The Healthy Landscape Approach to Land Management

A Foothills Research Institute,
Natural Disturbance Program Project

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Foothills Research Institute's core study area is located in west-central Alberta, with an administrative office in the resource community of Hinton, approximately three hours west of Edmonton.

The area covers about 2.75 million hectares (27,500 square kilometres), and includes Jasper National Park of Canada, Willmore Wilderness Park, William A. Switzer Provincial Park and the Forest Management Area of Hinton Wood Products, A Division of West Fraser Mills Ltd. It also includes some provincial management units and the Hinton Training Centre's Cache Percotte Training Forest. Within its boundaries are three forest types – boreal, montane, and sub-alpine – and many forest uses including timber, petroleum and coal extraction, tourism and recreation.

The partners of the Foothills Research Institute Natural Disturbance Program are Jasper National Park, Alberta Sustainable Resource Development, Hinton Wood Products, and Alberta Newsprint Company.

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EXECUTIVE SUMMARY

We propose a *Healthy Landscape approach* as an alterative land management model that focuses on ecosystem health as a primary and common management objective, not unlike Aldo Leopold's land ethic concept (Leopold 1949). It presumes that the local disturbance regime is a primary mechanism responsible for biodiversity, and landscape health can be evaluated by comparing historical landscape (disturbance) patterns and conditions to current disturbance patterns and conditions. A Healthy Landscape model is by design collaborative and integrative, and includes water as a landscape element. Potential advantages include planning efficiencies, sharing responsibility, regulatory streamlining, and focusing fine filter research and tool development. A Healthy Landscape approach is appropriate for any landscape in Alberta, and is potentially well suited as a backdrop for the new provincial Land Use Framework.

The Healthy Landscape model belongs to a larger family of natural pattern-based strategies. We identify and integrate 20 attributes of an NP-based approach into a simple Natural Pattern Integration (NPI) tool, and then define the minimum NPI requirements to qualify as a Healthy Landscape planning process. Although the "scoring" and the identified minimum requirements for a Healthy Landscape planning exercise are largely subjective, the objective of the tool, and this report is to raise awareness of the elements of a Healthy Landscape approach, and provide some common ground for evaluating different natural pattern-based land planning exercises.

We will continue to communicate about the Healthy Landscape concept via presentations and other written materials in order to solicit and integrate feedback. Ultimately, we hope to engage a group of management partners in a demonstration exercise to help evaluate the potential of the concept for use in Alberta and beyond.

INTRODUCTION

For the last 13 years, the FRI Natural Disturbance (ND) Program has been conducting research, developing tools, and disseminating knowledge of natural disturbance patterns in response to the needs of its' partners. Objectivity is a key ingredient of the ND Program. For instance, we have not been involved in the development of any form of natural pattern guidelines because we have never assumed there is only one way of using natural patterns to guide land management. In fact, the mandate of the ND Program includes the introduction, discussion, and demonstration of various integration possibilities to help agencies make informed choices of the option that best suits their needs. For example, the recently completed Hwy40 North Demonstration Project explored the use of natural disturbance patterns as a planning foundation for forest management operational planning (see Andison 2008 and 2009). The three-day professional short course developed by the ND Program is specifically designed to explore natural pattern application issues.

One of the more intriguing, and least explored manifestations of a natural disturbance pattern approach is to use the natural range of variation (NRV) as a common planning foundation for *all* land management activities. Not only has this never been attempted, but also no one has considered what this concept might mean in any detail.

Early in 2008, the ND Program was invited to expand on the concept of using natural disturbance patterns as a foundation for land use planning. More specifically, the request included a) describing the rationale behind the concept, and b) providing some preliminary implementation suggestions. The FRI ND Program responded to this unique challenge by assembling a panel of national experts to share perspectives and flesh out the concept. The result of the work of this team to date is embodied in this report.

Consistent with the FRI ND Program mandate, this report is more of a synthesis of ideas than a how-to manual. The goal of this document is neither to introduce new scientific knowledge based on empirical evidence nor to argue for or against one way of thinking. Rather, it is meant to provide some groundwork for broader discussions of the opportunities and challenges of what we call a *Healthy Landscape approach* to land management. The fact that there is enough interest in the idea to instigate this project suggests that our partners are ready to have this discussion.

The future direction of this project under the auspices of the FRI ND Program will largely depend on the nature of the feedback from this report and associated communication materials, and the traction of subsequent proposals for a demonstration.

The document includes two sections. In Part 1, the conceptual foundation of using natural patterns as land planning backdrops is summarized. It includes some examples and comparisons to more traditional resource-based management models. Part 2 begins the translation from concept to practice by introducing the elements of a Healthy Landscape model and a tool for evaluating the nature and extent of different natural pattern approaches.

Part 1: The Healthy Landscape Concept

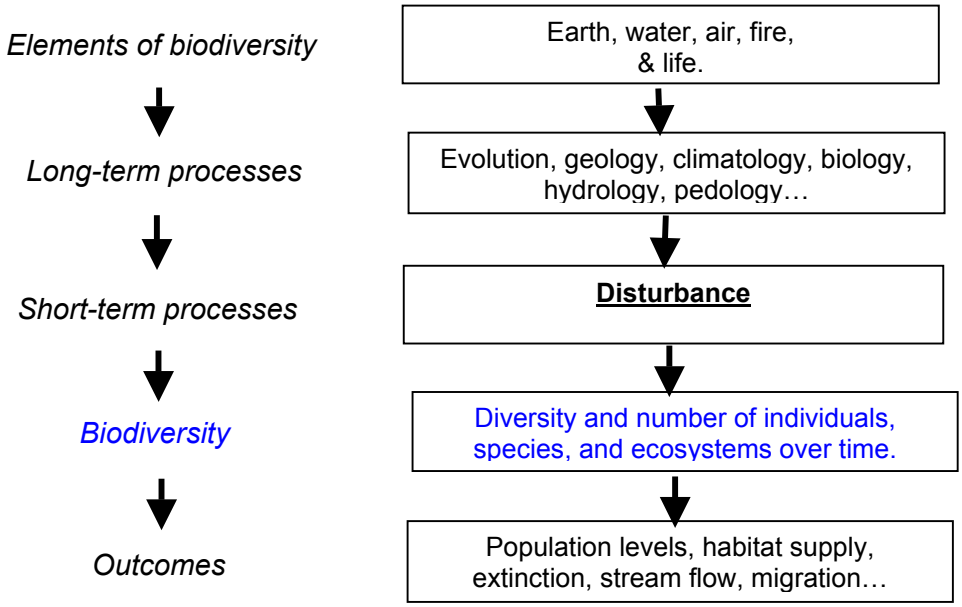
ECOSYSTEM HEALTH and BIODIVERSITY

Ecosystem health is something that virtually everyone agrees is important to maintain. Within Alberta, the draft Land Use Framework (LUF) recognizes this and identifies "healthy ecosystems and environment" as one of its three desired outcomes. Unfortunately, succinct and useful definitions of ecosystem health are rare.

Conceptually, a healthy ecosystem is one in which natural functions and structures are intact. This is what Aldo Leopold meant when he introduced the idea of Mother Nature's "cogs and wheels" (Leopold 1949). Our modern day version of cogs and wheels is *biodiversity* – the diversity of individuals, populations, and ecosystems. Thus, a healthy landscape ecosystem is arguably one that maintains natural levels of biodiversity.

Biodiversity is a product of the basic building blocks of life interacting with long and short-term natural processes (Figure 1). Biodiversity manifests itself in terms of population levels of individual species, habitat types, mutation rates, and so on.

