental effects that may result from the project". The EPP for the project will attempt to verify the accuracy of the environmental assessment effects and determine the effectiveness of mitigation efforts and overall project implementation. These data will be immensely important in contributing to the AM process.

MMTP sets a framework for monitoring and assessments throughout the project to utilize Adaptive Management best practices. They include a comprehensive definition of AM uncertainty and complexity; are deliberate in design and implementation; promote learning that influence action; ensure transparency in decision making; and have requisite capacity (Fitzpatrick, 2017, page 10). This is the proper framework for the integration of monitoring and information into informed decision-making as AM can be a promising management tool. This is recognized as such in the EIS. Structured Decision Making (SDM) can also provide a framework for identifying alternatives and actually developing and implementing the change-management process that is integral to the success of adaptive management. We currently use SDM to facilitate decision-making in the face of uncertainty in our own local watershed. The MMTP EIS does not currently utilize SDM for its AM program, but it could explore this concept to further decision-making.

In practice adaptive management can be slow and really divide participants. This is likely due to the complexity of integrated decision-making and the fact that final decision-making authority lays with Manitoba Hydro. Finally, and most importantly, the information collected within the EPPs needs to reflect the proper context. The ecological monitoring and information needs to integrate the project impacts into human health and well-being assessments. It is unsettling to find that no follow up monitoring is planned for VCs identified in Chapter 19, as noted in Section 19.9, "there are no requirements under CEAA 2012 to undertake follow-up and monitoring with respect to Project effects on community health and well-being." In Chapter 18, Section 18.9 states "There is no follow up monitoring required specific to the assessment of potential human health risk." With the exception of studies related to EMF, Manitoba Hydro will not conduct follow up studies related to potential project effects on human health. There are potential human health implications for current and future generations from changes in habitat, and biodiversity, and ecosystem services affiliated with MMTP. As per the Expert Panel's recommended approach with regards to avoiding adverse effects and minimization of harm, it is recommended that MMTP be required to conduct follow up monitoring with respect to how changes in biodiversity and ecosystem services affect human health and community health and well-being into the future.

Even with the best plan in place for AM, with a continued focus on mitigation of adverse impacts, there will often come a time when there is no effective way to mitigate adverse impacts. This is becoming increasingly apparent in local watersheds at home, as we

continue to document the decline of salmon in response to unanticipated high volume spills. To make the most from the proposed AM process, Manitoba Hydro should actively seek mutual co-benefits, clarify trade-offs, acknowledge and recognize uncertainty while embracing decision-making frameworks that reduce risks to planetary health. To do this, Manitoba Hydro will need to extend its EPP to make it directly relevant to the contributions of ecosystems to the environment and how these benefits effect human health and well-being within the MMTP project area, while shifting its focus from monitoring effects to conducting and monitoring enhancement activities that create benefits.

7. Assessment process and decision-making framework should focus on enhancement of biodiversity, ecosystem services, human health and human well-being.

The following sections explore in detail how the MMTP EIS and other Manitoba Hydro project assessments and monitoring frameworks need to shift away from the conventional environmental assessments and decision-making frameworks and begin to focus on the enhancement of environmental conditions and ecosystem services, for the ultimate benefit of human health, human well-being and environmental health.

8. Ecosystem services

Both humans and non-humans alike depend on the complex interactions of the abiotic (i.e., environment) and biotic (i.e., species) components of intact ecosystems. An ecosystem can be defined as a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit. Together, with deposits of non-renewable resources they constitute 'natural capital'. Natural capital delivers specific services in perpetuity that sustain and improve human and non-human life (Brummett et al 2012). These contributions are called ecosystem services (Munns et al 2002). Ecosystem Services have been defined as the market and non-market benefits to individuals, households, communities and economies receive from ecosystems (MEA 2005). They are delivered to society as goods (e.g., clean water, food, shelter, electricity) and services (e.g. purifying drinking water, waste decomposition, flood regulation, climate regulation, recreation) and both humans and non-humans rely on them for survival. Thus, the foundation of human well-being is reliant on the contributions of ecosystem services and the appreciation, or maintenance of natural capital.

The Millennium Ecosystem Assessment (MEA) separates ecosystem services into four categories: provisioning services, regulating services, supporting services, and cultural services (Millennium Ecosystem Assessment Program 2005). Figure 3 illustrates the different categories and how they interact and impact human health and human well-being.

