Wetland Information Needs

Results from ABMI public survey

October 2024

ABMI ALBERTA BIODIVERSITY MONITORING INSTITUTE

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Executive Summary

In the summer of 2024, the Alberta Biodiversity Monitoring Institute (ABMI) conducted a public survey to help inform an update to the organization's wetland monitoring approach. A complete copy of the survey design is provided in Appendix 1. The survey aimed to gather insights into how currently available wetland data is used, help identify what the data needs and gaps are, and to gain insight from survey respondents on promising opportunities in terms of emerging wetland information. A total of 62 respondents participated in the survey, providing valuable feedback on various aspects of wetland monitoring. Government representatives, environmental non-government organizations, consultants, academic researchers, and industry stakeholders all contributed perspectives to the survey results.

The results of this survey are part of a greater engagement effort taking place to help inform the update to the wetlands component of the ABMI's Ecosystem Health Program. In addition to this survey, the ABMI has established a Wetland Advisory Group comprising representatives from key stakeholder groups, and is also actively pursuing a separate engagement process to understand Indigenous needs related to wetlands.

Key Findings:

Inventory and Mapping Products: Respondents shared how they currently use available datasets and databases in their wetland related work. Respondents emphasized the importance of mapped resources and comprehensive wetland inventories, stating that these are both currently used and helpful in their wetland-related work (Figure 2 and Table 1). However, limitations were identified in existing mapped resources, particularly regarding data accuracy. Respondents highlighted the need for more detailed classifications, including wetland class, ownership status (e.g., Crown ownership), and wetland condition (Table 2), among other opportunities. Additional details on how various datasets and databases are currently being utilized can be found in Table 3.

Wetland Classification Preferences: Respondents showed a preference for summarizing wetland information based on wetland class (e.g., bog, fen, swamp, marsh, shallow open weltand), with 91% indicating this classification level would be useful (Table 5 and Figure 8).

Geographic Data Summarization Preferences: Respondents expressed interest in data summarized at various geographic levels, including at the watershed level (90%), individual wetlands level (82%), natural regions (83%), and at the province-wide level (82%) (Table 6).

Wetland Indicators: Survey results revealed interest among respondents for diverse wetland indicators, particularly those related to wetland area and landscape

distribution data, and wetland ecological function information concerning biodiversity (e.g., species or taxonomic groups). Interest was also notable for information on wetland environmental drivers and stressors, wetland ecosystem services, and wetland ecological functions, while data on policy effectiveness generated comparatively lower interest (Table 7).

Data Updates: Respondents favored wetland data updates every two to five years, with many acknowledging the need to balance timely updates with feasibility.

Looking forward: Additionally, there was strong interest in the future uses of information gathered from a province-wide program. A slightly higher number of respondents indicated they would more frequently utilize this information for the following purposes: informing land-use management decisions, staying informed about Alberta's wetlands, compiling data and generating reports, and supporting educational and outreach activities.

Overall, the findings underscore that wetland information is highly valued by respondents, with mapping and inventory data being among the most sought-after data types. The ABMI will leverage these insights to refine its approach to wetland monitoring and would like to express our gratitude to all those who took the time to complete this survey.

Distribution

The survey was disseminated through personal email invitations to individuals in local and regional government, federal government, different industry sectors (forestry, energy, agriculture), academics and research institutes, environmental non-governmental organizations (ENGOs) such as Watershed Planning Advisory Councils (WPACs), environmental consultants, as well as contacts from Indigenous communities. It was also shared through various external communication channels.

The survey remained open for a total of five weeks, resulting in 62 responses. The survey was sent out using the SurveyMonkey platform, and included reminder emails sent at three different intervals to encourage participation. Additionally, it was promoted across ABMI's social media platforms, mentioned in the ABMI newsletter, and featured in several external newsletters, including the Alberta Society of Professional Biologists , the Rural Municipalities of Alberta and in the Wetland Knowledge Exchange.

Limitations

The survey's findings may reflect a bias towards the use of ABMI data, as it was predominantly distributed through the ABMI's existing contacts and via the ABMI's external communication channels. In addition, we chose not to send personal invitations to the Government of Alberta (GOA) representatives because GOA were facilitating a separate internal wetlands business needs assessment survey at the same time. Nevertheless, this survey did receive responses from some individuals within the provincial government, and their insights have been included in the survey results.

Survey Results

Who we heard from

Survey respondents were asked to:

Indicate which perspective or sector best aligns with [their] profession or the type of organization [they] work for (select all that apply)

Results:

The survey gathered diverse perspectives, primarily from consultants (n=14) and environmental non-governmental organizations (n=21), which included eight individuals who self-identified as being from WPACs. Although the survey was shared with several Indigenous partners, we did not receive responses from individuals identifying with that perspective. *Figure 1* illustrates the distribution of perspectives captured in this survey.
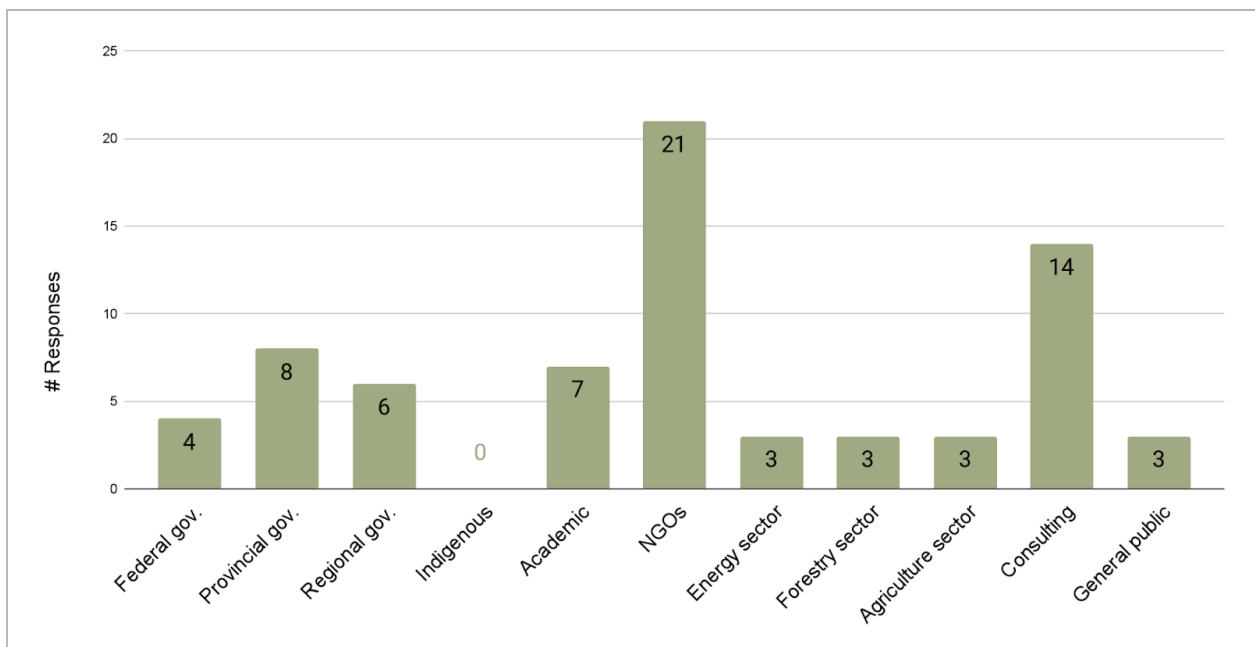

Figure 1. *Respondent demographics by sector and perspective. This table summarizes the perspectives represented in the survey responses. NGOs: non-governmental organizations.*

Types of evaluation and reporting products currently used

Survey respondents were asked:

Which currently available wetland evaluation or reporting products do you use? (check all that apply.)