Figure 1. How Biodiversity Happens.



Until now, we have focused management and monitoring efforts primarily on issue-specific "fine-filter" biodiversity components and outcomes. In Alberta, there are specific management strategies in place for old forest, woodland caribou, grizzly bear and water quality, to name a few. While a fine filter approach is necessary for maintaining critical species and monitoring, it is imperfect as a strategy for managing biodiversity. Species, habitat supply and clean water (for example) are the *result* of biodiversity, not *causes*.

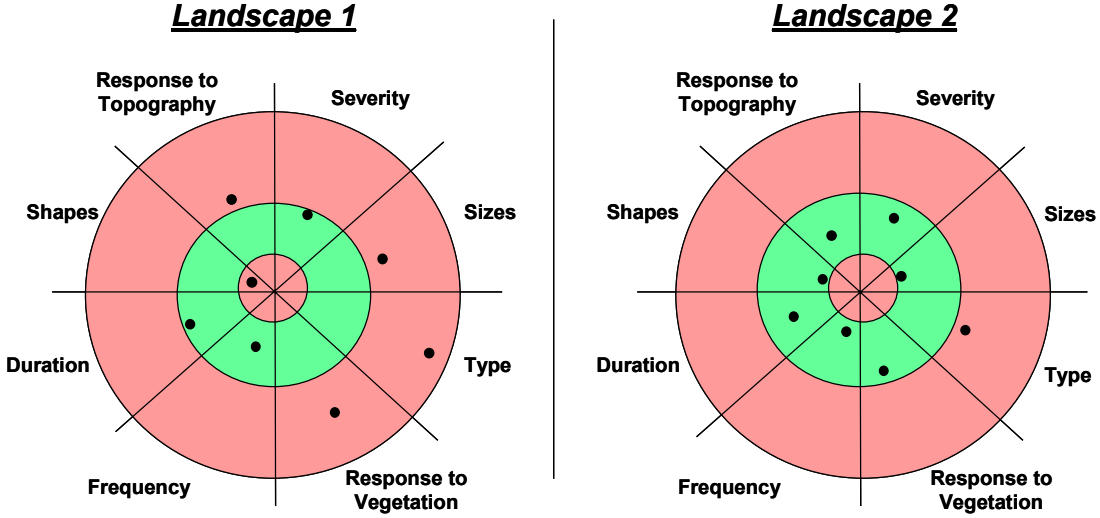
The alternative is to manage biodiversity via the causes. This strategy is both logical and practical. Logical because it mitigates an unrealistic expectation to understand all of

the details of biodiversity by focusing on the conditions under which biodiversity exists in the first place. And practical because it allows us to retreat from an untenable, and increasingly unpopular system of managing landscapes issue by issue, to one of managing overall (eco)system health. It is also practical because one of the short-term processes involved relates directly to our own activities. ***Disturbance*** is the ideal candidate upon which to focus both research and management efforts. Consider:

1) Disturbance is a common and necessary mechanism of natural ecosystem dynamics. Species have co-evolved with their local disturbance regime.
2) Experience strongly suggests that introducing disturbance attributes unfamiliar to the landscape ecosystem will often result in unpredictable and negative shifts in biodiversity - beyond historical levels.
3) Disturbance is the only short-term biodiversity process that we have any control over. Most of our interactions with natural systems are as agents of disturbance (harvesting, road building, land conversion, wildfire prevention, etc).
4) The historical disturbance regime of a given landscape is knowable. This disturbance ***natural range of variation*** (NRV) provides a biologically defendable baseline for virtually all management decisions.

Given this, a reasonable strategy for managing biodiversity values - and landscape health - is to use our knowledge of the timing, type, size, frequency, and severity of historic disturbance activities (and the associated coarse filter outcomes) as the starting point for management decisions. In its simplest form, one could say that Landscape 2 is healthier than Landscape 1 because it has seven of eight indicators within NRV, while Landscape 1 has only three (Figure 2).

Figure 2. Comparing the Health of Two Landscapes Using Eight Disturbance Pattern Metrics (Black Dots) Relative to NRV (Green Zone)



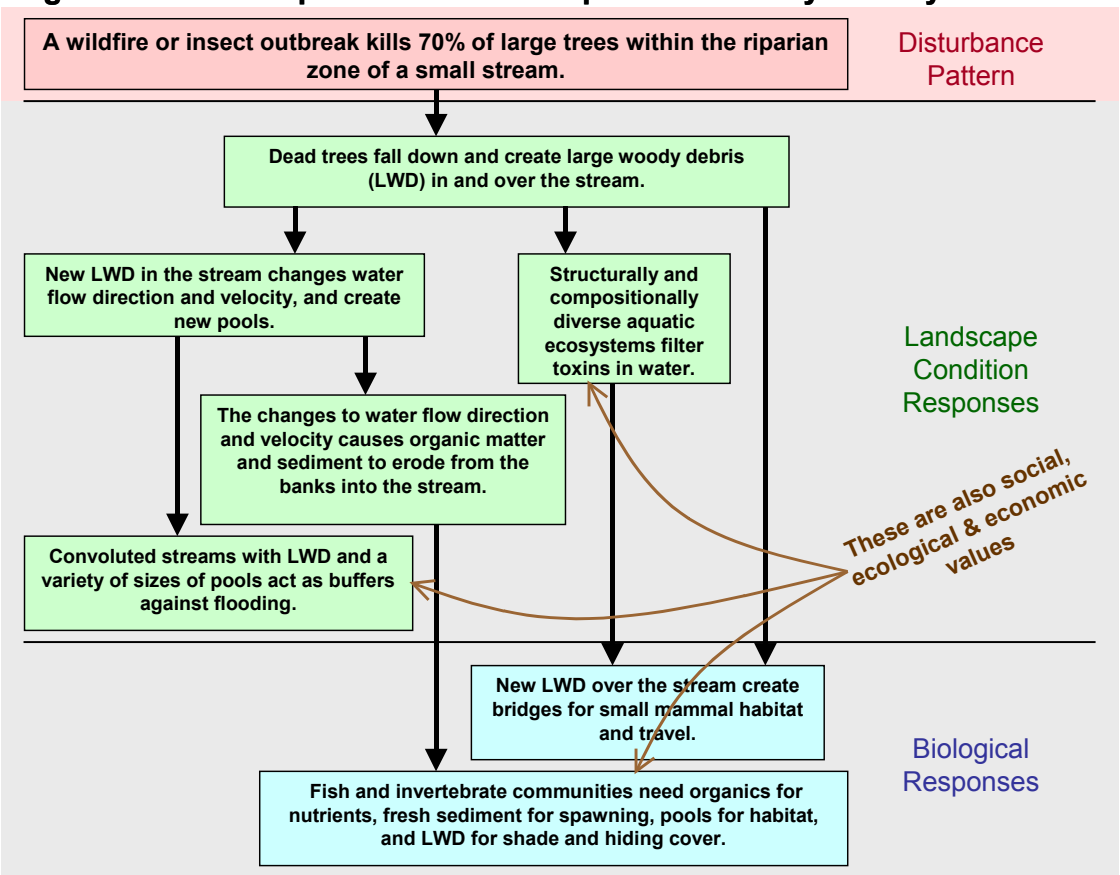
THREE MANAGEMENT MODELS

A *Healthy Landscape* approach to land management represents a paradigm shift. To better demonstrate what this involves, this section expands on Figure 1 by comparing three different "management" models: 1) Mother Nature, 2) Traditional, and 3) Healthy Landscape.