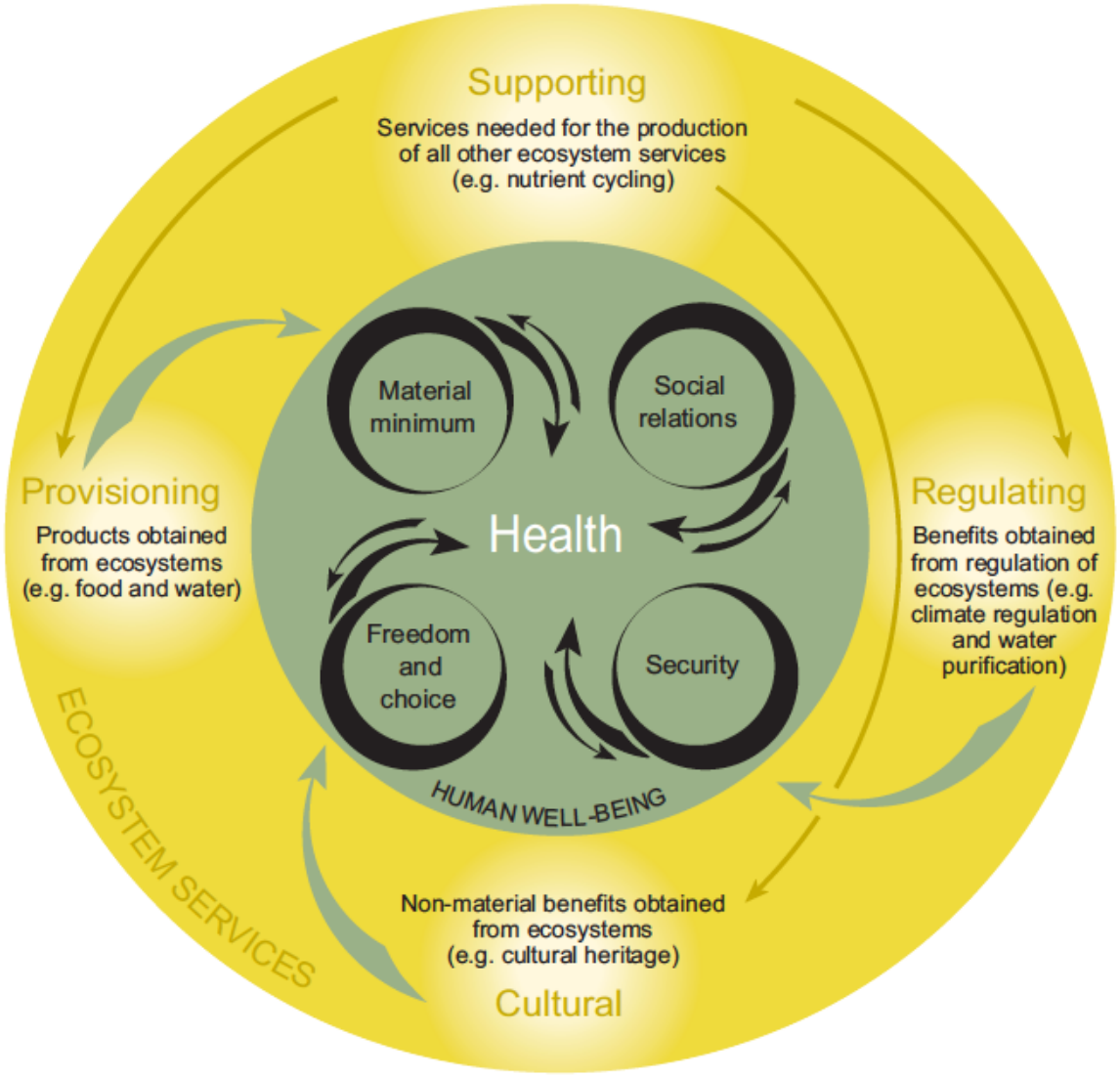

Figure 3. Ecosystem Services categories in the Millennium Ecosystem Assessment, showing their interactions, interdependencies and contributions to human health and human well-being.

The most basic example of a vital service is a daily supply of clean fresh water. Simply put, terrestrial and freshwater systems interact to provide the services of gathering, purifying, providing, and delivering the good, which is water. Another simple example is the production of food, which is completely reliant on the services that both aquatic ecosystems (e.g., water-related services) and terrestrial ecosystems provide (e.g. the production of necessary browse material to support mammal populations). For additional detailed explanations and examples of ecosystem services in relation to Manitoba Hydro projects, please see my submission to the CEC (McHugh, 2013) where they were extensively defined in regards to the Keeyask Generation Station CEC hearing.

