



Review and Evaluation of Adaptive Management in the Fish Habitat Management System for Yukon Placer Mining

March 13, 2020

Prepared for:



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Review and Evaluation of Adaptive Management in the Fish Habitat Management System for Yukon Placer Mining

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1.0 Introduction

1.1 Context

In late 2002, Fisheries and Oceans Canada (DFO) announced that the existing *Yukon Placer Authorization*, the “class”-based authorization system under the *Fisheries Act* in place since 1988, would be phased out and replaced with site-specific *Fisheries Act* authorizations. This decision faced significant opposition from many groups in the Yukon. These responses made it clear that a new management system would be needed which ultimately led to the development of the current Fish Habitat Management System (FHMS) for Yukon Placer Mining. In 2003, DFO committed to the development of this new integrated management system through an intergovernmental agreement with the Yukon Government and the Council of Yukon First Nations, and the plan for the new management system was designed in 2005 and implemented by 2008.

The Fish Habitat Management System (FHMS) for Yukon Placer Mining is founded on principles of adaptive management (AM) and a risk-based approach to decision making. The FHMS specifies sets of operational regulations and standards for placer mining based on watershed sensitivity and fish habitat suitability. These components are designed to support the management regime in achieving its dual objectives of a sustainable Yukon placer mining industry alongside the conservation and protection of fish and fish habitat supporting fisheries.

There is a need for an adaptive management framework to support the FHMS because there is uncertainty about whether the FHMS’ operational requirements will in fact balance these two objectives or whether they will shift the system toward achieving one of the objectives at the expense of the other. The 2005 *Final Report to the Minister of Fisheries and Oceans*, which outlines the structure of the FHMS, similarly explains that an AM approach “*recognizes uncertainty and the constraints of knowledge*” and thus provides a “*process for using new information from monitoring and research to modify management practices.*” The FHMS Adaptive Management Framework (AMF) provides an approach by which the effects of the operational requirements are monitored, assessed, and evaluated to determine whether these requirements need to be adjusted to better balance the objectives. In other words, the framework provides a mechanism for flexibility to account for the uncertainties inherent in the management of a complex economic and ecological system, and does so through an intentional, systematic design. The need and benefit for an AM approach is explicitly affirmed in the design of the FHMS, as illustrated by the following quotes:

“For the regime, adaptive management is an important tool to address the uncertainties inherent in regulating the placer industry to achieve no net loss of habitat productivity. Through adaptive management, habitat conservation and protection measures can be adjusted over time.” (YPISC & YPWC 2005, page 14)

“In December 2002, the Minister of Fisheries and Oceans announced the decision to phase out the YPA. This decision was not well received by many individuals and stakeholder groups in the Yukon and it was quickly recognized that a new management system was necessary to replace the YPA. The strong reaction to the Minister’s decision was followed by the development of a Record of Agreement (RoA) between the Yukon Government (YG), Fisheries and Oceans Canada (DFO) and the Council of Yukon First Nations (CYFN). In May 2003, the RoA was signed by the three parties.” (YPS 2008d, page 3)

Beyond the Yukon Territory, AM has a long history of implementation for more than 40 years (Holling 1978). Within North America it is currently being applied to the California Delta (DSC 2018), the Missouri River (Fischenich et al. 2018), the Platte River (PRRIP 2006), the Louisiana Coast (CPRA 2017), and the Great Lakes (GLRI 2016), among other places. Its popularity is due, in part, to many seeing the benefits of AM as a structured way to address and resolve uncertainties in the management of complex ecosystems. In its ideal form, the approach explicitly uses management actions to support structured learning by testing hypotheses about the effectiveness of different choices of decision makers, or in other words to ‘learn by doing’ (Williams



et al. 2009; Williams and Brown 2012; Murray et al. 2015). Despite the benefits, many acknowledge there are also challenges in its implementation (Olsson et al. 2006; Walters 2007; Childs et al. 2013); although some dispute that these challenges are unique to the approach itself (Scarlett 2013). Regardless, many insights have been gained about the approach which can be used as a benchmark against which to compare and assess the success of AM programs (Greig et al. 2013).

In the context of the Yukon, a substantial level of attention and effort has been invested in the design and implementation of an Adaptive Management Framework to support placer mining since 2008. The AM process identifies how information gathered from the three monitoring programs (i.e., aquatic health, water quality objectives, economic health) and Traditional Knowledge will be used to guide decisions about potential adjustments to the regulator framework related to the placer mining industry (YPS 2008a). It identifies the decisions to be informed and the decision-makers. The three effects monitoring protocols were implemented in 2008 (YPS 2008b; 2008c; 2008e). Recently, a review was conducted to understand how the FHMS, including the AMF, has been implemented (YPS 2016). As well, an external scientific review of the aquatic health monitoring protocol was conducted in 2018 (DFO 2019) and a review of the economic health monitoring protocol was conducted in 2019 (Kishchuk 2019). An abundance of background materials, first-hand experience, and data are available to gather insights about the success and challenges associated with the AMF since its inception.

Within this broader context, the purpose of this review and evaluation is to conduct an overarching examination of the design and implementation of AM as applied to Yukon placer mining with the intent of identifying areas of strength and opportunities for improvement that can strengthen its success. To do so, this document first describes an evaluation approach for undertaking this work (Section 1.2) that draws upon the best practice in AM (i.e., ideal phases, steps, elements, and enabling factors). Next, this document provides an overview of the current context and components of the FHMS that need to be considered in the context of AM (Section 2.0). The evaluation approach and a related set of evaluation questions are then used as a reference point against which the current context is assessed to understand how the AMF and supporting components compare to the best practice in AM (Section 3.0). Lastly, these evaluation insights are synthesized and used to identify a set of broad, overarching recommendations that focus on the highest leverage opportunities for improving the effectiveness and success with which AM is being applied in the Yukon Territory (Section 4.0).

1.2 Approach

As noted above, there are many years of experience upon which to draw and understand how adaptive management can be most effective. One definition of AM describes it as “a rigorous approach for designing and implementing management actions to maximize learning about critical uncertainties that affect decisions, while simultaneously striving to meet multiple management objectives” (Marmorek et al. 2019). Typically, AM is described as a process involving six sequential steps, organized in a closed learning loop (Figure 1). These steps often involve applying many specific elements that represent the components and best practice for undertaking work within each of these steps (see Table 1). Moreover, experience has shown that undertaking these steps and elements is insufficient on their own and that they need to be supported within a broader context and enabling environment, which can be described as a series of enabling factors (Table 2).



Figure 1. Phases and steps of the adaptive management cycle. Adapted from Williams et al. (2009).



Table 1. Summary of the generalized phases, steps, and elements of adaptive management. Adapted from Murray et al. (2015).

Phase of AM	Step of AM	Description of Step	Ideal Elements for Each Step
<p>Planning</p>	<p>Assess and define the problem</p>	<p>This step sets up the adaptive management problem that needs to be addressed through the actions of decision makers, alongside clarifying the desired outcomes or objectives they are trying to achieve. An important element involves being clear about and focused on critical “management uncertainties”; those unknowns that most affect the ability to understand the effectiveness of decision makers’ actions. A variety of tools can be used at this step to assess the potential outcomes from alternative actions, such as conceptual or quantitative models of the system.</p>	<ul style="list-style-type: none"> • Clearly state management goals and objectives • Identify key uncertainties (i.e., management questions) • Explore alternative management actions (experimental “treatments”) • Identify measurable indicators • Identify spatial / temporal bounds • Build conceptual models • Articulate hypotheses to be tested • Explicitly state assumptions • State up front how what’s learned will be used • Involve managers • Involve Indigenous communities and knowledge holders • Involve scientists • Involve stakeholders
	<p>Design actions</p>	<p>This step involves designing the management interventions based on results from the assess stage. This step may involve developing an implementation plan for the actions and monitoring plan for data collection that employs principles of experimental design. This step can also involve specifying how data from monitoring will be used, alongside the decision criteria and triggers to be considered in the evaluate step.</p>	<ul style="list-style-type: none"> • Implement management experiments (i.e., active and passive AM) • Include contrasts, replications, controls • Get statistical advice • Predict outcomes • Consider next steps under alternative outcomes • Develop a data management plan • Develop a monitoring plan • Develop a formal AM plan for remaining steps • Peer review the design • Obtain multi-year budget commitments • Involve Indigenous communities and knowledge holders • Involve stakeholders



Phase of AM	Step of AM	Description of Step	Ideal Elements for Each Step
Doing	Implement actions	This step includes implementing the management actions as designed and keeping track of what was implemented since there will inevitably be deviations from what was planned and what occurred.	<ul style="list-style-type: none"> • Implement contrasting treatments • Implement as designed (or document unavoidable changes) • Monitor the implementation
	Monitor responses	This step is focused on conducting various types of monitoring which can include collecting baseline data prior to implementation of any actions, evaluating effectiveness of management actions, as well as monitoring the status and trends of valued components.	<ul style="list-style-type: none"> • Implement the Monitoring Plan as it was designed • Undertake baseline (“before”) monitoring • Undertake effectiveness monitoring
Learning	Evaluate results	This step requires using the data from monitoring to develop insights about the effects of the management action and evaluate progress towards the ultimate objectives of the program. Analyses may include comparing outcomes to model predictions from the assess step, comparing results between treatment and control sites, or comparing outcomes to the management objectives. Analyses may occur on a regular, ongoing basis, but synthesis and insights may be developed at less frequent intervals.	<ul style="list-style-type: none"> • Compare monitoring results against objectives • Compare monitoring results against assumptions, uncertainties, hypotheses • Compare actual results against model predictions • Receive statistical or analysis advice • Ensure data analysis keeps up with data generation from monitoring activities
	Adjust management actions	This step brings information together from all the previous steps to determine whether adjustments in actions are required. In some cases, adjustments may be necessary while in other cases adjustments may only relate to changes in the models, monitoring, or analyses of emerging evidence. Decision makers (and often stakeholders) also need to be involved in this step, along with many other steps, otherwise adjustments are unlikely to occur.	<ul style="list-style-type: none"> • Develop meaningful insights and document learnings • Communicate learnings to decision makers and others • Adjust actions based on what was learned



Table 2. Enabling factors that provide the overarching support for the successful design and implementation of adaptive management. Adapted from Greig et al. (2013).

Enabling Factors	Description of Factors
Context & Problem Definition	<p>The problem context can cause AM to develop in very different ways. A proper consideration of the problem context can help ensure that AM is applied in the appropriate historic and local context. Context can strongly influence in positive and negative ways the institutional drivers motivating the need for AM and the relationships among individuals/organizations involved.</p> <p>Moreover, being clear about problem definition involves ensuring there is agreement among parties that the focus is on the correct problem, which includes how the problem is expressed. Problem definition needs to be durable and capture the larger context otherwise the focus can be lost or lead to crisis management.</p>
Trust	<p>Trust relates to the strength of the relationships among individuals / organizations, and affects their ability to participate, interact, and engage in the AM process. The parties involved need to trust each other, trust the process, and trust the science / knowledge that is being used to inform management decisions. Hence, trust is a critical enabler for AM to be successful.</p>
Leadership & Executive Direction	<p>Leadership is essential, but not sufficient for success. This factor involves having a clear vision and effective communication with leadership to gain broad support regardless of the level at which leadership is involved. Local leadership may be important in some cases where top down leadership will not work.</p> <p>A clear and strong commitment from executives facilitates success, backed up by the regulatory authority and/or a legislative driver to do AM.</p>
Organizational Structure	<p>This factor involves the structure being used to make decisions and be accountable within an organization and how other organizations are involved in decision making. The organizational structure will also influence the flexibility of the organization to respond to unexpected events and learn from the emerging science over time. Information should flow through the structure in a clear and transparent way, which can also be important for building trust and learning.</p> <p>The organizational structure also involves consideration of the participants involved in the AM process, which depends on the context. For public/shared resources, a participatory approach that involves varied stakeholders' perspectives in knowledge generation, deliberation, and decision making can enable success. The most effective AM programs have a small number of stakeholders who trust each other and can make decisions in an agile manner.</p>
Communication	<p>Effective, broad-based and two-way communication is necessary within and outside the organizational structure governing AM. This factor includes a consideration of the choice of language, world view being represented, and venues for communication.</p> <p>It is important that science activities and Indigenous knowledge integration are linked with existing management structures and processes rather than exist in their own isolated institutional structure.</p>
Funding & capacity	<p>AM requires sufficient human capacity and financial resources to be successful. The level of funding can be an indicator of the presence, or lack, of executive support.</p> <p>In some cases, there may be a need to increase capacity, which may be the number of people supporting the process and/or training for those involved so that they can learn new skills to facilitate successful implementation of AM.</p>



The scope of this review initially focused on evaluating the AM component of the FHMS which considers AM as one discrete component within the overall management system. As reflected by the above best practice summary of the ideal phases, steps, elements, and enabling factors, AM requires a much broader consideration of the enabling environment to understand how well it is being implemented and which factors affect its success. In its ideal and most effective form, AM is not merely an isolated tool to be plugged into a broader management system, but rather represents a management approach and mindset for framing and addressing uncertainty within a broader, structured, and integrated framework that supports progress towards the overall objectives of the management system. The scope of this review, therefore, did not simply examine the AMF as a single isolated component of the FHMS. Instead, it examined how AM is being enabled, applied, supported, and implemented within the context of the entire FHMS. We therefore considered all the pieces of the FHMS (in varying depth, as necessary to support the desired project outcomes), including the governance structure, watershed authorizations, watershed sensitivity and fish habitat suitability, compliance monitoring and inspections, operational standards, reclamation standards, traditional and local knowledge, the harmonized approach to assessment and licencing, and the AM process. These different elements are relevant to the various steps of AM and the factors that can either enable or inhibit its success. For example, although notionally referenced as a separate component of the AMF within the FHMS, watershed sensitivity and fish habitat suitability are strongly relevant to the assess step in the AM cycle as these tools represent assumptions about the current status of watersheds / fish habitats and provide important information about the operational requirements for implementing management decisions and supporting progress towards the overall objectives of the management system.