Management Model #1: Mother Nature.

Consider a wildfire that burns through parts of the riparian zone of a small stream (Figure 3). The ***disturbance pattern*** is the level of tree mortality, the size and number of any un-burnt residuals, the size and shape of the wildfire and so on. One of the many changes to ***landscape condition*** caused by the wildfire is that some of the dead trees remain standing for several years, and others will fall down and become large woody debris (LWD) in the riparian zone. Trees that fall in the stream create pools and change the direction and velocity of the water flow. Changes in water flow cause the stream to erode its banks, providing a new source of organic matter and sediment into the water. The combination of LWD, pools, and convoluted stream shape buffer the system against both floods and droughts.

Figure 3. An Example of a Natural Sequence of Ecosystem Dynamics.



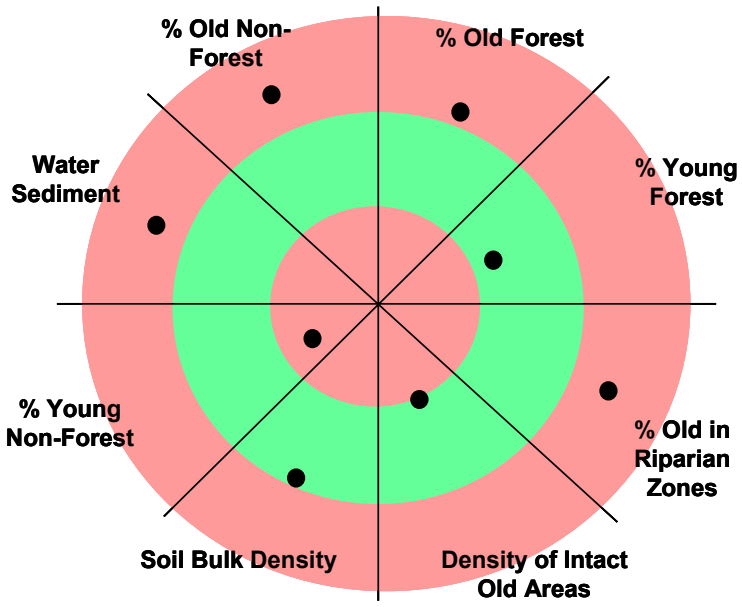
The ***biological responses*** to the landscape condition changes include both terrestrial and aquatic elements. Aquatic ecosystems need organic matter and sediment for food, habitat, and reproduction. The pools and LWD in the stream create a variety of habitat options for fish and other aquatic life. The LWD that falls over the creeks and the dead standing stems provide hiding cover, habitat, and travel corridors for small animals.

The Mother Nature model demonstrates four important aspects with respect to the natural functioning of ecosystems.

1) Disturbance patterns, landscape condition responses, and biological responses are all components of biodiversity.
2) With all due respect to feedback mechanisms, there is generally a hierarchy of cause and effect from **disturbance** to **condition** to **biological response**.
3) Although NRV is usually only associated with disturbance patterns, all components of biodiversity have an associated natural range: Species population levels, woody debris, water flow, and so on.
4) A healthy functioning landscape *always* provides ecological goods and services. In this example, at least three of the boxes represent other ecological, social, or economic (fine filter) values (Figure 2).

Thus, there are several nested layers of landscape health targets associated with NRV. Figure 2 illustrates ***disturbance pattern*** NRV, which is the most obvious. However, there are also ***landscape condition*** NRV targets (Figure 4), and ***biological response*** NRV targets. Note that landscape condition is not limited to vegetation, but extends to water and soils. Note also that species population dynamics is just a ***biological response*** version of NRV. This is not a new idea, just a new interpretation.

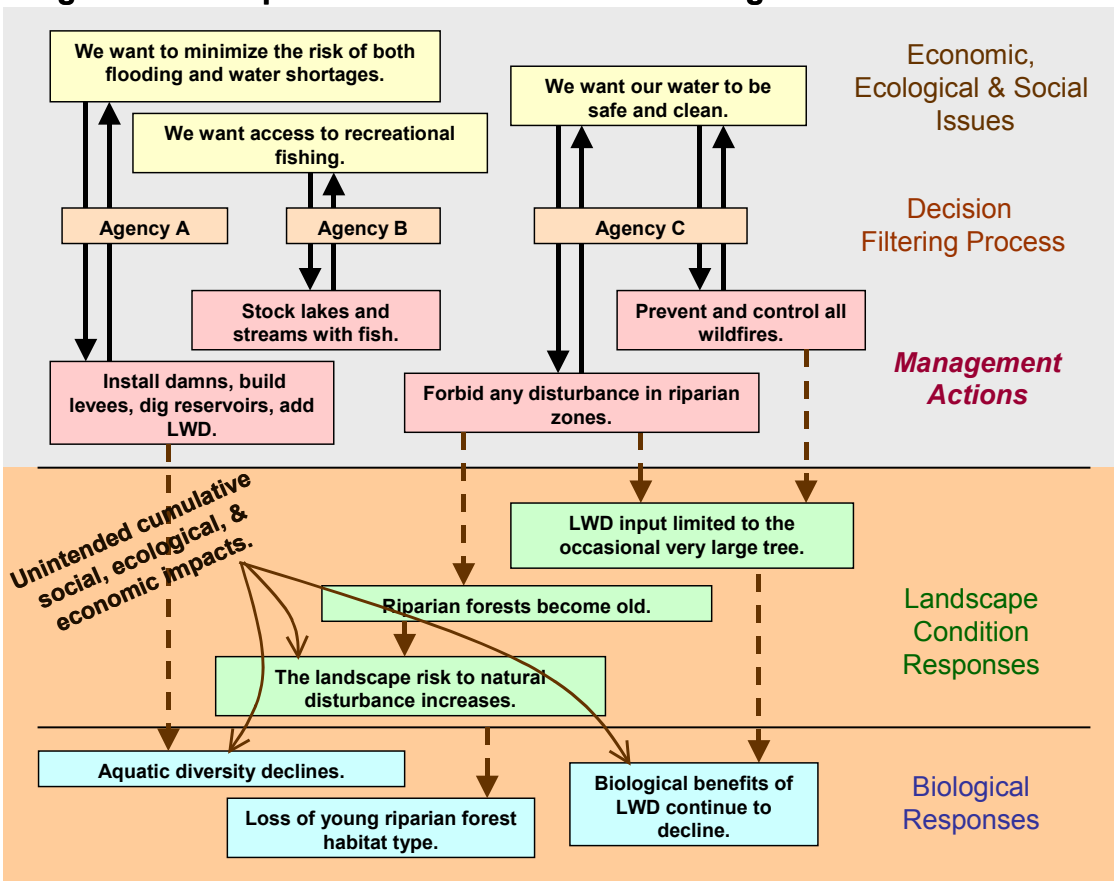
Figure 4. Example of Some Existing Landscape Condition Patterns (Black Dots) Relative to the Natural Range of Variation (Green Zone).



Management Model #2: Traditional.

In the traditional management model, the starting point is the achievement or maximization of one or more **social, ecological and economic issues**. In our example, the issues might be 1) potable water, 2) flood risk, and 3) recreational fishing opportunities, although they could just as likely be timber, natural gas, or recreation (Figure 5). **Management actions** are then designed to optimize or maximize the achievement of each issue; engineered flood control installations, stocking streams and lakes, and so on. Those management actions are subject to a **decision filtering process** that includes consideration of a series of social, economic, and ecological values, public input, and other regulatory requirements (Figure 5).