In 2005, a global ecosystem assessment estimated that 60% of the ecosystem services that were examined were being degraded or used in a way that was not sustainable (MEA 2005). Unfortunately, many of the benefits that ecosystems and natural capital provide are typically overlooked because they are not currently captured as part of the market economy, and rarely accounted for in day to day decisions by businesses, government and citizens (Maberly and Elliot 2011, Healthwaite 2010, TEEB 2010). Ecosystem services and biodiversity are inherently connected. Biodiversity plays an important role in the creation, support and maintenance of all ecosystem services (Kandziora et al 2012). In turn, land and water ecosystem services also conserve biodiversity. A reduction in ecosystem function, and consequently services, has been directly linked with a decrease in the diversity of species, or biodiversity. Ecosystem services are vital to climate change adaptation and mitigation and have been directly linked to human health and well-being (Myers et al 2013). The collective goods and services that ecosystems and biodiversity supply and maintain ultimately sustain human well-being (UNDP 2012, Myers et al 2013). Therefore, the ongoing loss of biodiversity and consequent reduction in ecosystem services has local and global human health implications.

Let us explore this concept further within the MMTP EIS: were ecosystem services and natural capital included in the EIS? If so, were they assessed within the correct context? In some cases, this EIS demonstrates Manitoba Hydro's dedication to considering the recommendations in my previous CEC submission: Monitoring For Ecosystems Services report to the CEC in 2013 (McHugh, 2013). We recognize that the MMTP EIS does present a much broader examination of the Project's potential effects on the human and environmental health of affected populations. Changes to some ecosystem services were included and assessed within the MMTP EIS. Explicit changes to natural capital were not addressed. In some cases, such as changes in biodiversity and the implications for human health and human well-being, important topic areas were not included altogether. In other circumstances, they were included however not necessarily in the right context, for example consider the Health Impact Assessment (HIA; more details below in Sections 9 and 10.) Essentially, the assessment of significant and cumulative adverse effects requires an integrated approach assessing how changes in ecosystem services potentially affect the environment, as well as human health and well-being. This concept is explained in more detail in the next section on human and environmental health. Just like you can't discuss economy and ecology without each other, the MMTP EIS should not discuss human and environmental health separately. In conclusion, several important ecosystem services were examined, however, in general, they failed to examine them within a transdisciplinary, integrated assessment framework regarding potential impacts to biodiversity and how those changes affect human and environmental health.

9. Human and environmental health

The World Health Organization defines Health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". This is a broader concept that extends beyond the human–only context and encompasses other species, ecosystems, and ecological underpinnings of the many drivers and protectors of health risk

(Romanelli 2015). Biodiversity, at the global scale, regulates earth's material and energy flows and its responses to gradual or abrupt change. At the micro scale, biodiversity of our very own bodily microbial communities contributes to our nutrition; helps regulate our immune system and also prevent infections (Romanelli 2015). This diversity of interconnected life at various scales underpins ecosystem functioning. Healthy, functioning ecosystems provide goods and services that are essential to human heath and well-being. As such, biodiversity is a key environmental determinant of human health, and environmental degradation reduces the ability of ecosystems to provide essential life-sustaining services. Consequently, the maintenance and enhancement of ecosystem services ultimately benefits human health (Romanelli 2015). Therefore, it is important that policies that govern the development of projects such as MMTP, should prevent the loss of biodiversity. This would simultaneously promote environmental protection and human health protection during the life-span of the project.

Gibson (2017) draws attention to the Panel's recommendation of *five* pillars of sustainability, (environmental, social, economic, *health, and cultural*) instead of the usual three (environmental, social and economic). This is not a novel idea, rather it is typical of the traditional First Nation philosophy of a holistic, interconnected, web of life where humans are an interacting part of nature and earth's systems etc**.** However it is a relatively new scientific concept. In western science the foundation of an emerging scientific discipline called Planetary Health, offers a new fresh lens with which to assess our relationships with the natural world, and more relevant to this review, environmental assessments. The Rockefeller Foundation- Lancet Commission on Planetary Heath defines it as "the health of human civilizations and the natural systems on which they depend," (The Lancet Commission, 2016). The approach is interdisciplinary and transdisciplinary, and investigates the "effects of environmental change on human health and also the political economic and social systems that govern these effects" (The Lancet Commission, 2016). The environmental determinants of health, and the recognition of biodiversity and health linkages are emphasized in the Planetary Health discipline. It is a foundation for the integration of relevant ecological and social information to be valued and presented in public health and environmental policies that should be explored and utilized to facilitate more effective EAs.

In addition to the new Planetary Health discipline, there are other non-traditional approaches that can be utilized in EAs such as MMTP, and within the overall Manitoba Hydro decision-making framework to better understand the potential implications of project effects on local human and environmental health. Here I'll provide an example from my own research practice to demonstrate this. Figure 4 is an artistic rendition and analogy of the integration of human health and environmental health in my local community. Surrounding Lillooet, British Columbia, hydro generation dams dominate our local and regional watersheds. Local people and watersheds are intimately tied together on the landscape, and this figure illustrates some of the complexity and interconnectedness within and between people and their environment. Generally, when all of the major headwaters and tributaries of an aquatic system are blocked, the collective ecosystem malfunctions, or declines. In the case of human health, a blockage in the circulatory system may cause a heart attack. In the specific case of ecology and the environment locally, severe and widespread degradation of freshwater ecosystems is quickly diminishing our local salmon

runs and putting them in jeopardy of immediate extirpation. This is a serious cause for both environmental and human health concern. Art is one way, as a researcher, that I am exploring this relationship to better understand the implications of these environmental changes.