They were provided with the following types of evaluation and reporting products:

- **Environmental Reports** (e.g.,Condition of Environment Reports, Wetland Policy Performance Reports)
- **Mapped Resources** (e.g., Alberta [Merged] Wetland Inventory, Map of potential wetland restoration sites, Map of high priority wetland conservation areas, Wetland Replacement Program priority maps, Watershed Resiliency and Restoration Program [WRRP] priority area maps)
- **Scientific Research, Technical reports, and Publications** (e.g., Peer-reviewed publications, Species at Risk reports)
- **Communication and Outreach products** (e.g.,Wetland Replacement Program Fact Sheets, Wetland Atlas of Alberta)
- **Natural Resource Management and Conservation Reports and Plans** (e.g.,Carbon offsets reports, SARA management plans, water storage reports)
- **Other** (please specify)

Results:

> **Environmental reports, along with scientific research, technical reports, and publications, are the two primary categories of resources used in wetland-related work.**

As shown in Figure 2, mapped resources (87%) and scientific research, technical reports, and publications (80%) were identified as the most common types of evaluation and reporting products currently used in wetland work. Environmental reports (57%), communication and outreach products (53%), and natural resource management and conservation reports and plans (50%) were also identified as being used by just over half of the survey respondents. Please note that after the survey, we identified some overlap between the response options "Environmental Reports" and "Scientific Research, Technical Reports, and Publications." Respondents may not have consistently distinguished between these two categories, which could have impacted how uses of these evaluation and reporting products were reported.

Open Comments (other):

Other ways respondents obtain wetland information include through in-house resources, by way of consultant reports, in Cows and Fish riparian health inventories, and via information shared by WPACs. Additionally, respondents shared that they learn about wetlands through directives and guidelines, by monitoring individual wetlands themselves, or information shared by experts at webinars.
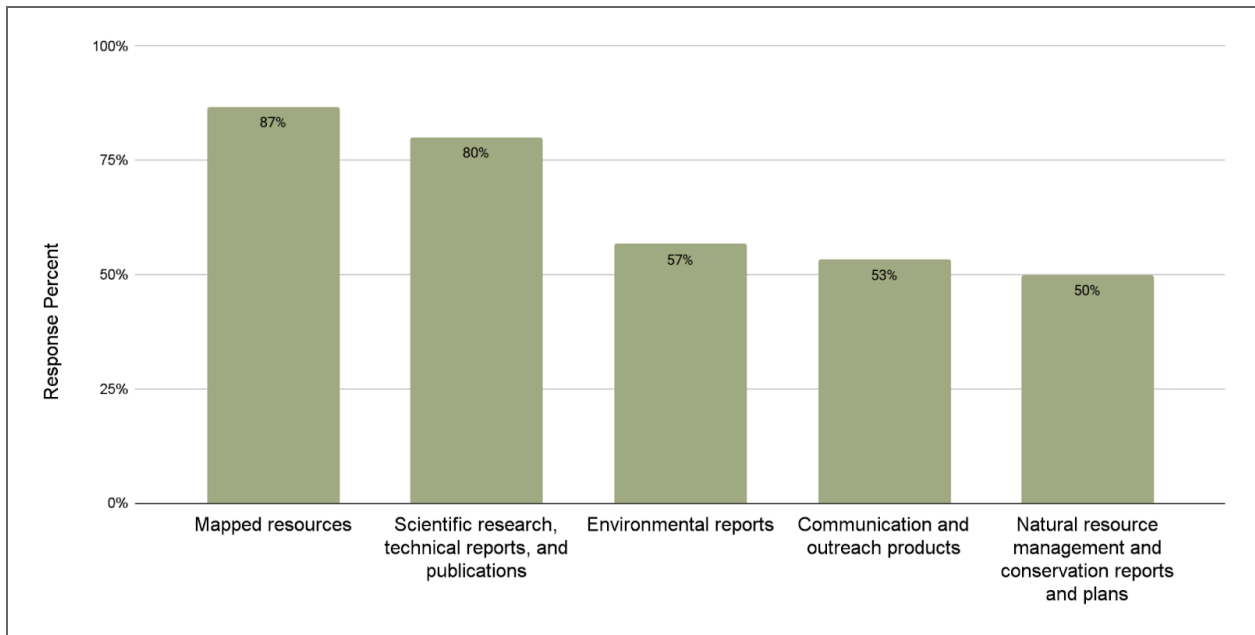
Figure 2. *This bar graph illustrates the types of wetland evaluation and reporting products most commonly used by survey respondents.*

Types of wetland information that are helpful

Survey respondents were asked to:

Rate how helpful the following types of wetland information would be in [their] work:

- Wetland inventory datasets (e.g., wetland mapping)
- Abiotic wetland monitoring data (e.g., water chemistry, sedimentation)
- Biological wetland data (e.g., biological species or communities)
- Wetland indices (e.g., riparian health assessment, indices of biological integrity)
- Environmental driver and human pressure datasets (e.g., human footprint, climate change, drought)
- Cultural ecosystem / biocultural datasets (e.g., a Wetland Traditional Ecological Knowledge database)

They were provided with the following selection options:

- Very helpful
- Moderately helpful
- Slightly helpful
- Not at all helpful

Results:

> Almost all respondents indicated that wetland inventory datasets were helpful or very helpful to their work. Similar numbers of respondents indicated that environmental driver and human pressure datasets, such as human footprint or drought information, and biological wetland data were "very helpful" to their work.

Survey respondents rated the helpfulness of various types of wetland information for their work, with results *(Table 2 and Figures 3 and 4)* indicating a strong preference for wetland inventory datasets and biological wetland data. Specifically, 77% (n=47) of respondents found wetland inventory datasets to be "very helpful," while 73% (n=45) rated biological wetland data as "very helpful." Environmental driver and human pressure datasets also received high ratings, with 73% (n=45) of respondents considering them "very helpful." Wetland indices were rated as "very helpful" by 56% (n=35) of respondents, while cultural ecosystem and biocultural datasets garnered a "very helpful" rating from 42% (n=26) . Abiotic wetland monitoring data received mixed feedback, with 44% (n=27) rating it as "very helpful."
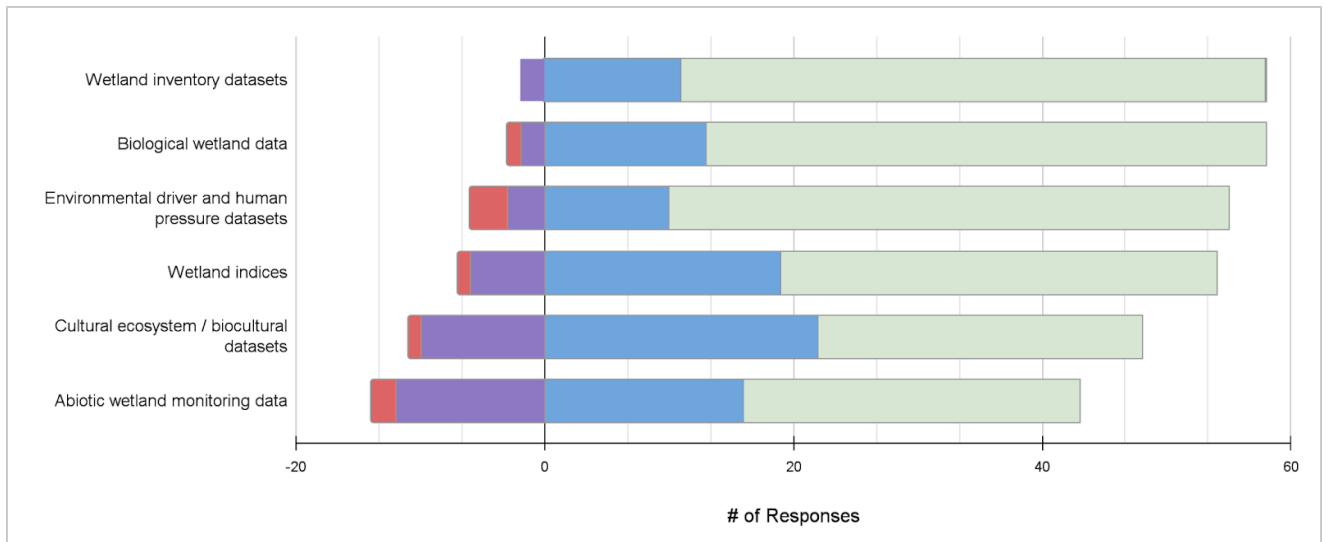

Figure 3 Likert Scale presents responses regarding how helpful different types of wetland information are in their wetland related work. Responses are categorized by helpfulness: green indicates "Very Helpful," dark blue represents "Moderately Helpful," purple denotes "Slightly Helpful," and red signifies "Not at All Helpful", as seen in Table 1

Table 1. The table presents responses regarding the perceived helpfulness of different types of wetland information in respondents' wetland-related work. The weighted average is calculated by multiplying the frequency of each response by its corresponding value, summing those products, and dividing by the total number of responses (excluding N/A).