In summary, all elements of the FHMS were considered in this review and not only the parts of the system that discuss AM or simply relate to the evaluate and adjust steps in the AM cycle. By considering the broad range of elements, it was better for assessing how all pieces of the system work together and influence the ultimate success of AM. In expanding the breadth of the scope, however, it was not possible to examine each element in as much depth. This work did not undertake a detailed review of each of the monitoring protocols, for instance. Below is a description of the four main tasks that were completed over the course of this project.

Task 1: Evaluation Approach

The first task involved developing an approach to guide the review and evaluation of the available information for describing the Yukon placer mining AMF (i.e., background materials and interviews). Based on the above best practice in AM, the evaluation approach involved developing a set of criteria and questions that were grouped into two parts (see Appendix A):

- (1) The steps and elements in the AM cycle that are involved in its ideal practice.
- (2) The factors that have been identified as important for enabling or inhibiting the success of AM.

As noted above, the success of AM will be contingent upon the effectiveness of implementation of each of the steps and elements within the AM cycle (Figure 1). As such, the first component of the evaluation approach involved questions that applied to each step of the AM cycle (Greig et al. 2013; Murray et al. 2015). Based on the work of many others, a variety of overarching factors have also been identified as critical to the success of AM (Greig et al. 2013; Duitz and Galaz 2008). The evaluation criteria for this second part of the approach were structured into a series of questions grouped into six enabling factors, including the characteristics of the problem for AM, the organizations involved in the AM process and interactions among them (i.e., organizational structure, leadership, communication, trust), and capacity to support AM (e.g., funding) (Greig et al. 2013; Allen et al. 2017).

Task 2: Literature Review

Background documents were compiled to provide an overview of the AMF and relate the information to the two components of the evaluation approach described above, specifically documents related to the FHMS (YPISC & YPWC 2005), the AMF (YPS 2008a), its development processes (Greig and Marmorek 2006), and recent reviews of components of the management system (YPS 2016; DFO 2019). This review included extracting information about how components of the system interact, but did not involve a detailed review of the mechanics or effectiveness of each of the components, in part, because the *Implementation Status*



Review (YPS 2016) already provided an in-depth assessment about the implementation of each of the components. Information gaps from the literature review were flagged as priorities to address during the interview task described below. In addition to a review of the available literature, several spatial data layers were compiled and mapped to provide a high level overview of the interaction between placer mining, salmon habitats, and First Nations within Yukon Territory (see maps in Section 2.0). A summary of these spatial data sources is provided in Table 3.

Table 3. Summary of the spatial data and sources for the maps provided in Section 2.0.

Spatial Data	Source
Placer Mining Claims	https://open.yukon.ca/data/dataset/placer-claims-50k
Territory Boundaries of Yukon First Nations	https://open.yukon.ca/data/dataset/first-nation-traditional-territories-250k
Aquatic Health Monitoring Locations	https://open.yukon.ca/data/dataset/aquatic-health-monitoring-sites
Water Quality Monitoring Locations	https://open.yukon.ca/data/dataset/cmi-water-quality-sampling-sites
Chinook salmon spawning streams	Brown et al. 2017

Task 3: Interviews

To supplement and provide additional validation to the information collected during the literature review, a series of interviews were conducted with key individuals using a semi-structured approach. A total of 24 individuals were identified in conjunction with Yukon government staff, of which 21 were interviewed in February and March 2020 (see Appendix B for list of interviewees). Twelve interviews were individual, and three were group interviews with individuals from the same organization. Individuals were identified because of their understanding of or level of experience with Yukon placer mining. There was also an interest in identifying individuals involved at a management level because of their understanding the effectiveness of the overall management system and because of their ability to provide insights about the evaluation questions given their experience, knowledge, and/or interest with the AM Framework. Lastly, there was also an attempt to include interviewees that represented a diversity of perspectives (e.g., from government, Indigenous communities, and stakeholders).

The semi-structured interviews focused on gathering information about the evaluation questions summarized in the evaluation approach (see Appendix A), while recognizing that not all questions would be relevant to everyone (i.e., interviews were somewhat tailored for each person). Individuals were provided the opportunity to expand on their answers where necessary and appropriate, and in cases where interviewees indicated that something about the management system was less than ideal, follow-up questions were used to probe the reasons and understand possible solutions that could be used to improve upon the current situation.

Task 4: Evaluation and Reporting

Raw notes from the literature review were organized and summarized according to the evaluation questions for the steps and enabling factors related to AM (see Appendices C). Raw notes from the interviews were compiled but are not provided since participant anonymity was assured when setting up the interviews. Notes from each of these research tasks were then synthesized and summarized to identify emerging themes about areas of strength and areas for improvement. Results from the evaluation task (i.e., summary of emergent themes) were summarized in Section 3.0 for each of the steps and enabling factors related to AM.

Upon collating insights, recommendations were then developed with the aim of highlighting the steps or enabling factors that would be most worthwhile adjusting, as well as highlighting opportunities for potential improvement (Section 4.0). In developing these recommendations, there was acknowledgement of the linkages across steps and among enabling factors. Development of the recommendations included consideration of the magnitude of the related concern(s), the related importance / urgency that a concern needs to be resolved, a qualitative assessment of level of effort required to implement the recommendation, and linkage(s) to other issues / opportunities for improvement. A draft report was prepared and presented at a meeting with Yukon government staff and IMG members, and subsequently finalized following the meeting.



2.0 Overview of Adaptive Management

This section provides a brief overview of the timeline of events and components of AM as they apply to the FHMS. Many activities and much work have been completed since the decision was made to move from a class-based to a site-based authorization system for Yukon placer mining. The process of developing and implementing the new regime has continued to advance and evolve over the last 2 decades (Table 4). A key milestone occurred in 2008 when the FHMS and the AMF were implemented following several years of foundational work. Key activities and components of work over this timeframe, and subsequently, include the:

- **Consultation process** to gather input from a broad spectrum of view on the FHMS (YPS 2008d);
- **Yukon Habitat Suitability Model** to determine watershed sensitivity and fish habitat suitability for relevant areas (YPS 2016);
- **Watershed authorizations** by DFO that describe the locations, conditions, and standards for placer mining activities (e.g., DFO 2010);
- **Operational and reclamation standards** to inform the design and implementation of placer mining activities (YPS 2010);
- **Aquatic health, water quality, and socio-economic monitoring protocols** to guide collection of relevant information and understand the effects of placer mining activities (YPS 2008b; 2008c; 2008e);
- **Compliance monitoring and inspections** to ensure that placer mining activities are implemented in accordance with the conditions of the watershed authorizations (YPS 2016);
- **Annual reports** that summarize results from aquatic health, water quality, and socio-economic monitoring (e.g., Government of Yukon 2019a; 2019b);
- **Adaptive Management Framework** to describe the various decision-making elements (YPS 2008a);
- Role and inclusion of **Traditional and Local Knowledge** to support the management system (YPS 2016); and
- **Governance structure** that describes the roles, responsibilities, and processes to support implementation and decision making within the FHMS (YPS 2016).

A recent 'implementation review' of these above components provides useful insights and recommendations about how they could be improved to further strengthen and increase the benefits of applying an AM approach to Yukon placer mining (YPS 2016). Figure 2 lays out many of these components in a logic or process model to clarify how they contribute to the ultimate outcomes of interest to the management system (adapted from YPS 2008a), while Table 5 aligns the above components of the FHMS with the six steps of AM to clarify alignment between these components and the framing of this review.

A series of maps of the Yukon River drainage are additionally useful for providing a broad overview of the current status of monitoring, distribution of placer mining claims, and areas of importance to Chinook salmon. In particular, Figure 3 highlights the overlap between placer mining claims and areas of Chinook salmon spawning (including watersheds of most potential conflict). Figure 4 clarifies the extent and alignment of aquatic health and water quality monitoring with placer mining claims (including areas of least overlap). Figure 5 illustrates the overlap between placer mining claims and the Traditional Territories of Yukon First Nations (including Territories with the highest density of placer mining claims).



Table 4. Timeline of major milestones in the development and implementation of the FHMS and AMF.

Year	Milestone
2002	The Minister of DFO announced the decision to phase out the <i>Yukon Placer Authorization (YPA)</i>
2003	<i>Yukon Environmental and Socio-economic Assessment Act</i> passed. Three levels of government established a new development assessment process to replace the CEAA.
2003	<i>Record of Agreement (RoA)</i> between YG, DFO and CYFN – an intergovernmental agreement committing to the development of integrated management regime for Yukon placer mining
2003	RoA establishes an Implementation Steering Committee and a technical Working Committee, with representatives from the three government parties plus industry
2004	Progress report on development of an integrated management regime for Yukon placer mining, which was endorsed by the Yukon Placer Implementation Steering Committee and the DFO Minister
2004	Outreach meetings with interested parties
2004	DFO Minister approves proposed framework of the new system
2004	Post-approval, committees continue work to further develop the new system's major components
2005	<i>An Integrated Regulatory Regime for Yukon Placer Mining: Final Report to the Minister of Fisheries and Oceans</i> establishes the base structure of the new management regime (led by Yukon Placer Implementation Steering Committee and the Yukon Placer Working Group)
2005	The Joint Placer Implementation Committee (JPIC) and the Implementation Management Group (IMG) are created to facilitate the consultation phase and implementation of the new management system. The JPIC replaces the Implementation Steering Committee. The IMG replaces the Working Committee.
2005	Yukon Placer Secretariat established as the coordinating body responsible for supporting the implementation of the FHMS
2006	<i>Yukon Placer Mining Environmental Management Regime – Adaptive Management Framework</i> workshop to review and refine the design of the AMF
2007	Target implementation date for new regime (as per 2003 RoA)
2006-2008	Consultation with First Nations governments, mandated resource management boards and stakeholders. <i>Fish Habitat Management System for Yukon Placer Mining: Consultation Report</i> published in November 2008.
2008	The <i>Fish Habitat Management System for Yukon Placer Mining</i> replaced the YPA in 15 Yukon watersheds on April 11, 2008
2008	All placer mining water use licenses issued after April 11, 2008 conformed to new operational requirements
2008	All 3 effect monitoring protocols initiated
2008	Publication of the <i>Fish Habitat Management System for Yukon Placer Mining: Adaptive Management Framework</i>
2009	First annual <i>Adaptive Management Report</i> and associated meeting (for 2008)
2010	By 2010 all operations are oriented around new sediment discharge standards. However, current licenses are not amended to reflect the more stringent engineering standards and site management practices because it is not feasible to adapt existing channels and structures to align with the new requirements.
2010	Watershed authorization issued for Mayo River



Year	Milestone
2010	Liard River suitability model created
2010-2012	Liard River Map developed and consulted on
2013	Amendments to the <i>Fisheries Act</i> which resulted in the following observations: “The 2013 amendments to the Fisheries Act had very little effect on the 16 existing watershed authorizations. They all remain valid and were not amended or changed in any way. However, the changes to the Fisheries Act have made the conditions of the watershed and any site-specific authorizations enforceable. Additionally, new regulations and policy have affected the site-specific review and authorization process and have implications for new operations in the Liard and Alsek watersheds.” (ISR, Section 5.2.3)
2015	<i>Implementation Status Report</i> prepared by Yukon Placer Secretariat (report released in 2016)
2016	GHOST review of Aquatic Health Monitoring Program
2018	CSAS review of Aquatic Health Monitoring Program
2018	As of April 2018, there are no remaining YPA licenses – all licenses have been brought into alignment with the FHMS through expiry or amendment of renewal.
2019	First year in which a potential AM evaluation of the monitoring data would solely represent conditions under the FHMS (i.e., “An evaluation should not be expected until after 2018” (ISR))
2019	The <i>2018 Adaptive Management Report</i> states that IMG is in planning stage of technical evaluation of AMF, which is anticipated to take several years, during which time “management decisions would not be made using the process prescribed in the AMF”. Effects monitoring and compliance monitoring to continue (as is, for now)



Adaptive Management Process Model for the Fish Habitat Management System for Yukon Placer Mining (FHMS)

Based on the Adaptive Management Framework (AMF, YPS 2008) and Effects Monitoring Protocols