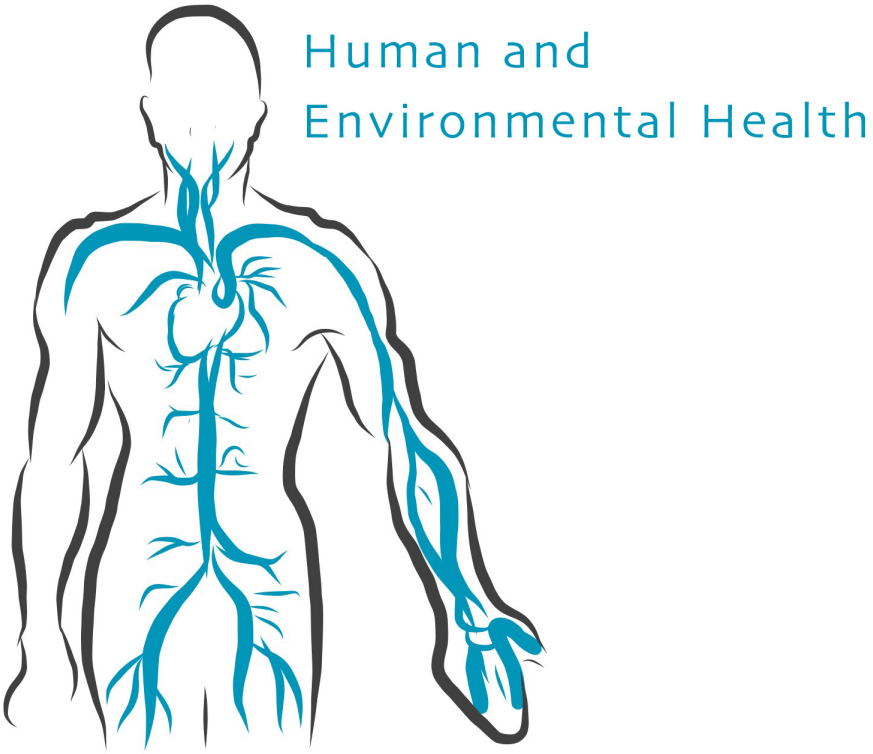

Figure 4. An artistic rendition of the complexity, integration and interconnectedness of human health and environmental health. This image is copyrighted and licensed under the Creative Commons 'Attribution' license. Therefore it cannot be distributed, reproduced or used outside of this specific report without the expressed permission from Coldstream Ecology, Ltd.

The Indigenous communities I work with, and Manitoba First Nations who participate in CEC hearings make numerous references that connect their health to the natural world and ecosystems they rely on. Areas rich in medicinal plants are referred to as 'our pharmacy' or 'our medicine cabinet', for example. I am told that during CEC hearings regarding regulation and management of Lake Winnipeg by Manitoba Hydro, First Nation participants shared their integrated philosophy and observation of the lake's health as parallel to a human system, with ecosystem contributions, or organs that are needed for the lake, or human body, to function effectively. One specific example cited included references to the Washow Peninsula as a 'kidney' for Lake Winnipeg. The concept of a kidney integrates the health and ecology of the entire Lake Winnipeg ecosystem. These references demonstrate how in some cases traditional knowledge identifies the complexity of ecosystems and their contributions to ecosystem services that sustain human health, in specific areas. This

information may be important to an EA, and could be used to further identify specific ecosystem services that are important to a project area.

I'll use the next few paragraphs to provide further evidence of how biodiversity and land use changes are intimately connected to human health, and why these changes are important to MMTP. In addition to providing high quality food and nutrition, biodiversity also performs the essential ecosystem services of disease protection and prevention, right here in Manitoba. High biodiversity has been documented to reduce frequency rates of pathogen transmission and lower the disease risk for humans, wildlife etc.; further, disease reservoirs persist where biodiversity is reduced (Ostfeld 2017). Decreases in biodiversity increase the risk of transmission for a variety of infectious diseases (Dantes-Torees 2015). Within the MMTP EIS, there was no discussion or assessment regarding how predicted changes in biodiversity may influence disease regulation ecosystem services. I'll use ticks as an example to explore this context further and demonstrate why this missing information is a concern within Manitoba and the MMTP EIS.