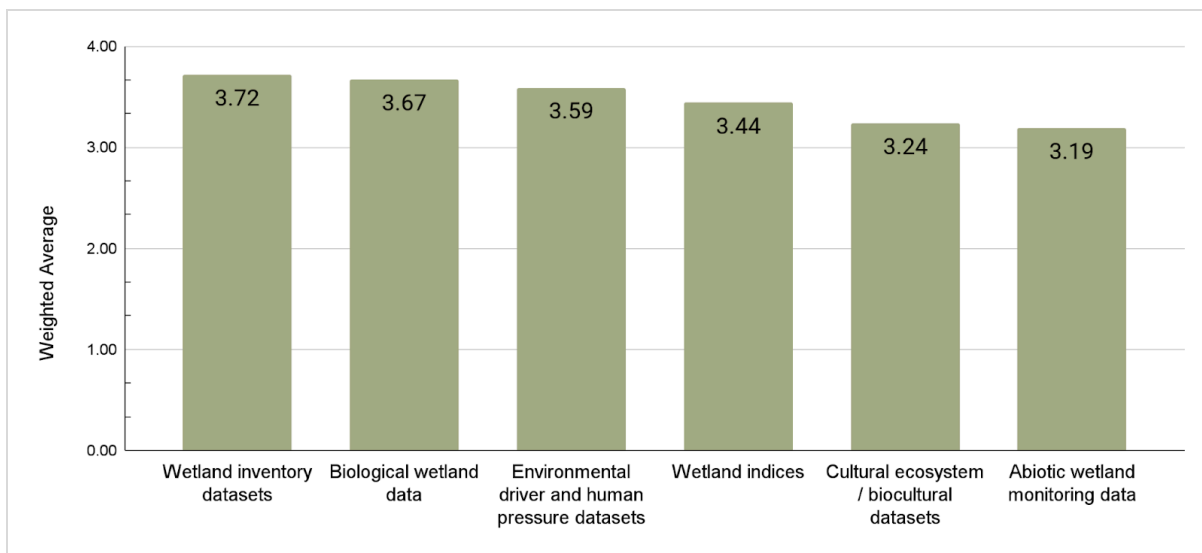|	Very helpful (Value=4)	Moderately helpful (Value=3)	Slightly helpful (Value=2)	Not at all helpful (Value=1)	N/A or uncertain (Value=0)	Weighted Average	Total Responses
Wetland inventory datasets	47	11	3	0	0	3.72	61
Biological wetland data	45	13	2	1	1	3.67	62
Environmental driver and human pressure datasets	45	10	3	3	1	3.59	62
Wetland indices	35	19	6	1	1	3.44	62
Cultural ecosystem / biocultural datasets	26	22	10	1	3	3.24	62
Abiotic wetland monitoring data	27	16	12	2	4	3.19	61

Figure 4. The figure presents the weighted average of responses regarding the perceived helpfulness of different types of wetland information in respondents' wetland-related work. The weighted average is calculated by multiplying the frequency of each response by its corresponding value, summing those products, and dividing by the total number of responses (excluding N/A).

Open-ended responses

The following section summarizes the responses to an open-ended question from the survey. The response summaries are presented in the text below, and further summarized in Table 3. These summaries aim to share key themes and insights drawn from the participants' feedback.

Survey respondents were asked as a follow-up question:

Is there any wetland information that is not currently collected or accessible that you wish you had? (Open Comments)

Results:

The most common comment was the need for higher accuracy and greater detail in wetland mapping products.

A total of 30 individuals responded to this open-ended question. Their responses were grouped into three main themes *(see Table 3)*, with some comments overlapping multiple themes and subthemes. The primary theme groupings were:

- Wetlands inventories and mapping
- Ecological function & connectivity
- Biodiversity and species data

The **wetlands inventories and mapping** (n = 17 responses) theme encompassed comments about improving data accuracy, with respondents highlighting the need for more detailed classifications, such as wetland class, ownership status (e.g., Crown ownership), and condition. Comments also emphasized the importance of historical data, particularly geospatial information to track wetland loss and changes in condition over time. Additionally, there was interest in assessing the proportion of wetlands under protection, with considerations for conservation targets like the 30x30 goal and tracking wetlands within Key Biodiversity Areas.

The **ecological function & connectivity** (n = 11) theme encompassed comments about understanding changes in wetland health over time and conducting riparian health assessments. Respondents highlighted the importance of hydrological function and connectivity, requesting detailed hydrological data, including hydroperiod information, precipitation impacts, and surface and groundwater connectivity. There was also interest in carbon data quantification for wetlands and in developing wetland health indicators to support watershed and riparian health reporting.

Respondents also identified a need for additional **biodiversity and species data** (n = 6), including information for wildlife (including camera and audio recording unit data), fish data, eDNA, and lists of rare wetland species.

Individual comments also noted the need for information on: wetland soil, precipitation data, location information (when using abiotic/biotic data), phosphorus mapping, and hydroperiod wetland valuation data from a natural asset perspective.

Table 2. Summary of open-ended responses regarding additional desired wetland information. Responses were grouped into three main themes: Wetland Inventories and Mapping, Ecological Function & Connectivity, and Biodiversity and Species Data.

Theme and Subtheme	# Responses
Wetland Inventories and Mapping	*17*
wetland mapping products (better accuracy, detailed classes, e.g., rich fen, poor fen, etc.)	8
wetland permanence and condition or interannual variations	3
status of wetlands/protection status (i.e. contributing to 30x 30 goals, or info on if in key conservation areas)	3
historical geospatial information (e.g., condition, wetland loss)	2
wetland status and trends	1
Ecological Function & Connectivity	*11*
wetland connectivity (including complexes, and surface water & groundwater connectivity)	3
ecological function changes	2
wetland riparian health reports /reporting)	2
carbon quantifications	2
hydrological function information	1
data on threats to wetlands	1
Biodiversity and Species Data	*6*
wildlife info	2
fish data	1
rare wetland plants and animals	1
age of treed wetlands	1
eDNA	1

Current use of existing wetland data and gaps

Survey respondents were asked:

How they currently use the available datasets and databases related to wetland work.

The datasets listed included:

- ABMI Biodiversity Intactness Index
- ABMI biological monitoring data (invertebrates, vascular plants, other vertebrates)
- ABMI Human Footprint Products
- ABMI wetland habitat data (e.g., bathymetry, water chemistry, site disturbance)
- ABMI Wetland Inventory
- ACIMS (Alberta Conservation Information Management System) data
- Alberta Geological Survey Permafrost classification model for Northern Alberta
- Alberta Merged Wetland Inventory
- Alberta Vegetation Inventory
- Bow River Region Wetland Inventories
- CABIN database (Canadian Aquatic Biomonitoring Network)
- Canadian National Wetlands Inventory
- Cumulative Environmental Management Association (CEMA) data
- Ducks Unlimited Canada boreal wetland inventory
- Ducks Unlimited Canada data (e.g., waterfowl population modeling results)
- Environment and Climate Change Canada (ECCC) waterfowl and habitat survey data or reports
- FWMIS database (Fish and Wildlife Management Information System)
- Oil Sands Data Catalogue
- Prairie Habitat Joint Venture information

Respondents were asked to select all applicable uses from the following options:

- To compile data, generate reports, and/or monitor compliance/ commitments
- Informing land-use management decisions
- For academic research
- Education, outreach, and/or keeping informed about Alberta's wetlands
- NA (I am unfamiliar with/don't use this dataset/database)

Results:

> **Four of the top ten datasets were geospatial wetland and vegetation inventories at the provincial or natural region scale. The ABMI Wetland Inventory was the most widely used dataset, with 87% of respondents using it for some purpose.**

The results *(Table 3)* indicated that several datasets are particularly prominent among users. The ABMI Wetland Inventory is the most widely used dataset, with respondents frequently using it for education and outreach activities, to compile data and generate reports, and to inform land-use management decisions. The ABMI Human Footprint Products and Alberta Vegetation Inventory were also commonly used for similar purposes.