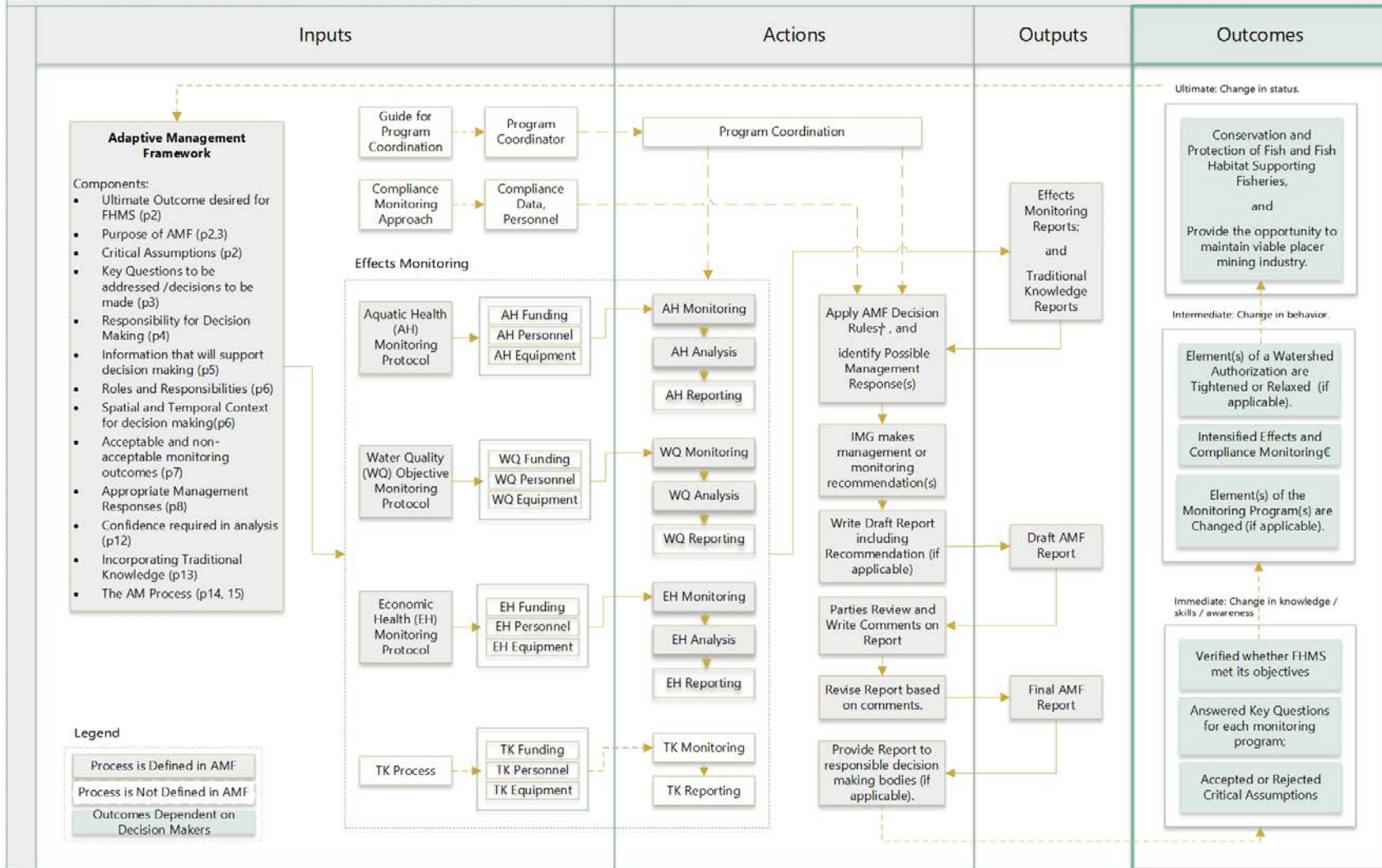


Figure 2. Process model representing the various components and linkages among the Adaptive Management Framework (Adapted from YPS 2008a).



Table 5. Summary of major components of the Fish Habitat Management System (FHMS) and their alignment with the steps of AM.

FHMS Components	Assess	Design	Implement	Monitor	Evaluate	Adjust
Consultation process	X					
Placer mining claims	X					
Yukon Habitat Suitability Model with determinations of watershed sensitivity and fish habitat suitability	X					
Watershed authorizations	X	X				
Operational and reclamation standards		X	X			
Aquatic health, water quality, and socio-economic monitoring protocols				X		
Compliance monitoring and inspections				X	X	
Adaptive management reports					X	
Adaptive management framework	X	X	X	X	X	X
Traditional and local knowledge	X	X	X	X	X	X
Governance structure	X	X	X	X	X	X



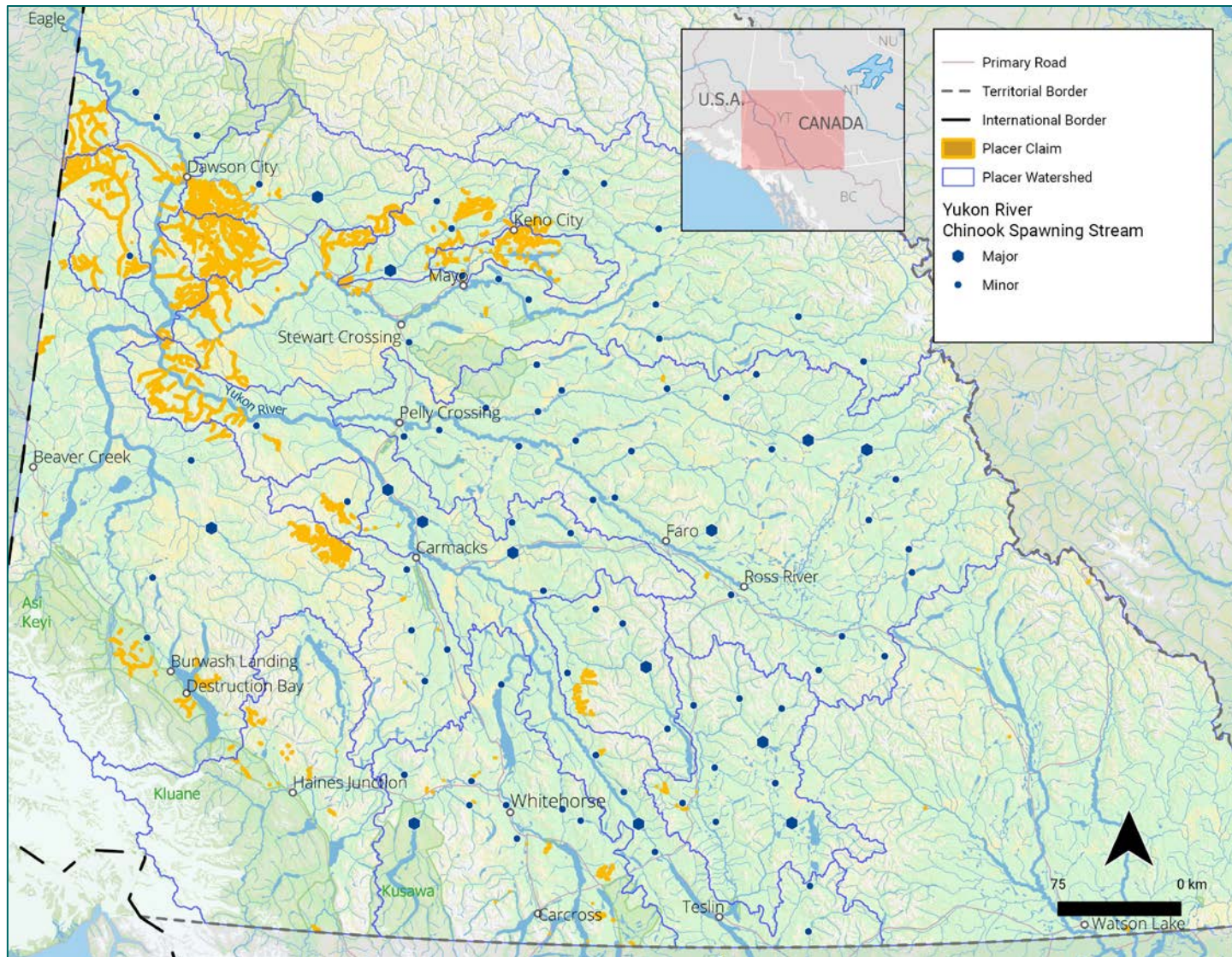


Figure 3. Overview map of placer mining claims and salmon spawning areas (Government of Yukon Open Data Portal and Brown et al. 2017).



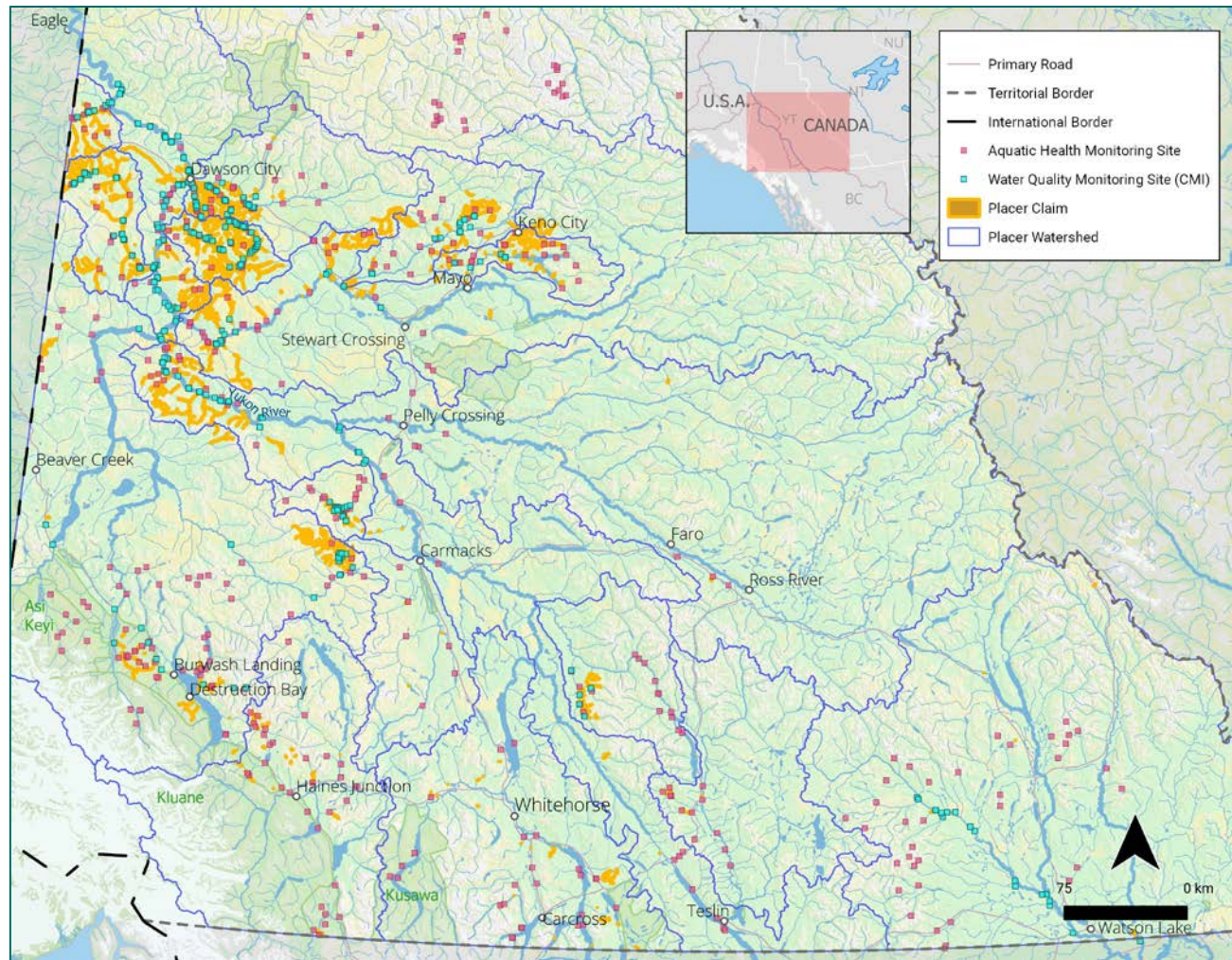


Figure 4. Overview map of placer mining claims and locations of water quality and aquatic health monitoring (Government of Yukon Open Data Portal).



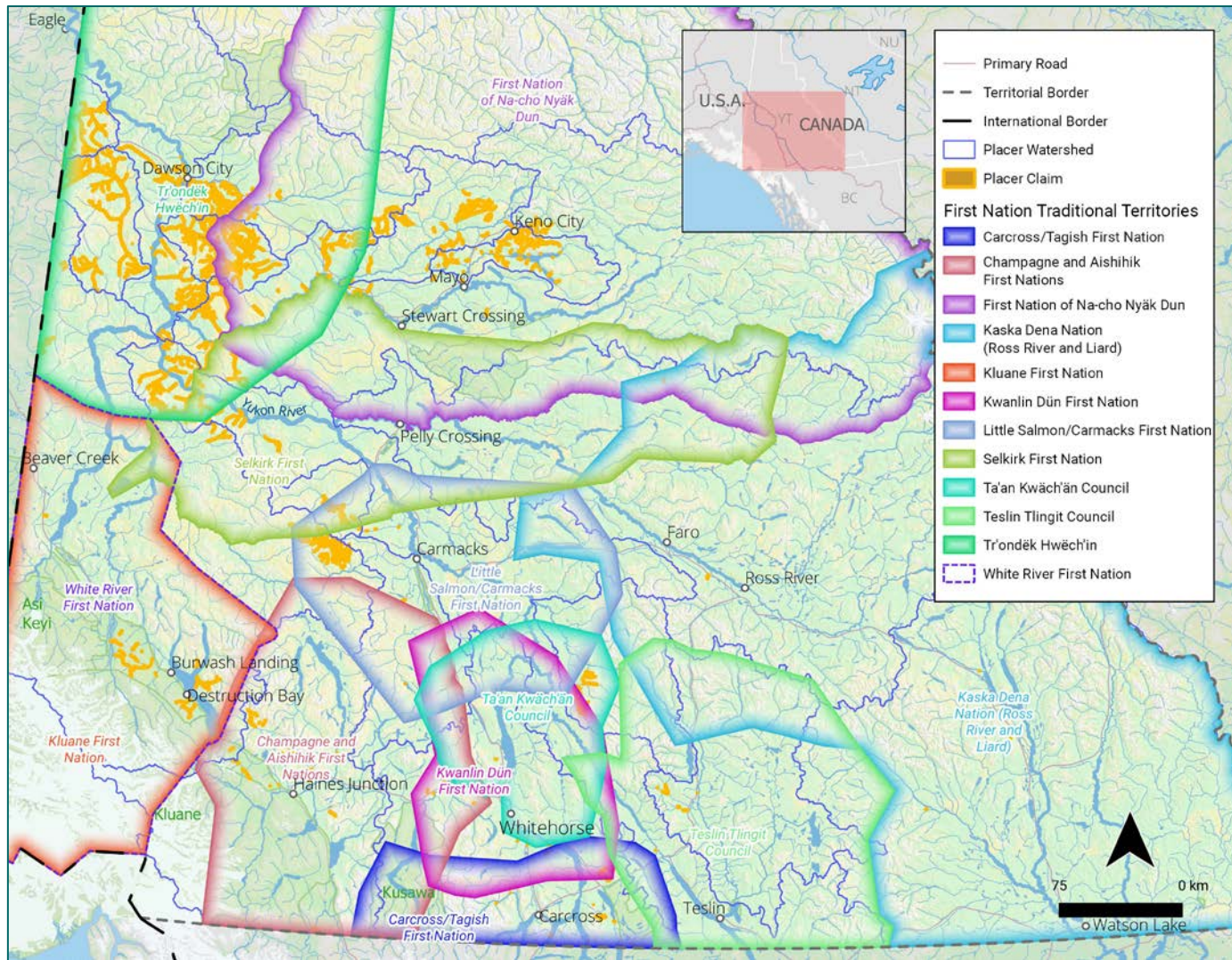


Figure 5. Overview map of placer mining claims and traditional territories of Yukon First Nations (Government of Yukon Open Data Portal).