Figure 5. Example of the Traditional Land Management Process.



The net result of the Traditional Management model is a series of coincidental, but separate activities on a landscape. Management choices are strongly associated with the original issue(s) and agency they serve (Figure 5). The various agencies involved also favour different disturbance tools. Prescribed burning for National Parks, tree harvesting for forest management companies, etc. Furthermore, each management agency also has its own filtering process. Filtering processes can vary dramatically in breadth and depth. Under a Traditional Management model, there are no requirements to coordinate disturbance activities, disturbance tools, or filtering processes among or within different types of land management agencies in Alberta.

One of the by-products of the Traditional Management Model is that **landscape condition** and **biological responses** occur as a result of the cumulative effects of many different management activities**.** If there is no mechanism or requirement to coordinate management activities, there is no way to track or predict their net impact. In the riparian example, the exclusion of disturbance activities in riparian zones combined with wildfire prevention will ultimately create a landscape with large quantities of older riparian forest. This increases the risk of insect and disease outbreak and fire threat for the landscape, but also fundamentally affects biodiversity. Early successional vegetation provides vital detritus, food, and habitat for both aquatic and terrestrial species, and facilitates water recharge in and around streams and creeks.

Management Model #3: Healthy Landscapes

If (bio) diversity is the key to healthy landscapes, and disturbance represents the dominant mechanism creating diversity, then disturbance patterns can provide a measure of landscape health. This knowledge can be exploited in several ways. The simplest would be to include disturbance patterns as decision filters in Figure 5, as many land management agencies do already. However, this is still fundamentally an issue-based approach. The problems associated with multiple filtering systems, overlapping disturbance solutions, and cumulative effects still exist.

Another possibility is to use landscape health more directly as a mechanism to coordinate not only management actions, but also the associated planning activities. Using our example, this might look something like Figure 6. The process begins with the collective agreement on the key landscape health issues, which in this case might include concerns that riparian management has been disconnected from the greater landscape. This provides a common starting point (as opposed to many different starting points with the Traditional Model).

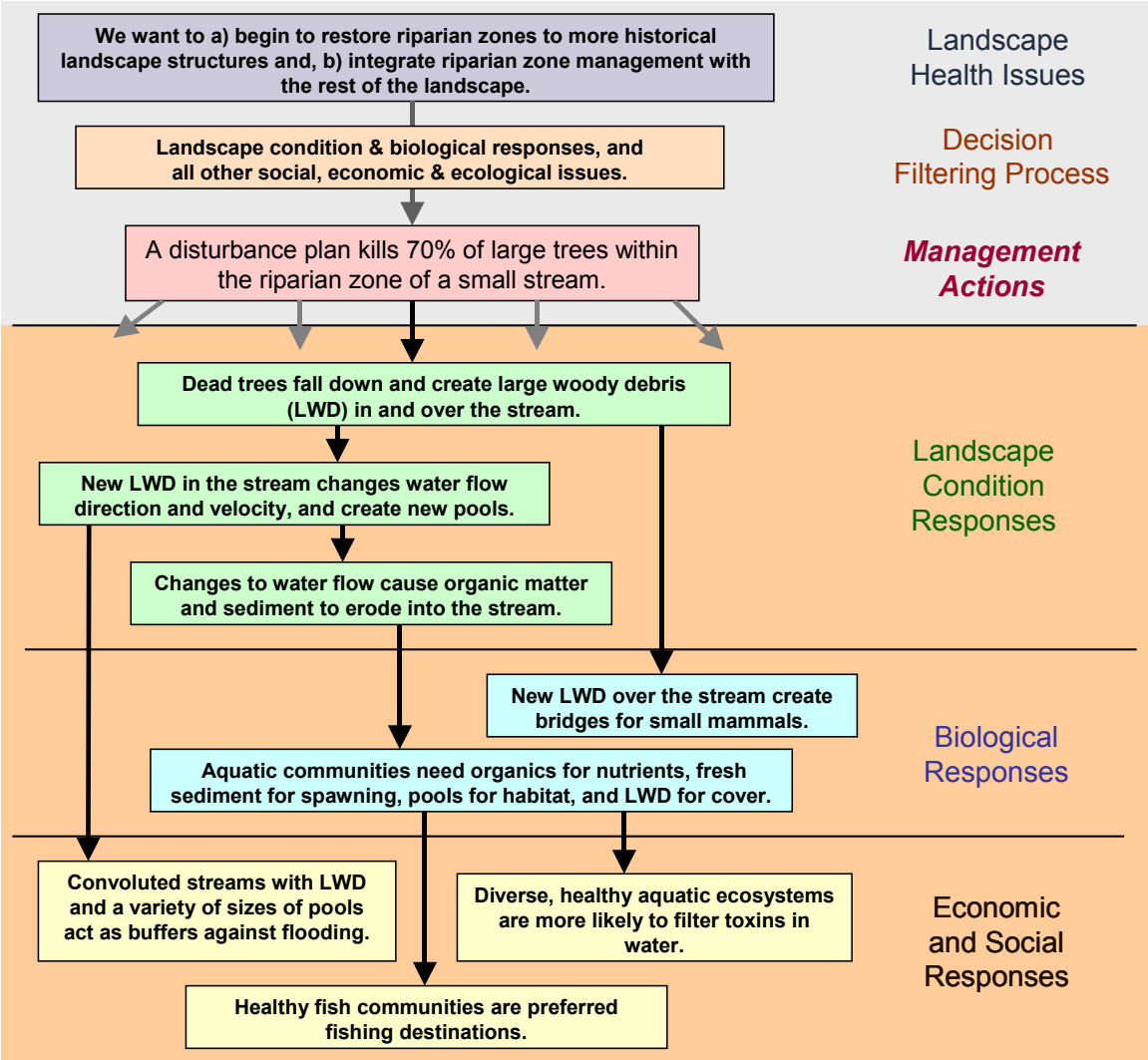
The filtering process includes the same social, economic, and ecological issues as the Traditional Model (Figure 6). The result of a Healthy Landscape plan is a single *disturbance plan* that can then be used to identify individual agency responsibilities (which may include their own secondary filtering process). In this case, the disturbance plan might include specific disturbance targets within the riparian zone (but could include many other elements). The outcomes of a Healthy Landscape plan include the landscape condition, and the biological, social and economic issue responses (Figure 6). However, the outcomes are no longer *cumulative* from a planning perspective because the disturbance plan accounts for all disturbance activities.

Initiating the planning process by referencing landscape health does not mean that plans must stay within NRV, social values are less important, or fine filter issues become secondary inputs. The new arrangement just means there will now be a universal way of assessing the risks of straying beyond NRV to achieve certain other goals.

Many cultural activities such as roads, oil and gas well-sites, seismic lines, water contamination, and chemical spills have no natural pattern equivalent: However, recall that disturbance NRV has associated ***landscape conditions*** and ***biological responses*** NRV (Figure 4). One could still evaluate the risks of those disturbance event(s) through an understanding of NRV. For example, we can measure the landscape condition of

linear features in terms of the resulting size of intact forest patches, which can be compared to the historical natural range. Similarly, rather than focusing on the number of bridge crossings per watershed, one could measure the pattern of sediment and suspended organic matter input (which has a natural range equivalent).

Figure 6. Example of a Healthy Landscape Management Process.