A critical finding of recent research suggests that it is "impossible to disconnect the mutual influences of global changes such as deforestation, land use change and climate change on tick-borne pathogen transmission systems" (Dantes-Torees 2015). If disturbance to habitat occurs, this may impact terrestrial mammal communities and the tick-borne pathogen transmission systems, for example. There is convincing evidence that biodiversity declines cause increased disease transmission from ticks to humans (Civitello et al 2015). As the distribution of ticks expands in response to global environmental changes that impact host availability, vegetation coverage and climate, this becomes increasingly important here in Manitoba. More than a dozen cases of emerging tick diseases were reported within the last two years in Manitoba (Zafar, 2016). In May, the CBC (2017) published three articles regarding Lyme disease in Canada. In one article, the Manitoba Lyme Disease Society warned of an expected bad year for tick borne-illnesses; in another article, Canada's top public health officer cited an increase in Lyme disease cases as a chief cause of human health concern as approximately 1 in 10 black legged ticks are estimated to be carrying diseases that may transmit to humans. On May 19th, a group of hikers on the Mantario Trial, a system just 150km east of Winnipeg, told CBC their story of pulling off hundreds of ticks during their three day journey. Manitoba Health identifies the region where MMTP would be built as a high risk location for ticks bearing disease. This is a specific example of the interactions between hosts, human disease, and the changing risk of disease transmission in relation to changing environmental conditions. There was no discussion in the MMTP EIS on how cumulative impacts or residual effects regarding changes in host availability, vegetation cover or the climate; and how changes may or may not influence the prevalence of human and wildlife disease in affected communities.

This a significant and concerning gap within the MMTP EIS, Manitoba Hydro project assessments and provincial and federal environmental assessment processes in general. A Health Impact Assessment was conducted within MMTP (EIS, Chapter 18), and baseline information on disease parameters for human populations within Manitoba was presented. This is a good starting point for this integrated assessment. However, in general (with the exception of the traditional foods VC of country food quality), the health impact assessment context did not extend to biodiversity, and there was little discussion regarding how

changes in the environment, such as land use, ecosystem conversion, etc. could potentially pose a risk to human health. In conclusion, the MMTP EIS would have been more effective if it an integrated environmental and health assessment approach was taken, and specific links and vectors associated with biodiversity declines and disease transmission were included in the assessment.

10. Significant adverse effects – does MMTP avoid them?

The Expert Panel explicitly recognizes the avoidance of adverse effects and the minimization of trade-offs as critical components of the recommended EA approach. The Panel says,

> A sustainability approach seeks to ensure that projects are planned to avoid or minimize harm and deliver benefits for current and future generations [p.20](Gibson 2017).

To understand how MMTP assessed significance of effects, we completed a high-level compilation summary of significant residual adverse effects and project contribution to cumulative environmental effects that have been acknowledged within select chapters relevant to our expertise and review of the MMTP Environmental Impact Statement (Table 1). Overall, Manitoba Hydro states that some negative environmental effects on fish and wildlife habitat, country food quality, and both land and traditional land use are likely to occur as the result of the Project. [See Section 9.7.3 (Page 9-115) for one example on wildlife]. However, each inference to the negative environmental effect concludes that, due to mitigation efforts as well as other factors such as environmental resilience, and low magnitude, frequency and duration of exposure to the effect as a result of the Project, the project will not lead to any significant adverse environmental impacts. For the seven chapters listed in Table 1, the overall conclusions for the project were the same: No Significant Adverse Residual Effects, and No Significant Residual Cumulative Effects, with one exception (Table 1).

The conclusions of no significant effects for the project were largely based on the assumption that mitigation is effective. We have established that ecological mitigation measures are not documented as being necessarily effective, and in many cases, are clearly not effective in maintaining, replacing or enhancing critical life sustaining ecosystem services, like the continued provision of clean fresh water and traditional, nutritious foods. Further, the assumption for the formula for residual and cumulative effect (mitigating, offsetting, no net loss) is not scientifically acceptable or agreed upon [NSW SWAC, 2002, US National Academy of Science and the General Accounting Office of mitigation banking in 2001 (cited in DEC, 2006) (cited in Hayes & Morrison-Saunders 2007)]. Mitigation is not scientifically or traditionally accepted as being effective at reducing environmental impacts, so it is unclear how meaningful the MMTP EIS conclusions of no significant effects really are.

Table 1. Summary table of acknowledged Significant Adverse Residual and Cumulative Effects in the MTTP for select EIS chapters.