3.0 Evaluation of Adaptive Management

This section provides a summary of the emergent themes from each group of evaluation questions to understand the effectiveness of the design and implementation of AM. This section draws upon information gathered during the literature review (summarized in Appendix C), applies insights gained through the interviews¹, and applies expert judgments from the report authors based on AM best practice. Consistent with the evaluation approach (Appendix B), this section is organized by the steps in the AM process (Figure 1) and enabling factors required for successful AM.

3.1 Findings related to the AM steps

Assess and Define the Problem

Three foundational issues arose from the review and evaluation of components contributing to the assess step in AM: (1) some lack of clarity and ambiguity around management objectives and the valued components that decision makers are trying to manage, (2) a lack of clarity around the decisions that are within managers control and those that can be adjusted, and (3) a narrow focus on a limited number of pathways of effects² from placer mining.

Regarding management objectives, the AMF states “...the *Fish Habitat Management System for Yukon Placer Mining* is intended to balance the objectives of a sustainable Yukon placer mining industry with the conservation and protection of fish and fish habitat supporting fisheries” (YPS 2008a). Hence, the management objectives of the system are focused on (1) sustaining the placer mining industry, and (2) protecting fish and fish habitat supporting fisheries. The valued components (VCs) that relate to these objectives are the placer mining industry, as well as fish and fish habitat supporting fisheries.

Although objectives are stated in the AMF, multiple interviewees indicated that the objectives were not clear enough, especially for those who have had limited involvement with the system. They expressed concerns about objectives being in opposition to each other and a lack of understanding about what AM is. A lack of clarity and precision around the management objectives is highlighted by the ambiguity around the VCs that decision makers are trying to manage. For instance, interviewees often noted that the system exists to sustain industry, as well as fish and fish habitat; however, one interviewee noted a lack of clarity around whether the second objective is focused on fish and fish habitat, or fisheries that rely on fish and fish habitat. Others noted concerns about how water quality and habitat are being used to draw conclusions about fish when there are other factors that also affect them.

The AMF states that the management actions to achieve objectives relate to “...decisions to change some element of the monitoring programs, or decisions to change some element of a watershed authorization” (YPS 2008a). The AMF identifies possible management responses to monitoring results, which include tightening or relaxing operational regulations, but it does not describe the process for how answers to monitoring questions at various geographic scales would be evaluated or how management responses would be triggered. Decisions related to changes in monitoring, however, will not affect the management objectives of interest to decision makers and should not be considered in the same way as decisions related to decisions about watershed authorizations or sediment discharge standards. Overall, many interviewees indicated that the management actions available to decision makers are not clear enough. These decisions

¹ A summary of interviews was not provided in this report to maintain anonymity of interviewees.

² Pathways of effects (PoEs) describe the mechanisms by which stressors lead to effects on valued components (VCs) of the ecosystem through known cause-effect relationships (DFO 2018). A PoE conceptual model characterizes the socio-ecological system according to components (e.g., species or habitats) and processes (e.g., aquatic habitat disturbance), displaying PoEs as linkages from stressors through system components to the desired endpoints of interest (i.e., the VCs) (Grant et al. 1997).



may have been clearer in the past, but people within organizations have changed, and the continuity of knowledge has not been sustained.

Lastly, multiple interviewees discussed how it is not clear why the system is narrowly focused on effluent discharge when there are multiple ways in which placer mining might affect the ecosystem. For example, there are concerns about how observed sediment discharge standard exceedances are being attributed solely to rainfall events while there is limited information about how rainfall may be interacting with placer mining operations or how other factors are being considered. YPISC & YPWC (2005) includes a conceptual 'pathways of effects' model for placer mining that illustrates the many different ways the industry may affect the ecosystem; however, it does not detail how impact pathways may affect fish. The AMF appears to be based on a limited set of pathways identified in YPISC & YPWC (2005) and it is not clear why the AMF is focused on the limited set (YPS 2008a).

Design Actions

The design step in AM includes designing management actions and designing a monitoring program to understand management effectiveness.

Two themes emerged from a review of the design of management actions: (1) a lack of clarity about the rationale for management actions, and (2) challenges with the scope and scale of management actions. Although there were not many concerns about the design of management actions, interviewees did note a lack of clarity about the rationale for the initial sediment discharge standard levels. They also noted an issue of scale mismatch in terms of considering how site-specific regulations relate and support management of watershed level ecological values. The issue of having site and watershed scale mismatches is something that is relevant for all steps in the AM process (e.g., need to consider in determining how to evaluate results, adjusting management, etc.).

Three concerns emerged around the design of monitoring: (1) challenges with the scope and design of monitoring protocols, (2) a lack of Indigenous Knowledge (IK)³, and (3) challenges with the coordination among programs. The monitoring plan is comprised of three protocols, which include ones for aquatic health (AH), water quality (WQ), and economic health (EH) (YPS 2008a, YPS 2008b, YPS 2008c, YPS 2008e). Specific questions, performance measures, and data collection processes are described in each protocol. The AH and WQ protocols are aimed at understanding environmental condition (i.e., invertebrate community or water quality), and how placer mining is affecting condition (YPS 2008b, YPS 2008c). The EH monitoring protocol is aimed at understanding how FHMS is affecting the viability of the placer industry.

For the AH and WQ protocols, information from the literature review and interviewees suggest major limitations in the ability of the protocols to collect the necessary data for analyses that can inform decision-making. DFO (2019) identified many concerns and proposed recommendations to improve the AH monitoring protocol, including ones related to replacing the current model, improving the sampling design (i.e., spatially and temporally balanced design with greater replication), and considering other analytical approaches. Although there has not been a similar review of the WQ protocol, interviewees expressed concerns about the inability to link results to placer mining operations and discussed the need to reassess their sampling design. Review of the EH protocol identified several concerns, including lack of data for several step 1⁴ indicators, need for new indicators, and uncertainty about what the threshold levels should be for triggering the step 2 survey (Kishchuk 2018), YPS (2016) recommends revisiting the step 1 indicators and Kishchuk (2018) stated *"As the panel survey instrument (the survey sent to placer miners) is now more than 10 years old, it is likely time to consider whether the survey continues to accurately reflect current industry circumstances. Any updates to the panel survey instrument should be completed in collaboration with panel survey members."* Interviewees noted that so far the protocol has never indicated any industry viability issues and so it's unclear whether there in fact have been no issues or whether the protocol is incapable of detecting issues. Subsequently, the extent to which the EH protocol is useful for decision-making remains unclear.

³ For the purposes of this document Indigenous Knowledge and Traditional Knowledge are used interchangeably.

⁴ In the original EH monitoring design, the 'step 1' analysis of indicators dictates whether the 'step 2' survey is to be conducted.



In addition, IK has not informed the AM process despite being acknowledged as an essential part of FHMS, and the AMF specifically acknowledges that IK may influence monitoring programs (YPS 2008a, Government of Yukon 2019a). The lack of inclusion of IK is discussed further in the Section 3.2 since this topic relates to engagement of First Nations in the 'Organizational Structure' for the management system.

Many interviewees discussed the lack of coordination among the different organizations involved in monitoring. In particular, being able to connect AH and WQ results to the extent of placer mining activity was noted as a major limitation to drawing inferences from available data. While it has been assumed that data management is happening within each of the organizations responsible for a monitoring protocol, there was no evidence of a broader data management plan.

Implement Actions

The prolonged phase of implementation and a lack of clarity around how sediment discharge standards would be adjusted were identified as key challenges related to the implement step of AM.

To illustrate, the Implementation Review (YPS 2016) highlights the mix of standards and timeframe over which implementation occurred: "*The new sediment discharge standards have been in effect in all Yukon River watersheds since 2010; however, water quality and aquatic health are also influenced by site management and restoration practices. These new standards are being phased in as water use licences are renewed, resulting in a mix of old and new operating and restoration standards*". It also appears there was a misunderstanding about whether interim sediment discharge standards were intended to change to a more stringent standard or stay the same in response to monitoring results. As a result of this lack of clarity, the "interim" standards have remained in effect for 7 years, though they are now being reviewed by DFO (YPS 2016).

Multiple interviewees expressed how phased implementation created a challenge for the monitor and evaluate steps of AM. For instance, it was not possible to use the data collected through monitoring to draw inferences about the effectiveness of the interim standards because operations on the same stream could be governed under different rules. As of 2018, all placer mining licenses have been updated. In the future, a lengthy implementation period may inhibit the ability of analysts to draw inferences in a reasonable time frame unless the actions (i.e., standards) are designed, implemented, and monitored with such a transition period in mind.

Monitor Responses

In general, monitoring has been implemented as designed. However, concerns have been noted about the monitoring protocols (discussed in 'Design Actions' above), and limitations in data analysis due to a lack of the appropriate placer mining data collected during inspections.

AH monitoring has generally been conducted as specified in the protocol, although additional data collection has occurred recently to address critiques of the monitoring protocol (DFO 2019). WQ monitoring has also generally followed the protocol consistently each year, with some minor enhancements (YPS 2016). EH monitoring has been undertaken using the indicators in the original design; however, data have recently become unavailable for several indicators. The main departure from the original EH protocol has been annual deployment of the panel survey regardless of step 1 results and that survey respondents have been those available and willing to participate rather than a sample based on industry demographics (YPS 2016). Interviewees indicated that inspections have been undertaken as planned, but that the information being collected has not been sufficient to meet intended needs (i.e., an inability to relate AH and WQ observations to observations from placer mining inspections). Some interviewees also expressed there may be limitations in the capacity to conduct inspections.

Evaluate Results

Based on the AMF, the FHMS should ideally support learning about whether the management actions are resulting in water quality, aquatic health, and economic conditions that are within or outside of tolerable limits for the identified VCs (YPS 2008a). Several issues appear to create difficulties in the evaluation of the data that emerges from monitoring: (1) challenges with combining different datasets, (2) a limited ability to account for potentially confounding factors, and (3) a lack of inclusion of IK.



Annual AM reports are regularly prepared which summarize data analyses for each of the three monitoring protocols (e.g., Government of Yukon 2019a; 2019b). However, these reports do not include cross-protocol analyses, syntheses of results over time, or draw inferences about whether outcomes are within or outside tolerable limits. Challenges within each of the three protocols make cross-protocol analysis difficult (as discussed in the 'Design Actions' section above). There are also challenges with coordination among protocols and a need for a process that details how data from the different monitoring programs should be combined to draw inferences that can inform decision-making, as illustrated by this quote from the Implementation Review: *"To carry out adaptive management evaluations, the results of all monitoring programs, including compliance monitoring, have to be analysed in combination. A system or process to facilitate this analysis has yet to be developed"* YPS (2016). Rather than a structure to combine protocol results (e.g., AMF table of 'Possible Management Responses'), there is a need for a process to combine data in cross-protocol analyses, which is necessary given the need to understand relationships among components that are being monitored within the different protocols.

One example of the challenge in combining datasets involves the sampling locations for AH and WQ. The original design called for AH and WQ monitoring to occur at the same locations, yet sampling designs also indicated that subsequent years of sampling should focus on areas with previously identified concerns. These areas of concern may differ for AH and WQ monitoring. As such, the two programs have increasingly collected data from different locations, which makes it difficult to conduct analyses that combine datasets from water quality and aquatic health monitoring.

Many interviewees also discussed challenges with combining data about placer mining operations with other monitoring data (e.g., collection of ecosystem condition data at a different time than mining operations data makes it difficult to combine data in analyses). There is a need for a more coordinated sampling design, as well as a need for a way to account for instances of non-compliance (YPS 2016). The phased in implementation of management standards was also noted as a challenge to conduct evaluations because multiple operations on the same stream could be operating under different standards which makes it difficult to attribute monitoring results to a particular management regime.

Additionally, improvements in data management are needed to support data sharing between departments. The datasets have become more complex and have required greater capacity to manage them the longer the management system has been in place (YPS 2016).

Interviewees also discussed how current data collection and analysis does not allow for evaluating the effect of placer mining in the context of the range of other potentially confounding factors that may be influencing the receiving environment. This limitation inhibits the ability of analysts to draw linkages between observed conditions and placer mining activity. There is a need to explicitly identify all the important factors that need to be monitored, understand how the different pathways of effect are interacting, and address any critical gaps in monitoring to fully understand cause-effect linkages.

Finally, IK has not been included in the evaluation step in the AM process, which appears to be an important gap (YPS 2008a, Government of Yukon 2019a). This topic is discussed further in 'Organizational Structure' section below given its linkage to First Nations engagement in the management system.