Landscape health also provides a focal point for the planning process, which is a significant practical advantage of the Healthy Landscape model. The entire planning step shaded in grey in Figure 6 is collaborative. The desired future landscape condition is jointly agreed upon among all land managers, regulators, resource users, and the public. In its purest form, there is one strategic filtering process, one strategic disturbance plan, and no cumulative effects (although unforeseen outcomes as a result of a disturbance plan are still probable). In the worst-case scenario, significant planning efficiencies are gained, and adverse cumulative effects are minimized.

TRADITIONAL vs. HEALTHY LANDSCAPE APPROACH

There are several key differences between the Traditional and Healthy Landscape management models:

1) **Planning Foundation.** A large number of different social, ecological, and economic issues provide multiple possible starting points for multiple agencies under the Traditional management approach. Under a Healthy Landscape management approach, ecosystem health provides a universal starting point for everyone. This is no way diminishes the relevance of fine filter issues and goals, but rather provides context for them - a *super-strategy*.

2) **Planning System.** Under a Traditional management model, there are many different management planning systems (often involving various strategic and tactical planning layers), all of which are independent of each other. A Healthy Landscape model provides a single planning system at the front end designed to generate a single land use (disturbance) plan for the greater area within which the agencies involved can then agree to coordinate various disturbance activities in time and space.

3) **Decision Filtering Process.** The decision filtering process changes in both form and function. In terms of form, Traditional land management models involve dozens of different combinations of public consultation, knowledge and data gathering, scientific consultation, modelling, and scenario building. The total cost of the many different filtering processes is enormous. A Healthy Landscape management model can streamline a significant amount of the most controversial and costly front-end filtering process into a single, standardized, shared process. In terms of function, a Traditional management model has no chance of identifying the cumulative impacts of many independent activities. The true impacts and risks of management choices cannot be evaluated unless consideration of all disturbance activities (natural and cultural) is cumulative. Since the Healthy Landscape model advocates a single filtering process, it provides the opportunity to identify potential net effects of different management choices at the front end.

4) **The Role of Fine Filters.** Fine filter biological issues are drivers under a Traditional model, and become shared primary decision filters under a Healthy Landscape model. This subtle shift, if anything, will encourage and focus fine filter research and decision-support model development A Healthy Landscape approach requires a robust and inclusive set of fine filter initiatives for two reasons. First, it provides the link between disturbance, condition, and response. Disturbance NRV may be the best available proxy for landscape health, but it is still a hypothesis that demands constant testing. Second, fine filter issues (such as woodland caribou, water quality and grizzly bear) will continue to be socially relevant, and thus fine filter knowledge and decision-support tools are critical elements of the filtering process.

5) **The Role of Biodiversity**. The Traditional model tends to associate biodiversity with the needs of a single species or biological function. In all fairness, this perception is warranted – the number of critical biological issues has only increased over time. One of the reasons for this is that landscape condition and biological responses are often unforeseen outputs of a Traditional management approach since a) they are often incidental to achieving success of any single value or objective, and b) no single agency has either the mandate or resources for managing cumulative impacts, and/or a landscape condition that has moved beyond NRV. Under a Healthy Landscape model, landscape condition and biological responses - and any associated risks - are linked directly to disturbance plan scenarios, and thus used as input filters for planning early in the process.

6) **Outputs vs. Outcomes.** The primary (intended) output of Traditional land management models is the delivery of the identified values (which are the primary inputs as well). Unintended outcomes include cumulative biological and landscape condition impacts. The intended outputs of a Healthy Landscape model include the landscape condition, biological, social, and economic responses *as equals*. Ideally, there are no unintended outcomes due to cumulative effects since the disturbance plan is inclusive.

7) **Management Focus.** The Traditional approach to land management involves many different models, each one designed to deal with a specific issue; water, forest management, oil and gas, fisheries, recreation, etc. Although a Healthy Landscape approach could work for any one or more of these issues, it is a conceptual foundation for all land - and water - issues. The Healthy Landscapes concept is a universal, holistic management model, and could be applied to any landscape, forested or otherwise, in Canada.

OLD IDEA, NEW INTERPRETATION

The Healthy Landscape model is not a new idea, but rather an extension of an existing, well-accepted concept. The Healthy Landscape model belongs to a family of approaches that use natural disturbance patterns. Forest management agencies and National Parks have more than ten years of experience in using natural (disturbance) patterns (NP) in Alberta. However, the integration of natural disturbance patterns has thus far been narrowly interpreted as a coarse filter tool for forest or park management.

In fact, there is no single *natural pattern approach*, but rather many possibilities based on either needs and/or level of commitment (Table 1). A small community forest may like the idea of integrating disturbance patterns as tactical-planning filters for forest management, but only have limited knowledge of the historical disturbance patterns. A large forest management company may have excellent knowledge and tools, and generate strategic forest management plan scenarios based on the natural range of a few key pattern metrics. A regional NP planning exercise may have extensive knowledge and tools, and involve 10 partners. All of these qualify as *natural pattern approaches*, but clearly they differ from one another in extent and content.

Determining where one is along the NP continuum is a matter of objectively evaluating the needs and the level of commitment. For example, Table 1 lists 13 possible elements of an NP-based approach. The community forest may only trigger one of these elements, thus qualifying as 'Approach A'. The forest company may trigger three elements, and thus meet the needs of 'Approach F', and so on. A Healthy Landscape model will need to address most of the NP elements, and might sit somewhere near 'Approach V'.

Table 1. The Natural Pattern (NP) Approach Continuum.

NP Element	Approach / Level					
	Abcde	**F**ghljk	**L**mno	**P**qrstu	**V**wxy	**Z**
NRV research	X	X	X	X	X	X
Pattern metrics	X	X	X	X	X	X
Suitable landscape size		X	X	X	X	X
Fully integrate variation			X	X	X	X
Full landscape content			X	X	X	X
Current condition considered			X	X	X	X
Integrating nat'l disturbance				X	X	X
Disturbance tools available				X	X	X
Active adaptive management					X	X
Regulatory streamlining					X	X
The landscape includes water					X	X
Deal with adjacent managers						X
Deal with co-managers						x

Although lacking in detail, the implications of Table 1 are noteworthy. It is a concrete manifestation of what many believe is a truism; not all declarations of adopting an *NRV approach* are equal in either depth or breadth. Openly acknowledging the fact that there are multiple interpretations of an NP approach is thus a significant step. Later in this report we present a tool for objectively evaluating NP approaches. The capacity to objectively and consistently differentiate between different claims of natural (disturbance) pattern based approaches is long overdue.

IS A HEALTHY LANDSCAPE APPROACH RIGHT FOR ALBERTA?

The Healthy Landscape model is well suited to Alberta for a number of reasons. Conceptually, it offers 1) a biologically relevant foundation for all land management decisions that support the land as well as the social and economic benefits that flow from it, 2) a starting point or the integration of policies and practices of dozens of different land management agencies, and 3) a direct link to evaluating ecosystem health in a simple but meaningful way.

Technically, many of the natural disturbance regimes in forested areas of Alberta already align fairly well with current cultural disturbance activities. For example, the frequency,

size, severity, and shapes of wildfires are well within our grasp to emulate with mechanical means and prescribed burns.

From a practical perspective, the Healthy Landscape approach has the potential to address many of the most serious natural resource challenges that Alberta currently faces. The decline in demand for natural resources, the associated waning fiscal resources available for planning, increasing public concerns over a wide range of biodiversity issues, and the high threat of mountain pine beetle and wildfire impacts combine to create significant challenges for management agencies working in isolation. The potential to integrate objectives, planning costs, the public input process, regulatory requirements, and disturbance costs and outcomes makes the Healthy Landscape model a viable candidate as an alternative management model.