Valued Component (VC)	Environmental Effects	Significance of Residual Effects	Significance of Cumulative effects
Community Health and Well-being	Changes in: health resulting from socio-economic change or associated with the mobile workforce; levels of stress and annoyance; Aboriginal health; and capacity of or demand on health care and infrastucture services. Section 19.3.2.2 (Page 19-14 bulleted list)	(...)the residual effects of the Project on community health and well-being are predicted to be not significant. Section 19.7.1 (Page 19-66)	It is not anticipated that any of these activities or uses will result in any additional effects on community health and well-being […] Section 19.6.4 (Page 19-66)
Fish and Fish Habitat	Changes in fish habitat or fish mortality. Section 8.5 (Table 8-9)	[… R]esidual environmental effects on fish and fish habitat are predicted to be not significant. Section 8.7.1 (Page 8-70)	No cumulative environmental effects on changes in fish mortality or health have been identified. (8.7.2)
Human Health Risk	Changes in: Country Food Quality, Electro-magnetic Field (EMF), Noise, and Air quality. Section 18.3.2.2 (Table 18-3)	The residual environmental effects of […] are predicted to be not significant. Section 18.7.1 (Page 18-56)	[… T]he residual cumulative effects of the Project […] are predicted to not be significant. Section 18.7.2 (Page 18-56)
Land and Resource Use	Changes in private property and rural residential development, designated lands and protected ares and resource use (forestry, groundwater, mining/aggregates, hunting and trapping). Section 16.3.2.1 (Page 16-18)	[… R]esidual effects of the project on land and resourse use […] are anticipated to be not significant. Section 16.7.1 (Page 16-115)	As such, the Project contribution to cumulative effects is considered not significant. Section 16.7.2 (Page 16-116)
Traditional Land and Resource Use	Changes in availability of resources and access to land. Section 11.3.2.2 (page 11-13)	The effects of the Project on the TLRU are assessed as not significant. Section 11.7.1 (Page 11-650	Considering the cumulative effects assessments for VC's related to TLRU and the characterization of effects on known and assumed TRLU sites, the cumulative effects on TLRU are assessed as not significant (last sentence in 11.7.2)
Vegetation and Wetlands	Changes in: Landscape intactness, native vegetation cover class, wetland class, invasive plant species, rare plant species, and traditional use plant species. Section 10.3.2. (Table 10-3)	Based on these summaries, potential Project effects on vegetation and wetlands are considered not significant. Section 10.7.1 (Page 10-112)	With the addition of Project effects, cumulative effects on vegetation and wetlands are assessed as being not significant. Section 10.7.2 (Page 10-112)
Wildlife and Wildlife Habitat	Changes in mortality risk to wildlife and capacity of critical habitat. Section 9.3.2. (Table 9-3)	With the application of mitigation and environmental protection mesasures, the projects residual effects on wildlife and wildlife habitat are assessed as not significant. Section 9.7.1 (Page 9-113)	The cumulative effects of the Project and future projects on current conditions of wildlife and wildlife habitat are assessed as not significant. Section 9.7.2 (Page 9-115)

Let us examine some important topics and VCs considered in Chapters 18 and 19, specifically related to traditional food and nutrition as an exploratory example of why this overall conclusion of no significant adverse effects may be questionable. The largest contributor to global disease burden is malnutrition. Effects are pervasive across the world, regardless of economic development status. Two billion people are lacking or deficient in one or more micronutrients. "Even one single serving of traditional animal source foods may result in significantly increased clinical levels of energy, protein, vitamin A, vitamin B6/12, vitamin D, vitamin E, riboflavin, iron, zinc, magnesium and fatty acids thus reducing the risk of micronutrient deficiency," (Romanelli 2015). One of the primary concerns of the impacted First Nation communities was the continued maintenance of ecosystem services surrounding food and nutritional provision (EIS, Section 19.5.5, 19-51).

The EIS examined this closely by assessing access to country food quality (Chapter 19), effects for plant harvesting (Chapter 11) and Wildlife and Wildlife Habitat (Chapter 9). Several examples presented below demonstrate that indeed, there are many important significant effects identified within the EIS. In Section 19.5.5, Manitoba Hydro states,

> However, based on the available information, it is likely that the Project will to some degree alter, interfere with access to and participation in traditional and cultural activities, and may contribute to decreased consumption of subsistence foods and traditional medicines for some community members.

Section 19.5.5.3.1 states,

> The assessment of residual effects for plant harvesting will result in adverse effects on plant harvesting by decreasing the availability of traditional use plant species and reducing the land base available for traditional plant harvesting activities.

Section 19.6.3.3 – Residual Cumulative Effects for Aboriginal Health, details numerous ways that the project is anticipated to have low to moderate cumulative effects. Below we've presented two examples that explicitly state,

> Effects are listed as expected to be permanent, continuous and irreversible. Cumulative effects on several of the VCs that influence traditional land and resource use, will also experience permanent effects; and

> The cumulative assessment of change in habitat availability (Chapter 90 – Wildlife and Wildlife Habitat) indicated that the contribution of future projects to wildlife mortality risk in the wildlife habitat RAA will be permanent, and that birds (a source of food identified by the Peguis First Nation) will be the most vulnerable to cumulative effects.