Adjust Management Actions

Key challenges related to the adjust step of AM include: (1) a lack of decisions to adjust (or confirm) the course of management actions, (2) a lack of process for how monitoring results should be synthesized to inform adjustments to decisions, and (3) a lack of clarity from decision-makers about how adjustments might be made and under what conditions (i.e., decision criteria and triggers).

Annual AM reports include results from monitoring, but they do not provide information that is sufficient to understand whether the FHMS is achieving its objectives or can sufficiently inform adjustments to management actions (as discussed in more detail above). The AMF describes eight possible outcomes from monitoring based on whether conditions are within or outside of 'tolerable limits' for each of the 3 monitoring protocols. For each of these possible outcomes, the AMF also describes possible management responses (YPS 2008a). Although 'tolerable limits' are defined within the monitoring protocols, they are not clearly identified within the AFM and many interviewees discussed the need for a clearer and more detailed process for determining how monitoring information should be synthesized and how adjustments to management actions would be triggered. Such a process and the related decisions also need to occur at a time scale that



is relevant to the placer industry (i.e., decisions need to be made so that operations can be adjusted before they are shut down).

3.2 Findings related to the enabling factors for AM

Context & Problem Definition

Broadly speaking, AM is appropriate in situations where decision makers have some control over a system, but there is a degree of uncertainty that affects their ability to understand what choices to make.

The AMF states “*The monitoring programs will assist in verifying the effectiveness of the management system in meeting its objectives and provide a rational basis for future changes, if appropriate*” (YPS 2008a). Although documents do not explicitly articulate the management uncertainty (i.e., why AM is being applied), implicitly it is whether placer mining management actions (i.e., operating standards) are enabling the FHMS to meet its objectives of balancing a sustainable industry with protection of fish and fish habitat supporting fisheries (YPS 2008a).

Some interviewees raised concerns about whether there is enough management control over fish and fish habitat given they are affected by many things other than placer mining. However, government agencies participating in the FHMS (i.e., federal, territorial, and First Nations) do have management control over how placer mining might affect fish and fish habitat through applying regulations, and potential management decisions include tightening or relaxing operating requirements (YPS 2008a).

Given there is a degree of management control over how placer mining operations affect fish and fish habitat and management uncertainty about how the standards should be set, AM is an appropriate approach for this context. Interviews expressed concern that AM is poorly understood, highlighting the need for more clarity about AM in general and why it is being applied in this context.

Trust

Experience in AM from many places has shown that for the approach to be successful, the multiple parties involved need to trust each other, trust the process that supports decision making, and trust the data and scientific knowledge being generated or used to inform decisions.

Most interviewees expressed that there is trust amongst the key parties involved in the AM process. Although there were some comments about programs acting independently, the general sense is that that it is not because of a lack of trust and that there are good working relationships.

For organizations with less involvement in the AM process, the lack of management adjustments resulting from the AM process and the lack of communication about the process has somewhat reduced trust in the program and reduced trust in the information being generated through the program (i.e., caused concerns about whether information generated is sufficient for making decisions).

Some interviewees also noted that the lack of First Nation involvement and lack of clarity about how IK will be used could affect trust in the process and reduce the likelihood of IK sharing.

Leadership & Executive Direction

Successful AM requires a clear leadership entity with the decision authority responsible for making decisions and implementing AM, as well as a strong commitment from leadership to undertake the process. Although documents are clear about who the leadership entities are, the system has evolved since its beginning and that management system is being implemented in a way that does not exactly align with guidance documents which causes a lack of clarity. The organizations originally involved in the formation of the AM process are all still engaged, but it appears support may be waning.

The AMF is based on an agreement among the organizations with the authority to implement decisions, which includes the Yukon government, Fisheries and Oceans Canada (DFO), and the Council of Yukon First Nations (CYFN). Documents outline how the Joint Placer Implementation Committee (JPIC), which is comprised of decision-makers from the organizations involved in the agreement, is the overarching



leadership entity. The Yukon Placer Secretariat (YPS) coordinates implementation of the FHMS (including AM of the system), and the Intergovernmental Management Group (IMG), which consists of representatives from the Yukon government, DFO and CYFN. These bodies make technical recommendations, conduct monitoring, and are involved in AM reporting (YPS 2016).

Thus, JPIC is clearly the decision-making entity and YPS and IMG are the entities responsible for implementing AM. However, interviewees noted that YPS has now been rolled into the Yukon government, so implementation is not functioning as originally designed and described. There is an ongoing need for IMG participants to discuss and decision on who will be responsible for tasks that were previously assigned to the secretariat. While some interviewees indicated that the entities responsible for leadership and implementation was clear, others, especially those less involved with the AM process, indicated that there was much less clarity.

All entities on JPIC have remained engaged, which implies ongoing support. However, interviewees indicated there has been high turnover of individuals, which has led to a lack of continuity of involvement and understanding about the AM process. Some interviewees also noted that representatives on JPIC do not hold the same level of seniority as previous representatives even though YPS (2016) states *"it is also important that the parties continue to appoint senior representatives who are able to make decisions on behalf of their respective organizations"*. Some interviewees noted that a lack of management adjustments may have led to a waning interest and support of senior officials in the program.

Organizational Structure

Effective AM programs are governed by an organizational structure that involves all relevant voices with clear roles and responsibilities in decision making. Four themes emerged in the review of the organizational structure supporting the FHMS: (1) a need to better involve relevant departments, boards and committees, (2) a need for better involvement of First Nations and incorporation of IK, (3) a need for better involvement of stakeholders, and (4) a lack of clarity around the current roles and responsibilities.

Federal, territorial, and First Nations governments (i.e., Yukon Government, DFO, CYFN) are involved in adaptive management of the FHMS (YPS 2008a). The JPIC is designed to include senior level representatives, and the IMG and YPS are designed to include individuals at the technical and operational levels (YPS 2008a, YPS 2016). Although the main relevant government decision-making agencies are involved in these bodies, interviewees noted that it would be good to have Environment and Climate Change Canada reengaged (they were more involved before), as well as the Yukon Department of Environment's Environmental Assessment team. It would also potentially be beneficial to have more structured involvement from various boards and committees (e.g., Yukon Water Board (YWB), Yukon Environmental and Socio-economic Assessment Board (YESAB), Fish and Wildlife Management Board and Yukon Salmon Sub-Committee (YSSC), Renewable Resource Councils). Although there may be a desire and need to increase the involvement of these other entities, careful thought would need to be given to their role and contribution to the process. Allowing for more voices in decision making may not always be better or necessary.

Many interviewees noted the need to improve First Nation involvement. First Nations were involved in initial development of the FHMS and AMF. First Nations were designed to have representation on the JPIC and IMG, and the AMF was designed to have IK inform decisions (YPS 2008a). Since the start of the system, First Nation involvement has not occurred as intended. The JPIC and IMG were each initially designed to have a CYFN representative, yet currently, two individual First Nations representatives participate. Individual First Nations representatives are notably different than a CYFN representative because they only represent their Nation and it may not be an appropriate responsibility for those individuals to distribute information to other Nations. All First Nations have been invited to annual meetings in which monitoring results are presented, but these meetings have largely been unsatisfying because they only involve presentations of monitoring results and no discussions about management responses. Due to the minimal involvement of First Nations, two years ago IMG began reaching out to First Nations to have tri-annual meetings. These meetings were designed to share information about the FHMS and discuss issues / concerns, which have been beneficial for building relationships.

In the initial development of the FHMS, the Yukon Government provided funds for each First Nation to host a workshop to document relevant IK, the importance of which is highlighted in the Final Report: *"Consideration of traditional knowledge was an essential part to assess the condition of watersheds"* (YPISC & YPWC



2005). Moreover, the AMF states that decisions will incorporate “*traditional knowledge provided by First Nations*” and that “*Traditional knowledge may influence the monitoring programs, may lead to changes to habitat suitability classifications, and may contribute to recommendations to change other elements of watershed authorizations*” (YPS 2008a). To-date, IK has not been shared or informed any decisions. Interviewees expressed that this outcome is largely due to the inadequate way in which First Nations have been engaged (i.e., via a letter request for IK). Recent attempts to create a formal IK sharing process have been put on hold for two reasons. First, the Yukon Government recently started working on a government wide IK sharing policy and it seemed appropriate to wait for that to be finalized. Second, the AMF does not have a clear process for how IK would be blended with the information being gathered through the monitoring protocols.

Interviewees noted that First Nation representatives and community members have indicated a desire to figure out how IK can inform the management system. To do so, it will be important that there is openness to redesign the process in a way that reflects First Nation worldviews. A beneficial step may be to undertake another round of workshops in which there can be conversations about how the management system can be adjusted to meaningfully incorporate First Nations participation and knowledge. First Nations representation on the IMG would also be a useful topic for such conversations given the lack of CYFN participation as initially designed. YPS (2016) also recommended that feedback be elicited from First Nations to understand why IK is not being shared, and to identify better alternatives for fostering IK sharing.

There is also a need for better involvement of the placer mining industry and other stakeholders (e.g., NGOs) in the organizational structure to support AM. The AMF states that a Yukon Placer Advisory Council (YPAC) was to be formed with stakeholders (YPS 2008a). This body was never formed, however, and multiple interviewees noted it would be beneficial to establish it to provide a structure for communication and engagement.

For those entities currently involved in organizational structure for the management system, interviewees noted that the roles and responsibilities are clear for some things and less clear for others. There is a terms of reference (ToR) for YPS, and a draft ToR for JPIC, but no indication of a ToR for IMG. There is clarity when it comes to which organizations are responsible for which monitoring protocols, yet less clarity about coordination roles. A lack of clarity around coordination may be due, in part, to the fact that YPS has been rolled into the Yukon Energy Mines and Resources’ Compliance Monitoring and Inspections (CMI). Interviewees noted that currently when a task comes up that would have been the role of YPS, it necessitates a discussion among IMG members about who should be responsible. Interviewees indicated that more clarity is needed for the roles that are less clear, documents need to be updated to reflect the current reality of roles and responsibilities, and terms of references are needed for existing entities.

Communication

Effective communication among the entities involved in the AM process, as well as with entities outside of the process, is critical for AM to be successful.

Interviewees involved in the management system indicated that communication among the parties involved is generally good. There is an annual AM meeting at which participants involved in the process are provided with an annual AM report, and results from the three monitoring protocols are discussed (Government of Yukon 2019b). However, some interviewees noted that better communication among the different organizations would foster better coordination. The shift of YPS to CMI has created a void in terms of communication and coordination among the different organizations and programs involved in the management system.

For those with less involvement in the management system, communication has been lacking. Multiple interviewees indicated that they wish there was better communication so they knew more about what was going on. Interviewees also noted that it can be difficult to find information about the management system, and it is not always clear who should be contacted for more information. Reports were accessible through the YPS website in the past (www.yukonplacersetariat.ca) but this site is now redirected to: <https://yukon.ca/en/doing-business/licensing/prepare-project-proposal-class-4-placer-activities>.

Interviewees also noted a need to improve communication with First Nations.



Funding & Capacity

AM requires sufficient human capacity and financial resources to be successful. Although large programs such as this always have to account for limitations in capacity, interviewees noted that the total amount of funding and capacity available for the AM process is less of a concern than a need to find improvements in the way resources are being used.

Specific areas were noted by interviewees as needing a reallocation of existing resources or allocation of new resources. In particular, there is a need for greater capacity to conduct overarching program coordination and communication. Coordination is a challenge when funding streams for different monitoring programs get approvals at different times. There is also an increasing need for greater capacity to coordinate data analysis and data management as the datasets have become more complex over time. Multiple interviewees noted that inspections and compliance monitoring is more capacity constrained than other parts of the management system. Resources would also be required to form the YPAC if that were deemed an important part of the management system in the future. Lastly, interviewees noted that First Nations involvement remains largely underfunded. Although resources exist for travel and accommodation to meetings, there is need for funding to better determine how First Nations should be involved, support their involvement, and allow for the compilation and sharing of IK.



4.0 Recommendations

The FHMS is a complex system, with multiple agencies and organizations involved to manage many placer mining operations that exist over a vast area. The initial design of the AMF includes many of the key components necessary for successful AM. Since implementation of the AMF, many of these key components have been consistently applied, many resources have been invested in these components, the key decision-making agencies have been committed to participating in the AM process, and many insights have been gained about how specific components of the system could be improved.

Moving forward, there is value in continuing to apply adaptive management and the AMF to the FHMS. There does not appear to be a need to completely change the way AM is applied, but rather adjustments can be implemented to improve the focus of some components and improve the balance of effort being allocated across the system. Individual components of the system can be improved and there can be more attention on coordinating the different elements of the system so that they are working more effectively together.

Four recommendations have been provided below to clarify opportunities for reinvigorating the system. The relationship between these recommendations and the AM steps is illustrated in Figure 6. It is important to note that undertaking these recommendations will require resources. In terms of sequencing, recommendations #1 and #2 are designed to be implemented first, and can be done concurrently, followed by recommendation #3. Recommendation #4 is separated into a near-term part that can be done immediately and a medium-term part that can be informed by the outcomes of the other recommendations.