The most commonly referenced datasets for all uses (presented alphabetically) are:

- ABMI Wetland Inventory

- ABMI Human Footprint Products

- Alberta Vegetation Inventory

- ABMI Biodiversity Intactness Index

- ABMI Biological Monitoring Data (invertebrates, vascular plants, other vertebrates)

- Alberta Merged Wetland Inventory

- FWMIS Database (Fish and Wildlife Management Information System)

- Ducks Unlimited Canada Boreal Wetland Inventory

- ABMI Wetland Habitat Data (e.g., bathymetry, water chemistry, site disturbance)

- ACIMS (Alberta Conservation Information Management System) Data

Table 3. *Totals of the different wetland evaluation and reporting products by use (each value represents one individual stating they use that product for that use), with* ***the top ten products tallied and indicated as bold and shaded***.

	To compile data, generate reports, and/or monitor compliance/ commitments	Informing land-use management decisions	For academic research	Education, outreach, and/or keeping informed about Alberta's wetlands	NA (I am unfamiliar with/ don't use this dataset/ database)	Sum Total (across four uses)	Total # respondents who answered question
ABMI Biodiversity Intactness Index	**18**	**21**	**13**	**20**	**22**	**72**	60
ABMI biological monitoring data (invertebrates, vascular plants, other vertebrates)	**20**	**18**	**11**	**22**	**17**	**71**	59
ABMI Human Footprint Products	**23**	**23**	**16**	**21**	**14**	**83**	60
ABMI wetland habitat data (e.g., bathymetry, water chemistry, site disturbance)	**16**	**14**	**11**	**17**	**23**	**58**	59
ABMI Wetland Inventory	**24**	**23**	**17**	**25**	**8**	**89**	60
ACIMS (Alberta Conservation Information Management System) data	**19**	**16**	**7**	**12**	**25**	**54**	59
Alberta Geological Survey Permafrost classification model for Northern Alberta	4	2	4	8	43	18	58
Alberta Merged Wetland Inventory	**23**	**18**	**14**	**14**	**19**	**69**	60
Alberta Vegetation Inventory	**23**	**19**	**16**	**15**	**16**	**73**	60
Bow River Region Wetland	6	1	1	4	45	12	56

Inventories							
CABIN database (Canadian Aquatic Biomonitoring Network)	10	8	4	10	41	32	59
Canadian National Wetlands Inventory	14	13	11	11	31	49	60
Cumulative Environmental Management Association (CEMA) data (e.g., the Guideline for wetland establishment on reclaimed oil sands leases guide)	8	4	6	6	44	24	59
Ducks Unlimited Canada boreal wetland inventory	**18**	**15**	**16**	**14**	**24**	**63**	59
Ducks Unlimited Canada data (e.g., waterfowl population modeling results)	10	5	7	14	35	36	59
Environment and Climate Change Canada (ECCC) waterfowl and habitat survey data or reports	9	6	9	13	36	37	58
FWMIS database (Fish and Wildlife Management Information System)	**23**	**17**	**5**	**19**	**19**	**64**	58
Oil Sands Data Catalogue	4	2	3	4	48	13	57
Prairie Habitat Joint Venture information	7	4	3	12	37	26	56

Open-ended Responses

The following section summarizes the responses to an open-ended question from the survey. The response summaries are presented in the text below, and summarized in a word cloud *(Figure 5)*. These summaries aim to share key themes and insights drawn from the participants' feedback.

Survey respondents were asked as a follow-up question:

Are there any key gaps in existing wetland information or monitoring datasets from [the previous question] that would help you in your work? For example, is the dataset outdated, does the accuracy need refinement, or are there missing baseline/historic datasets? Please specify which dataset.

Results:

The most common concern or gap was inaccuracy in wetland classification and mapping. The importance of field validation for geospatial maps was noted.

Survey respondents highlighted several gaps in current wetland datasets and monitoring resources that, if addressed, could significantly improve their utility across various applications. One commonly cited issue was inaccuracy in wetland classification and mapping, particularly in boreal and northern regions. For example, one respondent noted that "*accuracy of the wetland inventory classification and mapping is low in boreal areas, often under-mapped.*" Another respondent mentioned that "*all wetland inventory data currently available is too coarse to be utilized in my work. I would be grateful if a more accurate wetland inventory becomes available.*" Field verification to validate computer-generated mapping was also highlighted as a priority.

Another frequent theme was the need for local-level precision in datasets. Several respondents expressed interest in customizable spatial access to data, with one remarking that "*data for municipalities must offer specifics for that municipality; otherwise, a lot of this mass of information may be overlooked.*" Respondents also emphasized the need for tools that provide watershed mapping and data customization, enabling users to "*clip to our own watersheds or other extents*" for streamlined analysis.

Users also highlighted the importance of historical data and wetland loss. For example, one respondent expressed a need for historic inventories to assess wetland changes over time further noting that this would allow for "*better understanding of the scale of wetland loss and impacts in all major natural regions*"
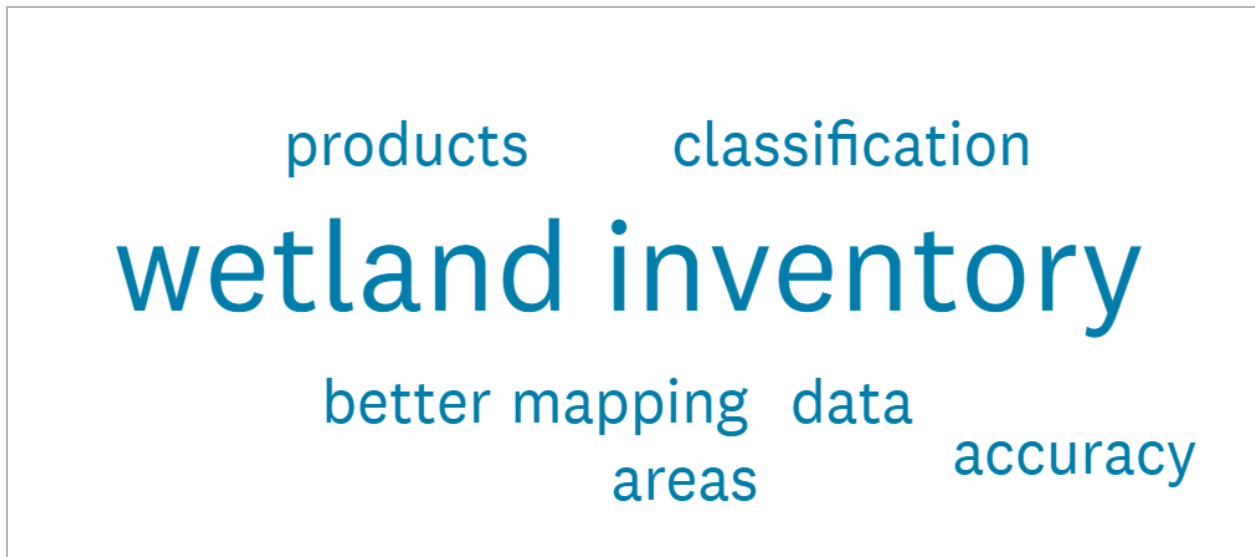
Figure 5. Word cloud generated from SurveyMonkey responses, highlighting key terms used in participants' open comments.