After detailing an entire section of adverse effects, some of which were irreversible, Manitoba Hydro finally concludes in the summary of Chapter 19, (Section 19.1) that,

> Project residual effects on community health and well-being are assessed as not significant; and

Project effects on Aboriginal health related to the availability of traditionally harvested food, and thus food security, will not be significant because changes in harvested foods within the RAA will not contribute to acute or chronic physical or mental health outcomes via adverse changes that are irreversible and detectable at a population level using existing population indicators; and finally,

Cumulative effects on community health and well-being are assessed as not significant.

For Manitoba Hydro to make these conclusions, they must make three assumptions: 1) that food, and the nutritional quality of that food, can be easily replaced by hunting or gathering in another area; 2) that local changes in biodiversity and ecosystems do not affect the nutritional quality of food; and 3) that changes in these parameters are currently detectable at a population level. All three of these assumptions are likely incorrect, at least some of the time. Furthermore, Manitoba Hydro failed to examine these parameters in an integrated way. Currently there is no plan to continuing to monitor Community Health and Well-being VCs, as law does not require it. The MMTP Socio-Economic and Land Use Environment – Technical Data Report (2015) is an excellent baseline summary document that can be used as a starting point to begin integrating the interactive human and environmental health effects.

These conclusions in Table 1 by Manitoba Hydro lead us to question the overall conclusions of no significant residual or cumulative effects for a project of this Scope. It further demonstrates the critical need for inclusion of the vision and implementation guidelines in the Expert Panel's report. The four principles should require an EA process to be: 1) transparent; 2) informed; 3) inclusive; and 4) meaningful. In light of these principles, I find myself asking if these overall conclusions of no significant effects were genuinely meaningful.

11. The precautionary approach and facilitating ecosystem resilience in an uncertain, changing climate

Manitoba Hydro states it utilizes the precautionary approach to guide the biophysical assessment within the EIS. Using the precautionary approach to environmental decision making and evaluation of potential economic and socio-ecological impacts would be taking the stance that environmental protection is the most likely way to protect and enhance health (MEA, 2005). Diverse functioning ecosystems provide more protection of services against emerging threats to human health and wellbeing, such as climate change and changing disease risks. We need to use the precautionary approach to identify solutions for a more resilient future. Manitoba Hydro could actively build and strengthen resilience using conscious design and maintenance of productive ecosystems. Rather than focusing on the mitigation of identified significant adverse impacts, environmental assessments should focus on the maintenance, restoration, and the facilitation of the resilience of ecosystems and their services, and collective benefits.

12. Regenerative sustainability and design

For the last two hundred years, the foundation of industrial activity has been based on degenerative design (Raworth, 2017). "We take earth's materials, make them into stuff we want, use it for a while, and then toss it away. Take-Make-Use-Lose. It's a one way system that runs counter to the living world, and it's devouring the sources of it's own sustenance," (Raworth, 2017). It is evident that a new approach is desperately needed that establishes a mutually beneficial relationship between human actions, human health and well-being, environmental quality and ecological integrity.

Gibson (2017) explains the federal Expert Panel's position on commitments to positive contributions to sustainability. He noted they explicitly recognized 'net-benefits' as a critical component of the recommended approach. The Panel says,

> Sustainability should be central to federal IA. To meet the needs of current and future generations, federal IA should provide assurance that approved projects, plans and policies contribute a net benefit to environmental, social, economic, health and cultural well-being (p.20).

This review presents evidence that the current societal approach we take in interacting with the planet, including the way we exploit natural resources and assess the consequential environmental impacts in projects such as MMTP, needs to change to reflect a new, more holistic and interdependent relationship with the earth.

13. Manitoba Hydro co-benefits and contributions to the health of people and the planet

The MMTP EIS states that the project will provide economic benefits to the area. However what are the co-benefits, besides jobs and revenue sharing? Did MMTP clearly identify benefits of the project, for each alternative route and together with stakeholders and First Nation and Metis communities? Ecological benefits within each chapter were either not expressly identified or were difficult to locate. However in the review, we identified one specific area where it was clear that the focus was on net benefits. Enhancement of critical habitat was planned for the Golden-winged warbler *(Vermivora chrysoptera).* This model should be extended for all species concerns – birds, plants, fish, wildlife etc. I'm told that Manitoba Hydro is the largest employer in the province, with the largest amount of infrastructure. One would therefore logically conclude that Manitoba Hydro projects and infrastructure should confer the largest benefits to ecosystems and humans alike.