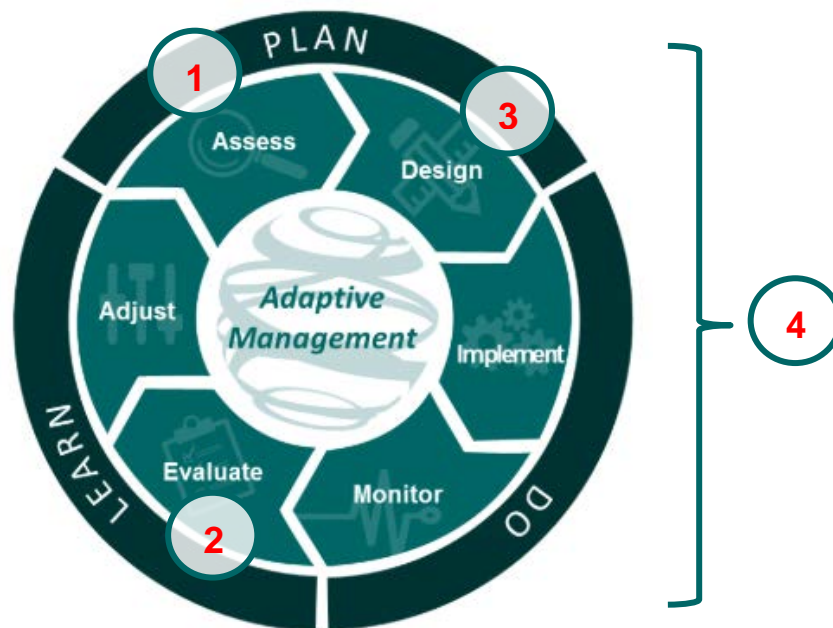


Figure 6. Link between the recommendations below and the relevant steps of AM.



1. Clarify foundational elements for AM including the FHMS objectives, management uncertainties, and management actions

For AM to be successful, it is essential that the system is aimed at resolving management uncertainties so that the effectiveness of management actions can be adjusted over time to achieve the overall management objectives. Thus, it is critical that each of these foundational elements (i.e., objectives, uncertainties, and actions) are clear, comprehensive, and logically connected.

The FHMS is clearly designed to (1) sustain the Yukon placer mining industry, and (2) protect fish and fish habitat supporting fisheries. AM is an appropriate approach for the problem context given these objectives, the degree of management control over placer mining, and management uncertainties involved. There is a lack of clarity, however, about whether the system is focused on the most critical pathways of effect, the subsequent unknowns within those pathways of effect, and the range of potential management actions that are best suited to meeting program objectives.

We recommend revisiting / clarifying the following foundational elements for AM:

- **Revisiting and “unpacking” the management objectives** to ensure they are still relevant given the intent of the system and described in sufficient level of detail. Revisiting management objectives involves reviewing the “valued components” (VCs), and being clear about what they are (e.g., fish, fish habitat), why they are the VCs of interest, and if there is a need to change them. Developing an objectives hierarchy is a helpful way to verify and provide more specificity to the management objectives (see Figure 2 in Reynolds et al. 2016 for an example of an objectives hierarchy). An objectives hierarchy allows for unpacking an objective (e.g., sustaining fish habitat) into how it is going to be done (e.g., protecting habitat characteristics for specific fish species) and desired targets (e.g., levels for habitat characteristics). It is appropriate if management objectives in an objectives hierarchy are in opposition with each other (i.e., they cannot both be maximized), since this is a common feature of the complex trade-offs often involved in natural resource management (e.g., Gregory et al. 2012).
- **Clarifying the pathways of effect** to ensure the FHMS recognizes all relevant pathways that link placer mining activities to the VCs of interest (i.e., the management objectives). Existing pathways of effects conceptual models in YPISC and YPWC (2005) can be used as a starting point for this work, alongside the technical expertise of scientists familiar with placer mining and aquatic ecosystems in Yukon Territory. For example, clarifying pathways of effects can involve reconsidering all ways sediment may be influenced by placer mining operations and other ways placer mining operations may affect fish and fish habitat. A simplified example of a pathways of effects conceptual model is displayed in Figure 7.
- **Reviewing the management actions** to ensure they are appropriate for achieving the management objectives, that all potentially relevant management actions are being considered, and that they are within decision makers’ control. For AM, management actions should ideally involve some uncertainty about the effectiveness of the action, should be a hypothesized effect of the action on the valued components, should be repeatable and adjustable, should not lead to irreversible consequences, and should have effects that are detectable within a timeframe relevant to decision makers. Revisiting the range of potentially relevant management actions involves examining if there are other management levers in addition to watershed authorizations that can be employed, noting that new management actions may highlight new critical management uncertainties. A pathways of effects conceptual model can be useful for highlighting where placer mining activities relate to stressors and identifying management actions that can influence those relationships (see Figure 7). It also explicitly displays how management actions are intended to lead to desired outcomes for the valued components.
- **Identifying critical management uncertainties** to ensure that learning is focused on the key information needs to improve decision making. For the effective application of AM not all uncertainties matter to decision makers. It is helpful to distinguish between “scientific uncertainties” and “management uncertainties” to ensure decision makers are focused on the “critical uncertainties” most relevant for AM (Nichols and Williams 2006). Reducing a scientific uncertainty can lead to better knowledge about the components and their interactions within a social or ecological system, but it may not reduce a management uncertainty. Reducing a management uncertainty leads to either rigorously confirming that current management actions are appropriate or informs how to change management actions to better meet the objectives. The learning strategy employed to reduce management uncertainties involves using



management actions, coupled with effectiveness monitoring, to reduce an uncertainty and learn about whether an action is having its intended effect on the system. Confirming the relevant management actions (in the bullet above) paves the way for identifying critical management uncertainties in that it allows for examining where given those actions there are uncertainties about how to undertake the.

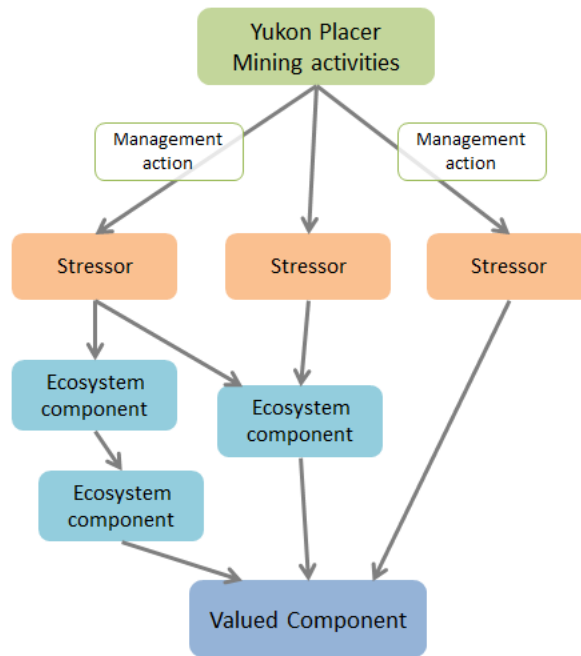


Figure 7. A simplified example of a pathways of effects conceptual model and how management actions can influence the relationship between placer mining activities and potential stressors.

Revisiting these elements ensures there is a common understanding and agreement around the foundational elements in AM, ensures that the management objectives and decisions being informed are consistent with the current authorities of governments involved, and highlights missing entities (e.g., First Nations). It will also provide a basis for designing monitoring aimed at gathering information that can trigger and lead to appropriate adjustments in management actions

2. Synthesize and evaluate existing data

It is common for a monitoring program to be implemented and subsequently revised to lead to the methodological improvements that are necessary to better align with the purpose of the program. As a result, the related datasets may have limitations to which various analytical approaches can be employed to deal with imperfect data and provide answers to questions given available data.

To date, the various monitoring programs have collected an abundance of data and some analyses have been completed. However, it seems that much more can be done to support cross program analyses and better gather insights from current datasets.

We recommend a greater allocation of resources into the evaluate step of AM, beginning with **conducting a comprehensive synthesis of existing data** from all monitoring to illuminate key insights, test program assumptions and predictions, and improve management actions. Such a synthesis should start with reviewing potential analytical methods and supplementary data sets that can be employed given dataset limitations. For example, it appears that quantitative data to describe the timing, location, and extent of placer mining activities is a critical missing piece of information. There are likely other sources of data beyond that collected by the current protocols that could be used as reasonable surrogate for this variable (e.g., remotely sensed measures of placer mining disturbance). Once these data are available, some areas that can be explored through data synthesis include better understanding the relationships between the extent of placer



mining operations and environmental condition (i.e., water quality and aquatic health), how the way in which discharge standards have been implemented related to environmental condition, and how results about environmental condition within each watershed relate to the previously developed watershed classifications.

A key requirement in undertaking AM is to **involve the right mix of technical expertise** in undertaking the work. For comprehensive syntheses and evaluation of data, the ideally mix of expertise includes a statistician, a quantitative analyst, and a decision analyst familiar with AM. This expertise can be provided by one or more individuals with a mix of skills but having the full suite of skills is important.

The outcomes from this recommendation will likely inform recommendation #1 in that it will lead to insights about relevant pathways of effects and management actions.

3. Review the monitoring design and evaluation process

Monitoring is a key step in the AM process to support evidence-based decision-making. The organizations involved in the management system have invested substantially in collecting data using the various monitoring protocols. This investment demonstrates a strong commitment to the success of the management system. Yet, monitoring programs often require adjustments after implementation, and issues with the initial data collection protocols are to be expected.

The experience gained through implementation of monitoring has highlighted limitations within the monitoring protocols and challenges in coordination, data collection, and data management among them. Many of these issues pertain to sampling design (i.e., when and where monitoring takes place), and some issues pertain to response design (i.e., how monitoring takes place), such as fundamental flaws with the overarching model for the aquatic health monitoring protocol (DFO 2019). Also, the lack of coordination among programs has limited broader syntheses and analyses.

We recommend **improving the monitoring design** by leveraging insights from previous work (e.g., DFO 2019, Kishchuk 2018, YPS 2016), employing insights gained from undertaking the previous recommendations, and applying knowledge about the types of monitoring that ideally occur to support AM. From recommendation #1, clarifying the relevant pathways of effect and critical management uncertainties will highlight the key components of the system that should be monitored. From recommendation #2, the comprehensive synthesis of existing data can provide insights about how current data are (or are not) meeting data needs. AM should be supported by a monitoring program that involves three distinct types of monitoring, with each serving different purposes (see definitions of monitoring as described by Roni et al. 2013):

- Long term and continuous monitoring of the status and trends of the VCs at critical locations relevant given management objectives. This monitoring provides information about the year to year variation in key performance indicators, which helps account for confounding effects. It allows for understanding changes in the condition of VCs even if some of the mechanisms driving change are beyond the control of system decision-makers (e.g., status and trends of Chinook salmon populations influenced by ocean conditions and harvest, which are independent from placer mining effects).
- Effectiveness monitoring of placer mining activities to inform decision makers about the effects of management actions and whether outcomes are aligned with management objectives. An effectiveness monitoring design should focus on variables that are most likely to be influenced by management actions and should follow principles of experimental design (replication, control, stratification) to provide the most cost-effective sampling design across a range of sampling locations with contrasting levels of placer mining development. Existing monitoring protocols fall within this type of monitoring.
- Targeted monitoring and/or short-term research studies that focus on providing answers to key questions or focal needs. Outcomes from such monitoring may lead to unanticipated adjustments in the conceptual understanding of the system, range of management actions being used by decision makers, or other changes to monitoring activities.

Consistent with the previous recommendation, a mix of expertise should be involved when reviewing the monitoring design, including a statistician, a quantitative analyst, and a decision analyst familiar with AM.

We also recommend **developing a process for coordinating sampling, data sharing, and analyses** (i.e., who is responsible for collecting data, who do they share it with, and who conducts analyses with combined



datasets). With such a review it will be important to think about how the outcomes from monitoring will be linked to adjustments in decision-making. In particular, a special consideration should be given to how data about placer mining operations will be collected and aligned with other datasets since this information is critical for being able to disentangle effects associated with placer mining from other potential drivers of influence on Yukon aquatic ecosystems.

4. Clarify roles / responsibilities and reinvigorate the organizational structure

For AM to be successful, it is important that there is a structure and processes to ensure that all relevant entities are involved (i.e., governments and other relevant voices) with clear roles and responsibilities, and clear lines of communication and coordination.

Since the beginning of the management system, some pieces of the organizational structure have never been implemented as designed, and for those involved, their roles and responsibilities have evolved. For example, the intended way First Nations were to engage, and approach for how IK was to be considered, never occurred as designed. Also, the YPAC was never formed, which was to be comprised of industry and other stakeholders. The YPS was an important part of supporting the implementation of the management system; however, since it has been rolled into CMI, the roles and responsibilities that were originally undertaken by YPS have never officially been redefined.

We recommend **in the near-term clarifying roles and responsibilities of entities involved**. This clarification should involve reviewing which entities are currently performing which roles and responsibilities, assessing whether there should be minor adjustment to enable better functioning, creating terms of reference to make these roles and responsibilities explicit, and updating documents to reflect these changes moving forward.

In the medium-term, we recommend, reinvigorating the organizational structure based on what was originally envisioned so as to include all of the relevant voices but in a way that ensures meaningful involvement. This process should involve reviewing the intent of the initial organizational structure, identifying where pieces were never implemented and gaps where entities should be involved, and redeveloping the structure. Examination of the system should include considering whether executive and management level entities are participating at the appropriate places, technical expertise exists where it is needed, stakeholders are involved, and there are effective coordination and communication entities. In particular, the reinvigoration process should focus on First Nation participation in the system. In particular, an allocation of resources should go toward working with the First Nations to understand how the system should be changed so that there can be meaningful First Nation participation and meaningful consideration of IK in the AM process. As the organizational structure is reinvigorated, it will be important to ensure that entities have the proper resources to perform their roles and responsibilities.

The lack of clarity around the decisions that need to be made (related to recommendation #1) and the lack of information synthesis (related to recommendations #2 and #3) may have hindered effectiveness of the organizational structure to-date. Therefore, it will be beneficial to undertake previous recommendations prior to reinvigorating the organization structure.