How respondents foresee using information collected from a refined monitoring program

Survey respondents were asked:

How do you foresee using information collected by a province-wide wetland monitoring program? (Select the frequency for each use case)

Respondents were provided with the following ways of utilizing information:

- Keeping informed about Alberta's wetlands
- Informing land-use management decisions
- To compile data and generate reports
- Supporting education and outreach activities
- Help in monitoring and reporting on sustainability goals/commitments
- Academic research
- Monitoring compliance with legislation/policy
- Compliance with Treaty rights

They were provided with the following options for frequency:

- Frequently use
- Sometimes use
- Rarely use
- Not at all
- N/A (e.g. I don't do this type of work)

Results:

> **There is a strong desire to use wetland information for a wide range of applications. There is no single application or use for wetland data.**

The survey results *(Table 4 , Figures 6 and 7)* indicate that the majority of respondents identified that information collected from a province-wide wetland monitoring program would be applied in many ways. Specifically, 32 out of 61 respondents (52%) indicated they would frequently use the data to stay informed about Alberta's wetlands, with a weighted average[1] score of 3.47. Informing land-use management was similarly identified as a potential future use, with 33 of 62 respondents (53%) rating it as a frequent application, resulting in a weighted average of 3.38. Report generation was also noted as a primary use, with 31 out of 61 respondents (51%) indicating frequent use, yielding a weighted average of 3.38.

Supporting educational and outreach activities were marked as frequent uses by 30 respondents and occasional uses by 15 respondents, yielding a weighted average of 3.27. The availability of this information would also assist in monitoring and reporting on sustainability goals and commitments, showing moderate potential use, with a weighted average of 3.16 and 26 respondents noting frequent use. Academic research scored a weighted average of 3.02, with 21 respondents indicating frequent use, while monitoring compliance with legislation and policy received a lower rating (weighted average of 2.92), noted by 17 out of 60 respondents (28%). Lastly, compliance with Treaty rights was reported as frequently relevant by four respondents (7%); among those who completed this question, 19 respondents indicated N/A (e.g., "I don't do this type of work").

Overall, the data suggest a strong interest in the future uses of information gathered from a province-wide program, with a slightly higher number of respondents indicating they would more frequently utilize this information for informing land-use management decisions, staying informed about Alberta's wetlands, compiling data and generating reports, and supporting educational and outreach activities.

1. Weighted average is calculated by multiplying the frequency of each response by its assigned value, summing these products, and then dividing by the total number of responses, excluding N/A, to reflect both the number and level of agreement.
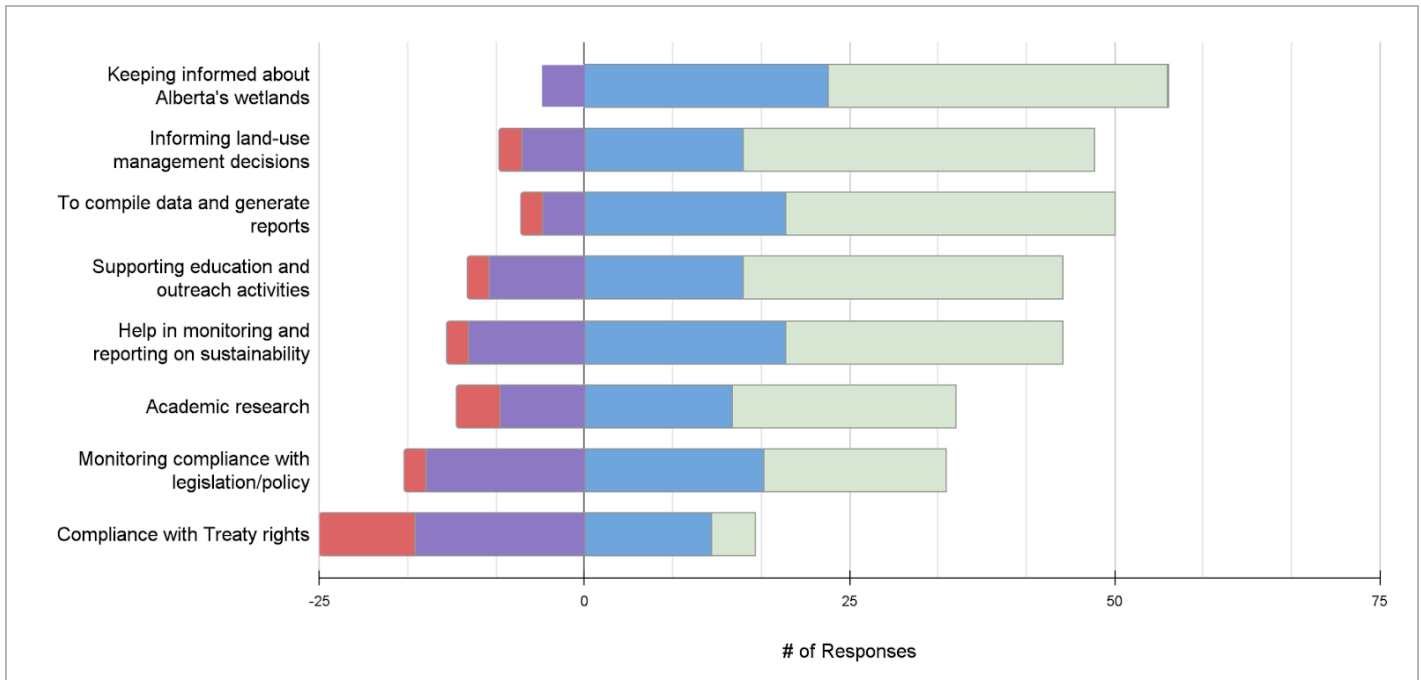
Figure 6 *Likert Scale presents responses regarding how frequently participants would utilize information from the program for various purposes. Responses are categorized by frequency of use: green indicates "Frequently Use," dark blue represents "Sometimes Use," purple denotes "Rarely Use," and red signifies "Not at All", as seen in Table 4.*

Table 4 *The table presents responses regarding how frequently participants would utilize information from the program for various purposes. The weighted average is calculated by multiplying each response frequency by its corresponding value, summing those products, and dividing by the total number of responses (excluding N/A).*

	Frequently use (value=4)	Sometimes use (value=3)	Rarely use (value=2)	Not at all (value=1)	N/A (value=nul)	Total # of Responses	Weighted Average
Keeping informed about Alberta's wetlands	32	23	4	0	2	61	3.47
Informing land-use management decisions	33	15	6	2	6	62	3.38
To compile data and generate reports	31	19	4	2	5	61	3.38
Supporting education and outreach activities	30	15	9	2	5	61	3.27
Help in monitoring and reporting on sustainability goals/ commitments	26	19	11	2	4	62	3.16
Academic research	21	14	8	4	15	62	3.02

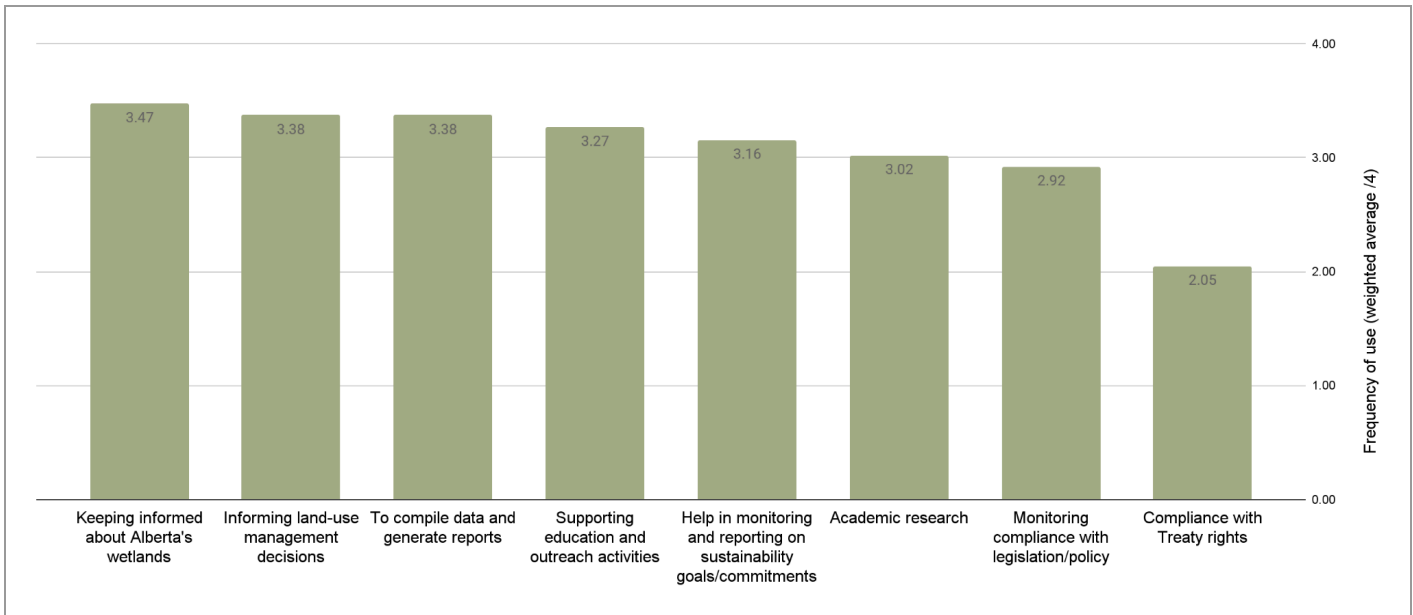|						
Monitoring compliance with legislation/policy	17	17	15	2	9	60	2.92
Compliance with Treaty rights	4	12	16	9	19	60	2.05

Figure 7 Weighted averages of responses regarding how frequently participants would utilize information from the program for various purposes. The weighted average is calculated by multiplying each response frequency by its corresponding value, summing those products, and dividing by the total number of responses (excluding N/A).