Manitoba Hydro should not use EAs to just conduct a required administrative and project planning exercise, but future assessments could play an active role in narrowing knowledge gaps etc. Complex linkages between ecosystems and public health need to be identified and characterized, and understood and integrated into environmental assessments. Steps that could be taken to reduce these uncertainties and increase the effectiveness during the EIS process, or during the life of the Project should:

- focus on VCs that encompass the ecological determinants of human health and well-being;
- catalogue the ways in which the changes to the environment directly or indirectly impact human health;
- facilitate a better understanding of the health services provided by biodiversity and how changes to ecosystems influence disease risks (Romanelli 2015);
- focus on documenting how the project, policies and management actions and subsequent environmental changes improve environmental health and human health (Ostfeld 2017);
- focus on changes in the availability of critical ecosystem services like the "quality of water and food, how changes in land and water use affect biodiversity, and if those changes potentially alter the transmission of vector borne, zoonotic and other infectious agents, " (Romanelli 2015);
- focus on reducing uncertainty regarding the effects of changes on the frequency and intensity of extreme events in aquatic and terrestrial systems. " (Whitmee 2015);
- make intentional decisions and design for environmental and human health co-benefits by looking purposefully for win-win situations;
- facilitate key action before key ecosystem services disappear and irreversible ecosystem changes occur (Whitmee 2015);
- and build on local resources and capacities to steward ecosystems and their services for the protection of health.

Collectively, myself and other professional biologists included, we need to start thinking creatively about how policies and processes such as EAs or EIS scoping documents, etc. could benefit by accounting for all essential and important ecosystem services. We need to move away from moderating or mitigating adverse effects towards a net-benefit model. Nature can and will contribute to addressing the health and social challenges of the times. Nature based solutions are needed, and EA processes need to be appropriately scoped to include the full range of potential risks, impacts and benefits that reflect today's ecological realities as well as today's societal values.

The health of the planet, and all of the life on it, is being challenged by rapid ecological changes, with serious implications for human health and well-being. Humans can, and should, act as a force behind positive environmental and human health change. Uncertainties in decision-making – gaps in our knowledge, etc. and not exactly knowing the path forward should not delay this action. Now is the right time to try something different, in an attempt to find an assessment framework that creates synergistic solutions. Manitoba Hydro has a chance to embrace the Planetary Health discipline as a framework for guiding environmental assessments. By focusing on integrated health, environmental, cultural and socio-economic effects, risks, and most importantly benefits, a real opportunity to begin designing win-win situations has arrived.

Final comments

Given the rapid earth changes apparent on a day to day basis, and the escalating degradation of the benefits we receive from nature, it was important that we not only

assessed the content of the MMTP EIS for potential adverse effects, but that we examined the effectiveness of the process itself. To this end, we engaged in an examination of the relationship that was adopted in the Manitoba Hydro Manitoba – Minnesota Transmission Project EIS approach, assessment and conclusions. This overarching question drove our review: Did the MMTP EIS reinforce healthy relationships between human beings and the environment? This submission detailed our examination of that relationship.

A small but significant number of issues related specifically to the MMTP Environmental Impact Statement, but that are also likely applicable to other Manitoba Hydro EAs, were identified as a potential cause for concern. The particular topics of that were addressed in this review included:

- the context and overall effectiveness of the MMTP Environmental Impact Assessment process;
- concerns surrounding some of the assumptions regarding the effectiveness of mitigation;
- significant gaps in important information relating to biodiversity, ecosystem services, human health and human well-being; and most importantly,
- a failure to link relevant ecological information to human health and human well-being in current and future contexts within project specific and cumulative effects.

Even after an extensive, expensive evaluation process such as the MMTP EIS, there are still significant gaps in important information relating to biodiversity and ecosystem services, and how they underlie and support human health and human well-being. Additionally, the context of assessment and the relationship between humans and the environment is often incorrect, as the EIS failed to integrate proper ecological and human health and well-being information into a transdisciplinary assessment. Conclusions in the MMTP EIS are not necessarily accurate or meaningful, nor do they appear to be effective in safeguarding the environment and protecting human health and human well-being.

EAs provide an immense opportunity to society and those impacted by proposed projects, to engage in meaningful, truthful and transparent discussions about potential project implications. Let's take advantage of this. We are at a critical juncture where we must shift our focus away from the conventional environmental impact assessment approach of mitigating significant adverse effects to the creation of co-benefits and synergistic solutions that enhance human and environmental health.

The discussion in this submission is intended to provide independent, objective feedback on the MMTP EIS to assist the CEC in making its recommendations. If the Commission would like further clarification on any of the topics within this report, please do not hesitate to contact me as I would be pleased to assist.

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