Philosophically, the concept is timely. A Healthy Landscape approach could potentially be used to deliver the new Alberta Land Use Framework (LUF) vision for individual landscapes, whole regions, or the entire province. Consider:

- The process outlined here is potentially a manifestation of the LUF vision to "…*respect and care for the land as the foundation…"* (GoA 2008). There is no greater level of respect for the land than using knowledge of Mother Nature to help manage it under the auspices of sustaining ecological health as the priority.
- One of the three desired outcomes of the LUF is "*Healthy ecosystems and environment*" (GoA 2008). This concept not only focuses on ecosystem health, it can provide robust mechanisms with which to explicitly measure and monitor it.
- A Healthy Landscape approach offers a universal, biologically relevant foundation for identifying and evaluating the risks of *thresholds* and *carrying capacity*, both of which are key concepts discussed in the LUF document.
- The LUF stresses the desire to "*…integrate provincial policies at the regional level."* (GoA 2008). The leap to a Healthy Landscape management model is not possible without policy and practice integration. The potential to streamline policies and practices within the provincial government alone is appealing.
- The LUF recognizes the need for integration of management activities and the importance of cumulative impacts. A *disturbance plan* is the ultimate manifestation of the integration of management activities. There is also reason to believe that there are economic efficiencies to be gained by coordinating planning and disturbance activities in time and space among many different partners.
- A Healthy Landscape approach can be applied to any landscape, forested or otherwise. Furthermore, management of highly culturally modified landscapes would particularly benefit from adopting a Healthy Landscape perspective since it introduces a universal ecological baseline.

Overall, this may be the ideal time to introduce a comprehensive new way of thinking about and managing landscape ecosystems

Part 2: The Healthy Landscape Model

Regardless of the potential of any new idea, the translation from concept to practice is never simple or obvious. If anything, the greater the associated shift in thinking, and higher the number of translation possibilities. The idea of managing landscapes based on ecosystem-based principles was described by Edward Grumbine (1994) as a "seismic shift in thinking". This suggests there are many possibilities of how a Healthy Landscape approach might play out.

The ultimate manifestation of any new concept is a product of:

a) How well the idea fits with current needs,
b) The degree of change required, and
c) The effectiveness of the communication of the concept with respect to (a) and (b).

The concept seems in step with current needs in Alberta, and we are well aware of the importance of communication. However, in the end, those who are most affected by new concepts must be involved in the implementation. With that in mind, this section offers an intermediate translation of the Healthy Landscape concept.

ELEMENTS OF A NATURAL PATTERN APPROACH

It is convenient that the Healthy Landscape model is only one of many possible natural pattern (NP) approaches. It means that we can design an evaluation system to identify where it fits within the natural pattern approach continuum (as shown in Table 1 on page 14).

There are at least 20 different elements associated with an NP approach (of which, only 13 are mentioned in Table 1). This list can be subdivided into four sub-groups: Technical, physical, process, and partnerships. There is no published literature associated with this topic, so one should consider this a first approximation. The list was complied based on the likely list of physical, knowledge, policy, and practice requirements for the ultimate application of an NP-based approach.

A) Technical Elements

The technical elements of a natural pattern based planning exercise are those largely scientific in nature. The only inputs required are scientific and modelling expertise, research, and NP-relevant decision-support tools. Any agency that currently has a land-based management mandate could develop and implement technical elements in isolation. The technical elements of a natural pattern approach are also well within our grasp – they either already exist, or they can be had with moderate effort.

i) The number and nature of the disturbance pattern metrics

There are dozens of possible disturbance pattern metrics. However, to start, it is important to include metrics that represent all aspects of a disturbance regime: 1) type, 2) frequency, 3) size, 4) shape, 5) severity, and 6) duration. The decision of which aspects to focus on depends on the priorities and objectives. In general,

severity is a pattern worth further exploration since it dictates the sizes, shapes, types, and mortality levels of undisturbed residuals. Note that the number and nature of disturbance pattern metrics is in part dictated by the available knowledge of the local disturbance regime (see element **iii** below). Adopting a complex set of pattern indicators unsupported by research may only add confusion. Figure 2 (for example) is not very comprehensive, but simple to understand.

ii) The number and nature of landscape condition metrics
Recall that the second level of natural patterns is *landscape condition* (Figure 4). The landscape condition provides important context for planning decisions. A landscape heavily influenced by cultural activity for many years may already be well beyond NRV and require some sort of disturbance pattern restoration plan. For example, one may design a disturbance plan that is deliberately beyond NRV in order to restore a landscape to a more natural condition.

iii) How well do you know the local historical disturbance regime?
Research strongly suggests that historical disturbance patterns are landscape specific. Thus it is always better to have broad-based local disturbance pattern research either in hand, or in progress. However, in the absence of local research, it is still possible to borrow some generalities from other regions to help achieve some level of natural pattern integration (see element **Ai** above).

iv) What NRV-based tools and spatial data are available?
A variety of existing decision-support tools, models and data can be brought to bear that will vastly improve the ability of a plan to address natural pattern issues. Many existing tools and models can also be adapted to incorporate NRV information. (Note: This is not an evaluation of management planning tools or data – only those that related to NRV).

B) Physical Elements

Physical elements are those that relate directly to the landscape under consideration. A natural based plan has a far better chance of success if the landscape is representative of one or more contiguous, independent disturbance regimes. Maximizing physical elements may or may not include partnership challenges.

i) Landscape size
Management of disturbance activities becomes more meaningful as landscape size increases (and the potential for inconsistencies with neighbours' plans decreases). As landscape size decreases, management options become limited, the risk of fragmentation increases, and individual management activities become less meaningful. A series of small landscapes managed in isolation essentially create a different form of unintended cumulative effects.

ii) Landscape continuity and content
A landscape should be contiguous, complete, and representative of the full range of ecosystem types of the general area. This is particularly important in areas where dramatic changes in stand conditions occur over short distances. In the

Alberta foothills, for example, it is critical to include parts of the montane, lower foothills, upper foothills and sub-alpine natural sub-regions since the historical disturbance patterns of each are intimately connected.

iii) Landscape boundaries
There are two parts to the issue of boundaries: 1) boundary location, and 2) the resulting shape of the landscape. Boundaries that are based on natural features and breaks are more likely to represent a biologically relevant area than are jurisdictional boundaries. Similarly, simply shaped landscapes are more likely to be biologically meaningful.

C) Process Elements

Process elements are those that require potential changes to policies, practices or standard operating procedures within an individual organization. Some process elements may require consultation and negotiation with other agencies, but they can all be achieved without any formal interagency collaboration.

i) Integrating variability
Natural processes such as disturbance are not deterministic, nor are they random. For all patterns there exists a range of possibilities. Capturing this variation is a critical part of managing for natural patterns. How is a plan going to introduce / embrace / encourage variability, and discourage the use of hard targets such as averages and minimums?

ii) How are natural patterns used in planning?
Natural patterns can be integrated into planning in a number of different ways. For example, pattern metrics can be used as post-planning NRV indicators, included with a list of other values meant to be balanced as a group, or they can be used as the starting point for planning decisions. Using natural patterns as the common starting point for planning decisions is the most advanced option.

iii) How is feedback incorporated?
The ultimate leap of faith involved in an NP strategy is that Mother Nature knows best. In other words, biodiversity values, and the associated goods and services, are sustainable if we create more natural disturbance patterns. This premise demands that knowledge gaps about the NRV-related pattern, condition, and response elements, as well as the likely social, and economic consequences of disturbance plan choices must be dealt with. The ideal feedback mechanism is an active adaptive management policy that requires a) making predictions, b) measuring outcomes / responses, c) comparing predictions to responses, and d) formulating new questions, knowledge, tools, and predictions for next time. In other words, integrating directed science with management in a continuous loop.