How often respondents would like to see data updated

The following section summarizes the responses to an open-ended question from the survey. The response summaries are presented in the text below. These summaries aim to share key themes and insights drawn from the participants' feedback.

Survey respondents were asked:

How often would you like wetland information to be updated? (For example, every two years, every five years, etc.) [Open-ended question]

Results:

Updating information every two to five years was supported by respondents. Many recognized the balance between timely updates and feasibility.

The majority of survey respondents agreed with the provided examples and suggested intervals between two and five years, emphasizing the importance of balancing practicalities with the need for timely information. A significant number advocated for updates every two years, with one respondent noting that "every two years, or as frequent as possible to still see change" would be ideal for tracking trends. Similarly, another respondent emphasized, "Given the increasing impact from human footprint disturbances – every two years would be excellent, five years at a minimum."

Several respondents highlighted that resource and scaling considerations might make a five-year update cycle more feasible. One respondent remarked, "Every two years would be great, but I think every five years is more realistic given scaling challenges." Others suggested that update frequency should vary based on regional and developmental needs, with high-impact areas potentially requiring more frequent updates: "Every two years for high disturbance/impact areas... other areas every five years or so," suggested one respondent.

Moreover, one participant pointed out, "More often is always more useful, but has to be balanced with cost and practicality. It depends on the dataset." A novel suggestion that emerged was the idea of having "every two years officially, but it would be great to have an online portal that would pre-publish monitoring data prior to final approval." Additionally, some respondents proposed a stratified approach, combining annual updates for high-priority data "to capture changes due to interannual variation," with broader updates every five or ten years to assess long-term changes.

The level of classification for summarizing wetland information

Survey respondents were asked:

Which level of classification do you want wetland information summarized at? (select all that apply.)

The levels of classification provided included:

- Wetland vs. upland
- Peatland vs. non-peatland
- Wetland class (i.e., bog, fen, swamp, marsh, shallow open water)
- Wetland form (e.g., forested, shrubby, open)
- Wetland type (e.g., water permanence, rich vs. poor fen)

Results:

> **Over 90% of respondents were interested in wetland information at the class level.**

Out of 60 respondents, there was a strong preference for summarizing wetland information primarily at the wetland class level, with 91% (n=53) selecting this option. The second most popular classification was wetland type (e.g., water permanence, rich vs. poor fen), chosen by 72% (n=42) of respondents. Wetland form (e.g., forested, shrubby, open) was also favored, with 68% (n=40) expressing a desire for this level of detail.

Additionally, 62% (n=36) wanted information categorized as wetland vs. upland. In contrast, peatland vs. non-peatland classification was the least favored option, with only 40% (n=22) selecting it. The complete results are summarized in Table 5 and Figure 8).
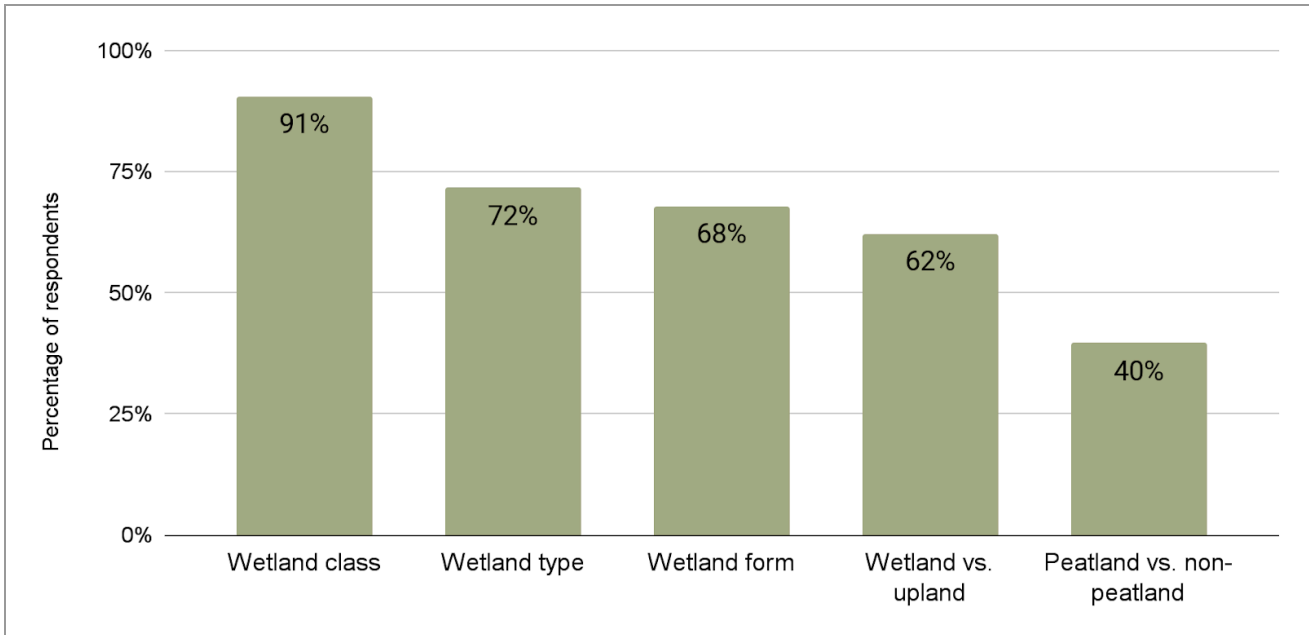
Table 5. Percentage of survey respondents indicating their preferred level of classification for summarized wetland information. Percentages are based on a total of 60 individuals who completed this question.

Classification Type	Percentage of respondents	Number of respondents in favor of classification type
Wetland class (i.e., bog, fen, swamp, marsh, shallow open water)	91%	53
Wetland type (e.g., water permanence, rich vs. poor fen)	72%	42
Wetland form (e.g., forested, shrubby, open)	68%	40
Wetland vs. upland	62%	36

Peatland vs. non-peatland	40%	22
Total Answered		60

Figure 8. *Percentage of survey respondents indicating their preferred level of classification for summarized wetland information. Percentages are based on a total of 60 individuals who responded to this question.*

Geographical regions or scales most useful to meet wetland information needs

Survey respondents were asked:

Are the following geographic boundaries or scales useful for your wetland information needs?

The geographical boundaries or scales provided included:

- Watersheds
- Individual wetland
- Natural Regions
- Provincial
- Municipalities/counties
- Quarter section

- Land-use planning framework areas
- Traditional/ancestral territories
- Treaty areas

Respondents were asked to rank their usefulness using the following criteria:

- Useful
- Not useful
- N/A (e.g. not sure)

Results:

> **Watersheds are an important geographic scale for collecting and sharing wetland information.**

Respondents were asked about the usefulness of various geographic boundaries or scales for their wetland information needs. The findings, displayed in *Table 6* and illustrated in *Figure 9* indicate a strong preference for watersheds as a useful geographical boundary, with 54 participants identifying them as useful. Individual wetlands also received notable support, with 48 respondents ranking them as useful for their information requirements. Natural regions were similarly deemed useful by 48 participants . Other geographic classifications, including provincial (n=46) and municipalities/ counties (n=39), were valued, though to a lesser extent.