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Appendix A: Evaluation Approach

Evaluation Component	Evaluation Questions
Steps of AM	
Assess and define the problem	<ul style="list-style-type: none"> a) Are management goals / objectives clearly stated? Are the valued components clear? b) Are the range of decisions / management actions available to achieve the goals / objectives clear? Are there clear management levers? c) Are critical uncertainties / assumptions about how actions can achieve goals / objectives clearly identified (i.e., is there clarity around the questions of relevance to decision makers)? Has a “systems analysis” been used to assess uncertainties and potential effectiveness of actions (e.g., conceptual model, quantitative model, lit review – weight of evidence approach)? d) Have performance measures been identified to help (1) evaluate progress towards goals / objectives (for status and trends monitoring) and (2) effectiveness of actions (for effectiveness monitoring)?
Design actions	<ul style="list-style-type: none"> a) Have management actions been designed in a way to reduce critical uncertainties (i.e., learn by doing)? b) Has a monitoring plan been developed? c) Is monitoring designed in a way to collect the relevant / appropriate information (i.e., resolve critical uncertainties, measure progress towards goals / objectives, include Indigenous knowledge)? d) Is the monitoring design scientifically and statistically robust? e) Is there a data management plan?
Implement actions	<ul style="list-style-type: none"> a) Have management actions been implemented as designed?
Monitor responses	<ul style="list-style-type: none"> a) Has the monitoring plan been implemented as designed? b) Has status and trend monitoring occurred, including prior to implementing management (i.e., baseline monitoring)? c) Has effectiveness monitoring occurred?
Evaluate results	<ul style="list-style-type: none"> a) Has data analysis and synthesis occurred? b) Have results been assessed to understand if critical uncertainties (or questions) are being resolved? c) Have results been used to understand if goals / objectives are being met? Are goals / objectives being met?
Adjust management actions	<ul style="list-style-type: none"> a) Is there a framework for how information from monitoring is going to be used to adjust decisions / management actions based on progress towards goals / objectives (e.g., decision criteria and triggers)? b) Have findings been documented to clearly articulate what was learned from monitoring and evaluation (e.g., changes to monitoring protocols and/or models in assessment stage)? c) Have findings been communicated to decision-makers and others within the governance structure? d) Have management actions been altered based on what was learned?



Evaluation Component	Evaluation Questions
Enabling Factors	
Context & Problem Definition	a) Is this problem applicable for applying an AM approach? <ul style="list-style-type: none"> i. What degree of management control exists? ii. What degree of management uncertainty exists?
Trust	a) Is there trust among the key parties involved in the AM process?
Leadership & Executive Direction	a) Is there a clear leadership entity responsible for making decisions and implementing AM? b) Is there clear executive direction / decision authority to implement AM?
Organizational Structure	a) Does the governance structure include all of the appropriate levels of authority (e.g., federal, territorial, and First Nations governments and at all levels - technical, management, and executive) and other relevant voices (e.g., stakeholders)? b) Are there clear roles and responsibilities for all individuals and organizations involved (e.g., terms of reference)?
Communication	a) Is there a clear avenue of communication and is there effective communication occurring among the individuals and organizations involved in the AM process? b) Is there effective communication to entities outside of the AM process?
Funding & capacity	a) Is there a gap between the level of funding / capacity that is necessary and the level that is available? If so, how significant is that gap?



Appendix B: Interviewees

Interviewee	Position and Organization
Jean Beckerton	Manager, Licensing Yukon Water Board Secretariat
Will Fellers	President, KPMA
Jeska Gagnon	Section Head, Fish and Fish Habitat Protection Program, DFO
Paul Kishchuk	Economist, Vector Research
Sebastian Jones	Fish, Wildlife and Habitat Analyst, Yukon Conservation Society
Elizabeth MacDonald	Executive Director, YSSC
James MacDonald	Chair, YSSC Board
Alice McCulley	Fish and Wildlife Projects Coordinator, Tr'ondëk Hwëch'in First Nation
Cathy Merkel	First Nation and Community Liaison Officer, YG EMR CMI PSPM
John Miller	Manager PSPM, YG EMR CMI
Bobbie Milnes	Manager of Mining Lands, YG EMR Mineral Resources
Nina Modeland	Adaptive Management Coordinator, YG EMR CMI PSPM
Amélie Morin	Manager, Dawson Designated Office, YESAB
Mark Nowosad	Manager, Environmental Monitoring, YG EMR CMI PSPM
Lewis Rifkind	Mining Analyst, Yukon Conservation Society
Brooke Rudolph	Executive Director, KPMA
Stewart Schmitt	Former President, KPMA
Jeff Schuyler	Senior Natural Resource Officer, YG EMR CMI
Carl Sidney	Board Member, YSSC
Cameron Sinclair	Senior Fish Biologist, YG Department of Environment, Fisheries
Al Von Finster	Board Member, YSSC

DFO = Fisheries and Oceans Canada
 CMI = Compliance Monitoring and Inspections
 EMR = Energy, Mines and Resources
 KPMA = Klondike Placer Mining Association
 PSPM = Program Standards, Planning and Monitoring
 YESAB = Yukon Environmental and Socioeconomic Assessment Board
 YG = Government of Yukon
 YSSC = Yukon Salmon Sub-committee



Appendix C: Summary of Information from the Literature Review

AM Step	Evaluation Question	Related Information
<p>(1) <u>Assess</u> and define the problem</p>	<p>a) Are management goals / objectives clearly stated? Are the valued components clear?</p>	<ul style="list-style-type: none"> • The 'objectives' section in the AMF doesn't clearly specify actual objectives of AMF. There is a broad statement: "FHMS... intended to balance the objectives of sustainable Yukon placer mining industry with the conservation and protection of fish and fish habitat supporting fisheries" (YPS 2008a) • Record of Agreement (predecessor to YPMR) was committed to regime that would "recognize the importance of a sustainable placer industry to the Yukon, and the importance of conservation of fish and fish habitat supporting fisheries." • "The integrated regulatory regime for Yukon placer mining is designed to achieve the two priorities of promoting a sustainable mining industry and protecting fish and fish habitat supporting fisheries." (YPISC & YPWC 2005) • "[YPMR] was designed to balance the objectives of 1) conservation and protection of fish and fish habitat supporting fisheries and 2) a sustainable placer mining industry in Yukon." (YPS 2016) • Valued components are industry, fish and fish habitat. But the ecological objective tends to be expressed as "fish and fish habitat supporting fisheries", so one could interpret that the two valued components are mining and fisheries. Juvenile Chinook are identified as the indicator species to represent fish and fish habitat more broadly, and identified as the "valued ecosystem component" for most of the watersheds. For three others, lake trout was identified for one, bull trout for another, and not yet determined for the third. (YPS 2008a, YPS 2016)
	<p>b) Are the range of decisions / management actions available to achieve the goals / objectives clear? Are there clear management levers?</p>	<ul style="list-style-type: none"> • "In a general sense, decisions made in the adaptive management process are decisions that will improve the habitat management system's effectiveness in conserving and protecting fish and fish habitat supporting fisheries, while maintaining a sustainable placer mining industry in the Yukon. Specifically, these will be decisions to change some element of the monitoring programs, or decisions to change some element of a watershed authorization." (YPS 2008a) • Operating requirements can be adjusted to be more/less stringent. Also, results can be used to increase or focus monitoring. (YPS 2008a) • AMF identifies "possible management responses" under each combination of effects monitoring outcomes (YPS 2008a).
	<p>c) Are critical uncertainties / assumptions about how</p>	<ul style="list-style-type: none"> • "The fish habitat management system and its effects-monitoring programs are based on a set of assumptions that must be tested as early as possible through the monitoring effort and data analysis".



AM Step	Evaluation Question	Related Information
	<p>actions can achieve goals / objectives clearly identified (i.e., is there clarity around the questions of relevance to decision makers)? Has a "systems analysis" been used to assess uncertainties and potential effectiveness of actions (e.g., conceptual model, quantitative model, lit review – weight of evidence approach)?</p>	<p>The assumptions are:</p> <ol style="list-style-type: none"> 1. WQO indicates aquatic health 2. WQO are appropriate for watershed/habitat sensitivity 3. The WQ & compliance monitoring program will provide enough info to determine source of sediment concentration 4. Benthic macro-inverts are effective primary indicator of aquatic health 5. RCA is appropriate bio-assessment method 6. WQ & AH monitoring will be frequent/extensive enough to generate meaningful results 7. Type A indicators in EH will reliably signal trend in industry viability 8. Monitoring can be coordinated among agencies to increase significance of data 9. Monitoring data from other parties can be used in AM process (YPS 2008a) <ul style="list-style-type: none"> • The "risk management framework" approach informed identifying what standards should apply for what levels of habitat suitability and watershed sensitivity. The RMF approach is not specific to FHMS, but is a structure/tool from DFO for assessing the combined impact of the severity of effect and the habitat sensitivity. • There is a conceptual "pathways of effects" model for placer mining in the YPISC & YPWC (2005), but how it relates to the AMF is not clear. The AMF only appears to address only certain potential impacts of placer mining and does not include linkages to VCs (i.e., make clear how the impact pathways affect fish) (YPS 2008a).
	<p>d) Have performance measures been identified to help (1) evaluate progress towards goals / objectives (for status and trends monitoring) and (2) effectiveness of actions (for effectiveness monitoring)?</p>	<ul style="list-style-type: none"> • Measureable indicators are detailed within each of the 3 effects monitoring protocols. The AHMP has an inherent performance measure in that the RCA makes a conclusion of whether sites are in reference or how close/far from reference they are, but there are no metrics for rolling up to larger scales. The WQO protocol is measuring TSS and comparing to the water quality objective, so it's a relatively clear example of having a PM and a benchmark expressed at site-level. The EHMP has multiple indicators that go into its evaluation. (YPS 2008b, YPS 2008c, YPS 2008e) • The monitoring programs are meant to inform an overall assessment of whether the outcomes are within/outside "tolerable limits". So in essence these are used to evaluate progress toward the objectives and the effectiveness of the operational requirements. However, there are no specific approaches defined for how to roll up the monitoring data to that higher level assessment. (YPS 2008a, YPS 2008b, YPS 2008c, YPS 2008e).
<p>(2) <u>Design actions</u></p>	<p>a) Have management actions been designed in</p>	<ul style="list-style-type: none"> • With a management action being a potential set of operational requirements and standards, by implementing that set and monitoring, the FHMS should (in theory) learn whether effects of that "action" result in a system



AM Step	Evaluation Question	Related Information
	a way to reduce critical uncertainties (i.e., learn by doing)?	within or outside the tolerable limits for the identified valued components. (YPS 2008a)
	b) Has a monitoring plan been developed?	<ul style="list-style-type: none"> • There are three effects monitoring protocols: Water Quality Objectives, Aquatic Health, and Economic Health.
	c) Is monitoring designed in a way to collect the relevant / appropriate information (i.e., resolve critical uncertainties, measure progress towards goals / objectives, include Indigenous knowledge)?	<ul style="list-style-type: none"> • Specific questions for each effects-monitoring program and data collection processes are described in each protocol. For AHMP and WQMP they are aimed at understanding condition of the invertebrate community or WQ and how placer mining is affecting that condition (YPS 2008a, YPS 2008b, YPS 2008c, YPS 2008e). • DFO (2019) review of AHMP highlighted multiple concerns and made recommendations, including ones related to replacement of the current model, improvements to the sampling protocol (i.e., spatially and temporally balanced design with greater replication), and consideration of other analytical approaches.
	d) Is the monitoring design scientifically and statistically robust?	<ul style="list-style-type: none"> • Aquatic health protocol was peer-reviewed (Greig & Marmorek 2006). • No comparable review for the WQMP.
	e) Is there a data management plan?	<ul style="list-style-type: none"> • No evidence of a data management plan in the reviewed documents. Implicitly, data from the three monitoring programs are being stored somehow (presumably by the agencies responsible for the monitoring). • "The longer the Management System is in place, the more comprehensive and complex the monitoring data set will become. Effective Adaptive Management will require YPS to provide strong leadership, coordination and data management." (YPS 2016) • YPS (2016) identifies the need for CMI to have increased data management capacity for assessing/reporting compliance of individuals/industry based on FHMS (including action levels and specific standards applied).
(3) <u>Implement actions</u>	a) Have management actions been implemented as designed?	<ul style="list-style-type: none"> • Watershed authorizations operationalized the standards set forth in the YPMR plan, and they have been implemented in 16 of 18 watersheds (Watershed Authorizations, YPS 2016). • "Also noteworthy is the effect the phased approach to implementing the new standards has had on adaptive management evaluations. The new sediment discharge standards have been in effect in all Yukon River watersheds since 2010; however, water quality and aquatic health are also influenced by site management and



AM Step	Evaluation Question	Related Information
		<p>restoration practices. These new standards are being phased in as water use licences are renewed, resulting in a mix of old and new operating and restoration standards. By April 2018, all placer mines in the Yukon River basin will be operating under the new standards. To effectively assess the Management System, a performance evaluation should only be attempted in areas where there is a clear understanding of when and where the new standards have been applied. As such, the original vision for a performance evaluation after 3 to 5 years of monitoring has not been met. IMG is planning to complete performance evaluations, but will not attempt to do so until there is sufficient data to support such evaluations and it is clear what standards were in effect at the time monitoring was occurring." (YPS 2016)</p> <ul style="list-style-type: none"> • It appears there was a misunderstanding about whether the interim sediment discharge standards were intended to change to the more stringent standards unless monitoring results indicated otherwise, or whether the interim standards would not change unless monitoring indicated they should. The result is that "interim" standards have remained in effect for 7 years. (YPS 2016)
<p>(4) <u>Monitor responses</u></p>	<p>a) Has the monitoring plan been implemented as designed?</p>	<ul style="list-style-type: none"> • AHMP "generally found to be followed consistently each year" (YPS 2016). In light of DFO (2019), AHMP is currently being redesigned. "The IMG is currently in the planning phase of a study re-design process. DFO and Yukon government will carry out targeted studies in 2019 to answer several key questions that will be used to inform a revised approach to aquatic health monitoring. An interim approach to evaluating aquatic health will be used while the new program is being developed." (Government of Yukon 2019b) • WQMP "generally followed consistently each year... departures from the protocol tended to be enhancements" (YPS 2016). • EHMP has been carried out as designed other than panel survey being conducted every year despite results of step 1 and membership different than originally suggested (YPS 2016). • Inspection of placer mining operations - some inspections at beginning of season (ensure familiarity with license requirements), during sluicing (ensure compliance with sediment discharge standards), end of season (assess progress of reclamation work) (Government of Yukon 2019b). • Inspection program is "designed to be pro-active, where the timing and frequency of inspections constitutes a deliberate effort to reduce or prevent risk" (Government of Yukon 2019b).
	<p>b) Has status and trend monitoring occurred, including prior to implementing</p>	<ul style="list-style-type: none"> • Although conservation of fish and fish habitat supporting fisheries is one of the main objectives, the program does not include any status / trend monitoring in terms of fish. However, the AHMP and WQMP are explicitly intended to provide information for the indicators related to fish habitat condition, and strata are based on habitat suitability for juvenile Chinook (YPS 2008a, YPS 2008b, YPS 2008c, YPS 2008e).