iv) Is natural disturbance activity integrated?
It is impossible to plan for individual natural disturbance events since their location and extent cannot be predicted. However, they are far more predictable over large areas and longer timeframes. A robust NP-inspired plan acknowledges those risks

by creating a strategy to deal with as they occur. This involves a willingness to adapt planned activities to harmonize with natural events.

v) Do plans consider the entire landscape?
There may be parts of the landscape where conflicting policies may be actively preventing disturbance for some reason (riparian zones, bogs, non-merchantable forest, meadows, lakes, streams, wetlands, and so on). A more complete plan for disturbance activities is more likely to sustain a healthy landscape and a suite of social and economic values.

vi) What disturbance tools are available?
The more disturbance options there are available, the greater the likelihood of natural pattern emulation. The list includes prescribed burning, flooding, harvesting, thinning, girdling, road building, etc. Disturbance tools that occur naturally (such as flooding and prescribed fire) are functionally superior to surrogates (such as harvesting and thinning).

D) Partnership Elements

Partnership elements are those that require collaboration with other agencies. Achieving some level of success with partnership elements requires an entirely different type of commitment that involves policy changes, regulatory streamlining, education, communication, and perhaps even realigning agency functions. Partnership efforts recognize two distinct types of partners: Neighbours (*i.e.*, agencies with the primary management responsibility for adjacent landscapes), and co-managers (*i.e.*, multiple agencies responsible for resource management on the same piece of ground).

i) What proportion of land neighbours are involved?
Disturbance planning that involves neighbouring areas under the jurisdiction of other agencies increases the size of the landscape, and reduces the total number of management plans for a given area. In particular, the relationship between the capacity to deal effectively with water management issues and landscape size is direct and significant. A long list of land partnerships also potentially provides a greater range of tools, systems, and expertise.

ii) Level of involvement of land neighbours
There are degrees of cooperation among neighbours from sharing plans as they occur, to sharing initial stages of planning, to fully collaborative planning activities.

iii) What proportion of co-land managers are involved?
Disturbance planning that involves all actual and potential management agencies operating on a given land base is necessary to address cumulative effects. There are many different land management agencies that have rights and responsibilities on the same piece of land. For example, Alberta Environment is responsible for water; the Federal Department of Fisheries and Oceans is responsible for fish habitat; Alberta Tourism Parks and Recreation is responsible for provincial parks; Parks Canada is responsible for National Parks; Alberta Energy is responsible for the rights and access to oil and gas; Alberta Sustainable Resource Development is

responsible for the access to timber; and grazing rights fall under the purview of Alberta Agriculture and Rural Development.

iv) Level of involvement of co-managers.
The greater the participation level of each land management agency on a single landscape, the more "natural" the pattern outcome is likely to be. Involvement can take many forms, from sharing ideas, data, and knowledge, to offering advice and input, to full collaboration on the final product.

v) Does the team include water-related agencies?
The capacity of single agencies to deal effectively with water issues is limited. Water is included here because it is the primary mandate of non-tenure based agencies. Having the Department of Fisheries and Oceans (DFO) and/or Alberta Environment involved in landscape planning denotes a fundamental shift in perspective in terms of what it is we are managing. That perspective must include recognition of linkages between the terrestrial and aquatic components of the landscape, the consideration of water at multiple scales, and in an integrated aquatic ecosystems approach.

vi) Intra-agency regulatory collaboration
Regulatory agencies that create highly integrated policies and practices are more likely to encourage an integrated landscape management approach. For example, this would include the various branches and departments within ASRD developing and adopting an integrated set of requirements for planned disturbance options.

vii) Inter-agency regulatory collaboration
The many provincial and federal agencies involved in different aspects of natural resource management have different, and potentially overlapping policies and procedures. Perhaps the most challenging institutional element required for integrated NP-based landscape planning is to better align these requirements. Ideally, land managers need a clear and complete set of guidelines.

A NATURAL PATTERN INTEGRATION TOOL

The simplest form of a natural pattern-based evaluation system is shown in Table 2. The 20 elements listed above can score a maximum of 10 Natural Pattern Indicator, or 'NPI' points each. Assuming equal weighting, the maximum NPI score is 200. If one or more of the four element categories are particularly important to track, sub-totals can be compared to maximum scores separately. Note that this only evaluates *the degree to which a landscape is managed based on the concept of a natural pattern foundation* – it in no way evaluates planning outcomes, or overall planning commitment or quality.

Note that the tool makes at least three simple assumptions, for the reasons given below:

1) **These are the only 20 relevant NP elements.** If more elements become obvious over time, they can be easily added. The maximum possible score of 200 is an arbitrary number.
2) **The scoring is subjective**. The point of the model is not to evaluate an absolute score relative to some passing or failing grade, but rather to evaluate a

relative score (compared to the scores of other NP efforts). For example, a plan that scores 60 NPI points is generally a more advanced NP planning exercise than a plan that scores 30 NPI points.

3) **Each element is equally important.** We are collectively not in a position to argue otherwise and assign different weights to each element. In any case, it is always possible to compare individual element scores directly.

Table 2. A Tool For Evaluating the Expectations of an NP-Based Plan.

NATURAL PATTERN INTEGRATION GAME		
How Natural is Your Planning Exercise?		
TECHNICAL ELEMENTS	**Max.**	**H.F. Min.**
The number and nature of disturbance patterns being included (0=none, 10=many and varied)	10	7
The number and nature of landscape condition patterns included (0=none, 10=many and varied)	10	7
How well do you know the historical disturbance patterns? (0=not at all, 10=intimately)	10	7
What pattern related decision-support tools & data do you have available? (0=none, 10=plenty)	10	7
Technical Sub-Total	**40**	**28**
PHYSICAL ELEMENTS	**Max.**	**H.F. Min.**
Is the size of the landscape large enough to be a disturbance regime / ecossytem ? (0=no, 10=yes)	10	7
Is the landscape complete, and representative of the larger region? (0=no, 10=yes)	10	7
How well do the boundaries align with natural boundaries? (0= not at all, 10= very well)	10	7
Physical Sub-Total	**30**	**21**
PROCESS ELEMENTS	**Max.**	**H.F. Min.**
To what degree is (disturbance pattern) variation included? (0=not at all, 10=intimately)	10	7
How is NRV used in planning? (0=not at all, 4= post-hoc, 7=indicators,10= foundation)	10	7
Is feedback incorporated? (0=no, 3=passive AM, 5=focused research, 10=active AM)	10	7
Are responses to natural disturbance events part of the plan? (0=no, 10=fully integrated)	10	7
Do plans include consideration of all parts of the landscape? (0=no, 10=yes)	10	7
How many, and what type of disturbance tools are available?		
(2 points each for harvesting and thinning, 3 points each for fire and girdling)	10	7
Physical Sub-Total	**60**	**42**
PARTNERSHIP ELEMENTS	**Max.**	**H.F. Min.**
What proportion of land neighbours are involved? (0=none, 10=everyone)	10	7
Average level of involvement by land neighbours (0=just chit chat, 10= fully integrated planning)	10	7
What proportion of overlapping land partners are involved? (0=none, 10=all)	10	7
Average level of involvement by land partners (0=just chit chat, 10= fully integrated planning)	10	7
Does the plan include water-related agencies? (0=none, 10=all)	10	7
Intra-agency regulatory collaboration (0=none, 10=complete)	10	7
Inter-agency regulatory collaboration (0=none, 10=complete)	10	7
Institutional Sub-Total	**70**	**49**
	Max.	**H.F. Min.**
Technical Sub-Total	**40**	**28**
Physical Sub-Total	**30**	**21**
Process Sub-Total	**60**	**42**
Partnership Sub-Total	**70**	**49**
TOTAL	***200***	***140***

The benefit of a simple form of an evaluation tool is the ease with which it can be explained and understood. At this stage, shared understanding is our greatest need. Even with the obvious subjectivity, the NP evaluation model still provides the capacity to identify specific strengths and weaknesses, compare planning strategies to one another, track progress, and establish thresholds (for a Healthy Landscape approach for example). The inclusion of the four element sub-totals only adds another layer of information. For example, two NP planning efforts may both score 80 NPI points overall, but one may score very high on Technical elements, and another very high on Partnership elements. This is valuable information in terms of generating realistic expectations.