Traditional/ ancestral territories and treaty areas were the least selected geographic boundaries, with 29 and 25 respondents, respectively, indicating these as useful. Notably, 18 and 17 respondents marked these categories as N/A (e.g., not sure), suggesting that these geographic boundary categories are not widely incorporated into western science and other activities by our survey respondents. However, no survey respondents selected 'Indigenous community representative' as their professional affiliation. These boundaries may well have relevance to audiences not well-captured by our survey, and will be considered through other engagement activities that target Indigenous perspectives.

Overall, the results highlight a preference for watershed and individual wetland classifications while suggesting varied levels of interest in broader geographic scales.

Table 6. The table displays the number of respondents' rating on the usefulness of different geographic boundaries or scales for their wetland information requirements.

	Useful	Not useful	N/A (e.g. not sure)	Total # of responses
Watersheds	54	4	3	61
Individual wetland	48	7	3	58
Natural Regions	48	8	3	59
Provincial	46	9	1	56
Municipalities/ counties	39	10	8	57
Quarter section	35	12	9	56
Land-use planning framework areas	30	11	13	54
Traditional/ ancestral territories	29	10	17	56
Treaty areas	25	11	18	54
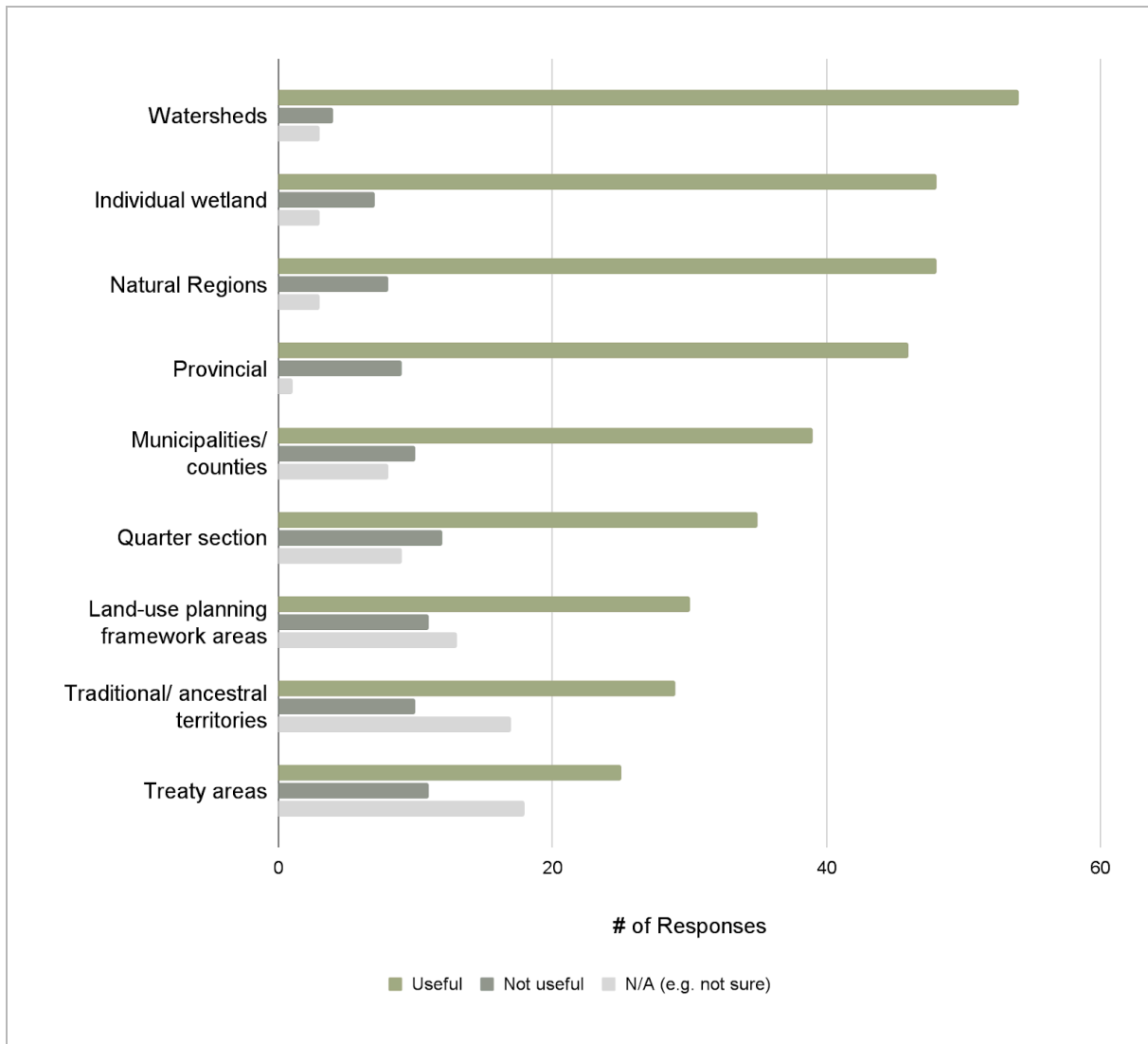
Figure 9 *The figure provides a visual summary of the relative usefulness of each geographic classification based on survey responses.*

Indicators that respondents would use in wetland work

Survey respondents were asked to:

Rank the extent to which you would use each of the following indicators in your wetland work:

- Wetland area and landscape distribution
- Wetland ecological function - biodiversity (e.g., species or taxonomic group)
- Wetland environmental drivers and stressors (e.g., fire, climate, human footprint)
- Wetland ecosystem services (e.g., ecological function from a human value or use perspective)
- Wetland ecological functions - other (e.g., hydrology, water quality, biogeochemical processes)
- Wetland policy effectiveness (e.g., wetland area loss, replacement funds collected and spent, timelines for regulatory review)

They were provided with the following selection options:

- Definitely would use
- Probably would use
- Probably wouldn't use
- Definitely wouldn't use
- N/A (e.g. unsure)

Results:

> **All respondents said they would use information on wetland area and landscape distribution (aka "where wetlands are").**

The survey results indicate a strong interest in utilizing various types of wetland information among respondents. As displayed in the accompanying *Table 7 and Figures 10 and 11* (one illustrating a Likert scale and the other weighted averages), 63% (n=38) of participants stated they would "definitely use" wetland area and landscape distribution data, with an overall weighted average of 3.63. Similarly, 60% (n=36) expressed they would "definitely" or "probably use" information on wetland ecological function related to biodiversity, resulting in a weighted average of 3.57.

In terms of wetland environmental drivers and stressors, 48% (n=29) indicated they would "definitely use" this information, while 43% (n=26) said they would "probably use" it, yielding a weighted average of 3.42. Wetland ecosystem services and ecological functions received comparable interest, with weighted averages of 3.41 and 3.39, respectively. Conversely, interest was lower for wetland policy effectiveness, with 37% (n=22) indicating they would "definitely use" this data and a weighted average of 2.93. However, our survey did not target provincial government agencies and regulators, who are the primary users of the provincial wetland