AM Step	Evaluation Question	Related Information
	management (i.e., baseline monitoring)?	<ul style="list-style-type: none"> • There was some baseline monitoring for the WQO and AH monitoring programs, to provide grounding for the results collected through the FHMS (YPS 2008b, YPS 2008c, YPS 2008e). • "The aquatic health monitoring program's reference sites represent current baseline conditions, and efforts to collect baseline water quality data were increased as early as 2004" (YPS 2008d). • Monitoring occurred prior to implementing management for some operations because of phasing in of standards (YPS 2016).
	c) Has effectiveness monitoring occurred?	<ul style="list-style-type: none"> • Inspections information has been collected (Government of Yukon 2019b), which in theory allows for understanding of effectiveness.
(5) <u>Evaluate results</u>	a) Has data analysis and synthesis occurred?	<ul style="list-style-type: none"> • Annual AM reports are produced. Within these, data analysis for each of the three monitoring protocols is summarized. There does not appear to be cross-indicator synthesis or synthesis of results over time. (Government of Yukon 2019b).
	b) Have results been assessed to understand if critical uncertainties (or questions) are being resolved?	<ul style="list-style-type: none"> • It does not appear that there has been integrated evaluation as per the design in the AMF to understand whether the outcomes from each effects domain are within/outside tolerable limits. (Government of Yukon 2019b) • "Ability to incorporate non-compliance considerations yet to be developed" (YPS 2016)
	c) Have results been used to understand if goals / objectives are being met? Are goals / objectives being met?	<ul style="list-style-type: none"> • It does not appear that there has been integrated evaluation to compile data from the monitoring protocols to understand whether the FHMS is achieving its objectives. (Government of Yukon 2019b) • "the interim sediment discharge standards have been yet to be considered in the context of adaptive management, as subject to the results of the monitoring (particularly water quality monitoring)" (YPS 2016) • Challenges / work remaining that have limited the FHMS' ability to answer the questions listed in YPISC & YPWC (2005) include: <ol style="list-style-type: none"> 1. Reliable method of tracking mines discharging upstream of WQ site not developed 2. Need system to consider compliance results in combination with monitoring 3. Process for removing "Previous Development" designation not yet established 4. Phase II of EHMP has not been able to survey same cross section in successive year, and has inadequate sample size <p>(YPS 2016)</p>



AM Step	Evaluation Question	Related Information
(6) <u>Adjust management actions</u>	a) Is there a framework for how information from monitoring is going to be used to adjust decisions / management actions based on progress towards goals / objectives (e.g., decision criteria and triggers)?	<ul style="list-style-type: none"> The AMF includes a framework showing how the 8 combinations of monitoring outcomes would inform different types of decisions to increase monitoring or implement a management action of either increasing or decreasing the stringency of the operational requirements in the FHMS (YPS 2008a). YPS (2016) notes that there is no defined process for how to combine monitoring results to make an aggregate assessment: "Most notable is the challenge of developing an effective means to facilitate consideration of the results of all monitoring programs in combination. To carry out adaptive management evaluations, the results of all monitoring programs, including compliance monitoring, have to be analysed in combination. A system or process to facilitate this analysis has yet to be developed." The 2018 annual report states "This report communicates the results of the 2018 effects monitoring programs and the adaptive management process that was followed". But then also states during the prospective technical evaluation of the AMF "management decisions would not be made using the process described in the AMF" (Government of Yukon 2019b).
	b) Have findings been documented to clearly articulate what was learned from monitoring and evaluation (e.g., changes to monitoring protocols and/or models in assessment stage)?	<ul style="list-style-type: none"> AM annual reports include results from the monitoring but do not detail learning applicable for management (Government of Yukon 2019b). DFO (2019) details what has been learned from the AHMP, and what is not possible to learn given the existing protocol.
	c) Have findings been communicated to decision-makers and others within the governance structure?	<ul style="list-style-type: none"> Successful implementation will require 'regular and effective communication with communities, miners, stakeholders and special interest groups' (YPISC & YPWC 2005). The IMG holds an "Annual Adaptive Management Meeting" to discuss the AM program and the results from the three monitoring programs. (Government of Yukon 2019b)
	d) Have management actions been altered based on what was learned?	<ul style="list-style-type: none"> The 2018 AM annual report states "IMG is in planning stage for a technical evaluation of the AMF" and "IMG anticipates that this work would occur over several years, during which, management decisions would not be made using the process prescribed in the AMF" (Government of Yukon 2019b) Although there is suspension of decisions, documents do not indicate any prior changes to management actions.



AM Step	Evaluation Question	Related Information
		<ul style="list-style-type: none"> The 2017 AM annual report states "Based on the results of the monitoring conducted in 2017, additional monitoring at priority sites has been recommended. Additional information that would support the adaptive management evaluation process has also been identified, for example, information on placer mining activities upstream of monitoring sites." (Government of Yukon 2019a). "Performance evaluations have not yet been attempted. The Management System's performance can only be assessed after the new standards have taken effect. An evaluation should not be expected until after 2018" (YPS 2016)

Enabling Factor	Evaluation Question	Related Information
(1) Context & Problem Definition	a) Is this problem applicable for applying an AM approach? i. What degree of management control exists? ii. What degree of management uncertainty exists?	<ul style="list-style-type: none"> i) Based on the AMF, potential decisions that can be made are: 1) increase monitoring, 2) tighten operating requirements, 3) relax operating requirements. It also states "depending on the magnitude of unacceptable monitoring results, the most likely management response will be focused or intensified monitoring" (YPS 2008a). These action are within management control. ii) The AMF does not explicitly state the management uncertainty. It does state "The monitoring programs will assist in verifying the effectiveness of the management system in meetings its objectives and provide a rational basis for future changes, if appropriate." So implicitly the management uncertainty is whether management actions are enabling the FHMS to meet its objectives (of balancing a sustainable industry with protection of fish an fish habitat supporting fisheries). (YPS 2008a)
(2) Trust	a) Is there trust among the key parties involved in the AM process?	<ul style="list-style-type: none"> <i>N/A - this type of information is not in documents.</i>
(3) Leadership & Executive Direction	a) Is there a clear leadership entity responsible for making decisions and implementing AM?	<ul style="list-style-type: none"> "The Joint Placer Implementation Committee (JPIC) ultimately provides direction for the implementation of the Management System and consists of senior representatives from DFO, the Yukon government and CYFN. The Yukon Placer Secretariat (YPS) is the coordinating body responsible for supporting the implementation of the Management System. The Intergovernmental Management Group, consisting of representatives from DFO, Yukon government and CYFN, provides the YPS with operational support. The Yukon Placer Advisory Council (YPAC) is yet to be activated; it was intended to provide a forum for industry and non-governmental organizations to provide input into the Management System." (YPS 2016)



Enabling Factor	Evaluation Question	Related Information
		<ul style="list-style-type: none"> • The YPS terms of reference indicate: <ul style="list-style-type: none"> ○ JPIC is comprised of individuals from YG, DFO, and CYFN, and it provides strategic direction, oversight and decision recommendations. ○ IMG is comprised of individuals from YG (EMR & ENV), DFO, and CYFN, it is chaired by YPS, and it makes recommendations regarding operational / technical issues, conducts monitoring, and does AM reporting. ○ YPS is comprised of individuals from YG, and it coordinates implementation and consultation, distributes information, is first point of contact for regulatory advice, and coordinates AM. <p>(Appendix A of Appendix 2 in YPS 2016)</p>
	b) Is there clear executive direction / decision authority to implement AM?	<ul style="list-style-type: none"> • The AMF was designed based on an agreement from the entities with the authority to implement the decisions that could result from the AM process (i.e., YG, DFO, CYFN). The strategic direction and decision recommendations are made by the JPIC, which includes senior representatives from those constituent agencies. (YPS 2008a) • YPS (2016) states "To date, all parties have remained committed and engaged" and "Long-term commitment [to AM] provided in the Letter of Understanding Regarding the Implementation of the New Fish Habitat Management System for Yukon Placer Mining 2008-2010." • YPS (2016) indicates that there has been significant and ongoing turnover of the JPIC representatives and therefore "effective briefings from the YPS and the IMG are essential to ensuring productive JPIC meeting and sound decision making". Also, "it is also important that the parties continue to appoint senior representatives who are able to make decisions on behalf of their respective organizations"
(4) Organizational Structure	a) Does the governance structure include all of the appropriate levels of authority (e.g., federal, territorial, and First Nations governments and at all levels - technical, management, and executive) and other relevant voices (e.g.,	<ul style="list-style-type: none"> • The AMF was designed based on an agreement from the entities with the authority to implement the decisions that could result from the AM process (i.e., YG, DFO, CYFN). This includes the federal and territorial governments as well as First Nations. (YPS 2008a) • The JPIC is designed to include senior level representatives, and the IMG and YPS are designed to include individuals at the technical and operational levels (YPS 2008a, YPS 2016). • There is an interest of some First Nations to participate directly rather than through CYFN (YPS 2008d). • "Consideration of traditional knowledge was an essential part of assess the condition of watersheds" (YPISC & YPWC 2005)



Enabling Factor	Evaluation Question	Related Information
	stakeholders)?	<ul style="list-style-type: none"> • “The use of Traditional Knowledge is an essential part of the Management System and the AMF describes how Traditional Knowledge will be considered during adaptive management processes. First Nation governments are invited on an annual basis to share Traditional Knowledge that may be significant to the management of placer mining activity in their traditional territories. No Traditional Knowledge has been shared in response to the annual invitations. Reasons for this have been documented and relate to the collection process, ownership, storage, and use of this information.” (Government of Yukon 2019a) • YPS (2016) discusses how TK has not been shared in part because of development of a broader TK policy/process occurring. • YPS (2016) recommends that YPS should elicit feedback from First Nations on why TK is not being shared, better alternatives for fostering TK sharing, and then the IMG should adopt a new approach. • There is a draft ToR for the Yukon Placer Advisory Council but it was never formed (YPS 2016). • YPS (2016) indicates that YPS has working relationship with Yukon Water Board (YWB), the Yukon Environmental and Socio-economic Assessment Board (YESAB), the Yukon Fish and Wildlife Management Board, its Salmon sub-Committee, and the Renewable Resource Councils in Yukon communities.
	b) Are there clear roles and responsibilities for all individuals and organizations involved (e.g., terms of reference)?	<ul style="list-style-type: none"> • There is a terms of reference for YPS (<i>see information in 3a above</i>). No indication that there is a terms of reference for JPIC or IMG. • “YPS responsible for “facilitating the participation of non-governmental organizations in the decision-making process by establishing the Placer Advisory Council” (YPS 2008d) • There is a draft ToR for the Yukon Placer Advisory Council but it was never formed (YPS 2016).
(5) Communication	a) Is there a clear avenue of communication and is there effective communication occurring among the individuals and organizations involved in the AM process?	<ul style="list-style-type: none"> • There is an annual AM meeting at which the annual results from the three monitoring protocols are presented and discussed. Attendees at the meeting are provided in the annual report (Government of Yukon 2019b).
	b) Is there effective communication to entities	<ul style="list-style-type: none"> • There were outreach meetings in development of YPMR (2004-2005) with Yukon Fish and Wildlife Management



Enabling Factor	Evaluation Question	Related Information
	outside of the AM process?	<p>Board and Salmon Subcommittee, Yukon Water Board, Yukon Environmental and Socio-economic Assessment Board, Dawson city community leaders (business, city, FN, fishermen), Nacho Nyak Dun First Nation and community members (YPISC & YPWC 2005).</p> <ul style="list-style-type: none"> • Documents do not appear to have any information about ongoing communication to entities outside the process. • www.yukonplaceseecretariat.ca which appears online as though it is supposed to have AM reports and documents is redirected to https://yukon.ca/en/doing-business/licensing/prepare-project-proposal-class-4-placer-activities
(6) Funding & Capacity	a) Is there a gap between the level of funding / capacity that is necessary and the level that is available? If so, how significant is that gap?	<ul style="list-style-type: none"> • YPISC & YPWC (2005) identifies that a coordinated management approach and establishing a secretariat will produce "cost-efficiency". • YPS (2016) notes that federal funding for the YPS stopped in 2009-10. • Continued existence of supporting bodies indirectly indicates that at least core level of human/financial resources exist.