Thresholds for overall total and the four category NPI scores can now be established and compared to actual outcomes to determine the type of NP approach. In this simplistic form, perhaps only three or four types of NP approaches need to be defined. For example, an NPI score of 30-60 might denote a "basic" NP approach, an NPI score of 61-120 an "intermediate" approach, and any score higher than 120 an "advanced" approach. A slightly more sophisticated version of defining NP types would be to use the four sub-totals as keys to understanding the specific strengths and weaknesses. For example, a *Technical and Physical* NP approach would probably look much different than a *Process and Partnership* approach, although they may score the same overall.

SOME *NPI* SCORE REFERENCE POINTS

Before discussing where the Healthy Landscape approach might fall within the NPI scoring system, it is helpful to define some reference points. For example, the average Alberta landscape today would score about 50 NPI points (Table 3), although this varies considerably. The average score is informative for several reasons:

1) Most land-based resource management agencies in Alberta already accept and use one form or another of an NP approach. In contrast, most tenure-only resource management agencies (*e.g.*, those with resource rights, but no long-term or permanent land base) have marginal interest in the concept. This disconnect is symptom of *issue-based* management strategies, as opposed to *ecosystem-based* approaches.

2) The average Alberta landscape scores consistently highest in the Technical elements, thanks in large part to a substantial ongoing investment in historical disturbance regime research. In fact, there are several landscapes in Alberta that would score extremely well on their Technical and Physical NPI merits.

3) The Partnership and Process scores for the average Alberta landscape are low. It is not unusual for a landscape to have more than 10 different agencies with management rights, and there are few incentives to collaborate. These are likely the most challenging elements to achieve.

The most likely to generate a high NPI score in Alberta is a large National Park (Table 3). The investment in disturbance regime research is moderate to high, the size and orientation of large parks tends to be well suited to landscape management, and there are no internal land co-management partners to deal with. While the current average

score of 115 may seem low, the potential of large National Parks to be involved in a more sophisticated version of an NP approach via partnerships (such as a Healthy Landscape model) is relatively high.

Table 3. Maximum Possible NPI Scores Relative to the Alberta Average, the Minimum Suggested for a Healthy Landscape Approach (in Dark Green), and Several Examples.

Natural Pattern Scenario	Natural Pattern Element Category (from Table 2)				Total
	Technical	Physical	Process	Partnership	
Maximum Possible Score	***40***	***30***	***60***	***70***	***200***
Estimated Alberta Average	18	10	15	12	50
Large National Park (ave)	20	25	30	40	115
Large FM Area (ave)	20	25	20	20	90
Small FM Area (ave)	20	5	20	5	50
Small provincial forest / park	15	5	10	5	35
Healthy Landscape Minimum	28	21	42	49	140
Landscape A	35	13	26	9	83
Landscape B	29	15	44	21	109
Landscape C	18	22	45	55	150

An average large Forest Management Area (FMA) in Alberta scores a 90 on the NPI scale (Table 3). Under the circumstances, this is still a considerable accomplishment. Remember, this is not an evaluation of management effort or outcomes, but rather the commitment to the 20 NP elements. Many large FMAs in Alberta have made significant commitments to an NP approach, but they have limited control over all of the management activities on a given landscape. This means that both Process and Partnership points will be limited.

The capacity of smaller landscapes to score high on the NPI scale (regardless of the land management agency involved) is limited (Table 3). Small landscapes suffer reduced NPI scores because of low Physical and Partnership NPI points. The smaller the landscape, the more important it is to create partnerships from a natural pattern perspective. Fortunately, this is one of the easiest weaknesses to deal with. Even the smallest provincial forest areas or Parks can dramatically increase its NPI score by collaborative planning with one or more adjacent land management agency.

WHAT IS A HEALTHY LANDSCAPE *NPI* SCORE?

Given the high expectations, we are fairly confident that a Healthy Landscape approach is on the high-end of the natural pattern continuum (Table 1 on page 15). A Healthy Landscape model should therefore have a high to very high NPI score overall, but also be well balanced among the various elements. For example, of the 20 NP questions, one should generally be able to answer, “yes” to each one to qualify as a Healthy Landscape model. With this in mind, as a conservative starting point, we propose that a Healthy Landscape designation requires an average score of 7 out of 10 NPI points for each element, which translates into a total minimum score of 140. Furthermore, assume

that there is an equivalent minimum requirement (also averaging 7 out of 10 NPI points per element) for each of the four element categories (as per Table 3).

Thus, it is possible to score very high on one or more of the four element groups, but not achieve a Healthy Landscape designation. For example, landscape A and landscape B both exceeded the Technical requirements of a Healthy Landscape approach, but fell short on both Physical and Partnerships elements (Table 3). Landscape D exceeded the minimum requirements on three of the four element categories, as well as the overall threshold of 140 points, but their plan did not qualify as a Healthy Landscape Approach because it fell short of the required Technical elements (Table 3).

So what would it take to achieve a Healthy Landscape designation? For large to medium-sized landscapes, the main challenge is to improving Process and Partnerships. Many of the larger landscapes in Alberta already exceed the Physical requirements, and are very close with respect to the Technical requirements (Table 3). The focus of smaller landscapes should be on forming meaningful partnerships.

MOVING FORWARD

The release of this report marks the beginning of the next phase of the FRI Healthy Landscape project. This next phase will involve two related components. First, a dedicated communications effort will be initiated focusing largely on soliciting feedback to the many ideas and tools presented here. Related briefing notes, presentations, workshops, posters, and a journal manuscript will complement this report.

The second objective of the next phase of this project is to engage a willing collection of resource management partners in some form of a demonstration of the Healthy Landscape concept. The exact nature of this exercise could be anything from a virtual exercise, to a fully engaged multi-stakeholder process, or some sort of hybrid between these two extremes. Regardless, such a demonstration would ideally:

a) ***Link logically and practically with ongoing strategic planning exercises***. The process should produce data, tools, and knowledge that could be easily integrated by subsequent LUF, DFMP, or other strategic planning exercises.

b) ***Include a minimum of five partners, at least three of which should be land partners***. This provides a reasonable assessment of the potential for planning across administrative boundaries.

c) ***Involve several millions of hectares***. At the very least, the landcape ecosystem should be meaningful.

d) ***Use real data and issues, and identify realistic management options.*** The more ‘real’ the demonstration, the more likely we will gain new insights from the experience.

The ultimate goal of this project is to fully explore and share the potential opportunities and challenges of a Healthy Landscape approach to the point where land management agencies and the associated management partners are able to make an informed decision about if or how to use it.

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