policy. Overall, these findings highlight a significant demand for comprehensive wetland data, particularly regarding area distribution and ecological functions.
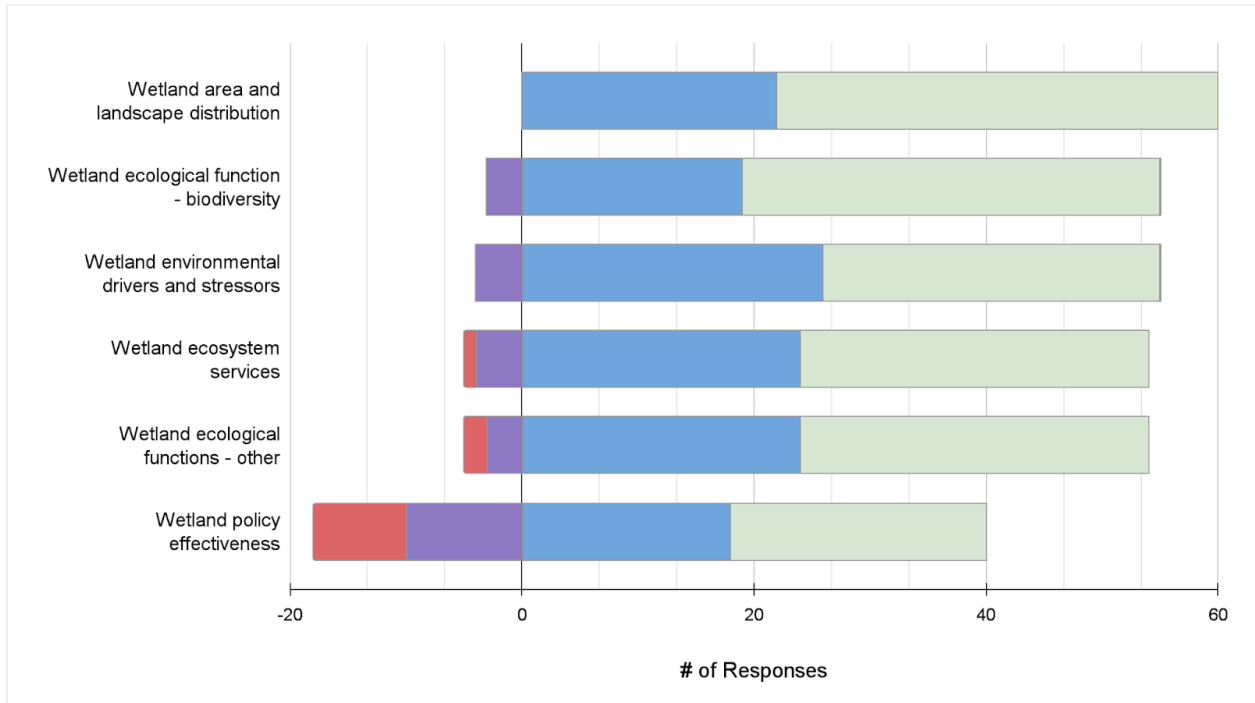

Figure 10 Interest in various wetland information types among respondents. This table presents survey results on respondents' interest in different types of wetland information. Responses are categorized by frequency of use: green indicates "definitely would use," dark blue represents "probably would use," light blue denotes "Probably wouldn't use," and purple signifies "definitely wouldn't use" as seen in Table 7.

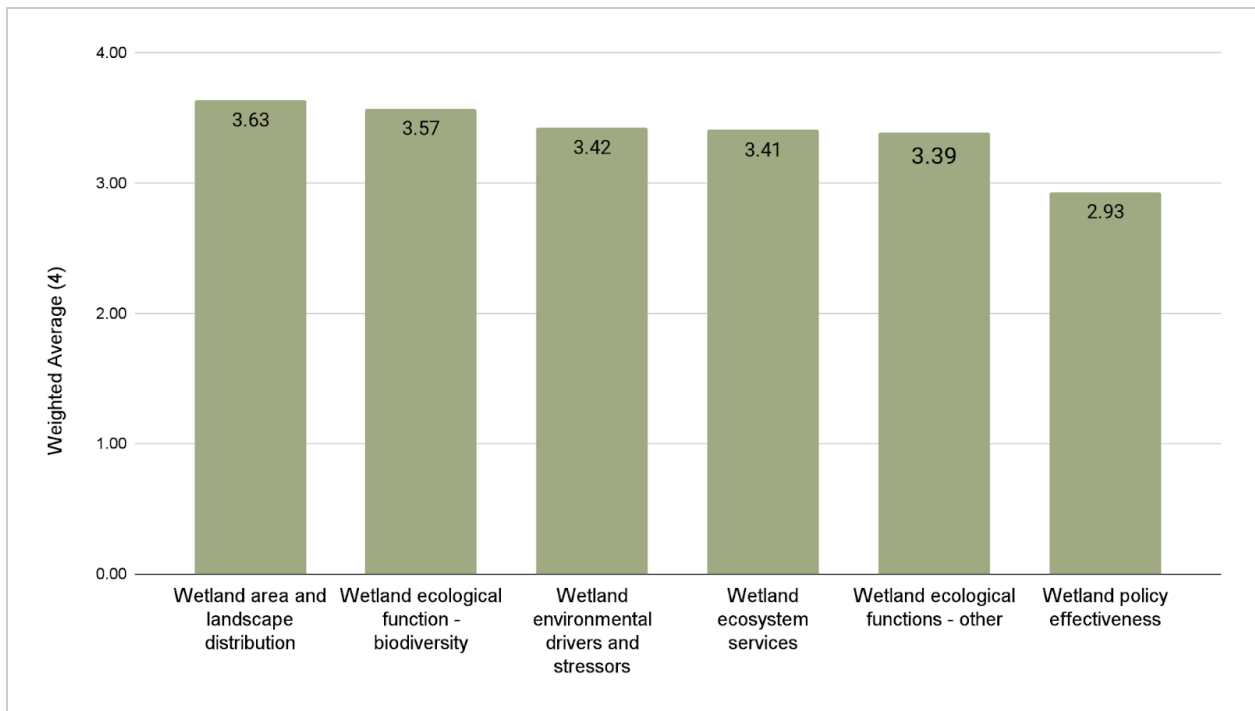*Table 7 Interest in Various Wetland Information Types Among Respondents. This table presents survey results on respondents' interest in different types of wetland information. The weighted average was calculated by assigning values to each response option, then multiplying each response by its assigned value, summing these products, and dividing by the total number of responses, minus those who responded N/A.*

Wetland Indicators	Definitely would use (Value=4)	Probably would use (Value=3)	Probably wouldn't use (Value=2)	Definitely wouldn't use (Value=1)	N/A (e.g. unsure) (Value=0)	Total # Responses	Weighted Average
Wetland area and landscape distribution	38	22	0	0	0	60	3.63
Wetland ecological function - biodiversity (e.g., species or taxonomic group)	36	19	3	0	2	60	3.57

Wetland environmental drivers and stressors (e.g., fire, climate, human footprint)	29	26	4	0	1	60	3.42
Wetland ecosystem services (e.g., ecological function from a human value or use perspective)	30	24	4	1	1	60	3.41
Wetland ecological functions - other (e.g., hydrology, water quality, biogeochemical processes)	30	24	3	2	1	60	3.39
Wetland policy effectiveness (e.g., wetland area loss, replacement funds collected and spent, timelines for regulatory review)	22	18	10	8	1	59	2.93

Figure 11 *This table presents weighted averages from survey results on respondents' interest in different types of wetland information. The weighted average was calculated by assigning values to each response option, then multiplying each response by its assigned value, summing these products, and dividing by the total number of responses, minus those who responded N/A.*

A deeper look: wetland indicator use by sector/perspective

Different sectors and perspectives have similar yet varying indicator needs. Most emphasize wetland area and landscape distribution, and wetland biodiversity information as the top indicators they would use in their wetland work.

Table 8 ranks wetland indicators by sector responses, while Table 9 provides the corresponding weighted scores. Together they illustrate the preferences assigned to these indicators for different sectors and perspectives. Results indicate that wetland area and landscape distribution and wetland biodiversity information are the top needs, receiving the strongest support from ENGOs, the federal government, and the energy sector. Sector-specific interests are also evident; all levels of government as well as agricultural and forestry respondents prioritize environmental drivers and stressors as one of the top two indicators; while the provincial government notably ranks wetland policy effectiveness highest. *Note: Some sectors and perspectives had smaller sample sizes, which may limit the depth of analysis.*

Table 8: *This table displays ranking scores for each wetland indicator by sector and perspective. Darker shades of green indicate higher rankings and lighter shades lower rankings. n=number of respondents from that sector/perspective.*

		Indicators rank by sector/ perspective								
Indicator Type	ALL RESPONSES (Ranked)	ENGOs (n=21)	Consultants (n=14)	Regional Government (n=6)	Federal Government (n=4)	Provincial Government (n=8)	Forestry (n=3)	Energy (n=3)	Agriculture (n=3)	Academic (n=7)
Wetland area and landscape distribution	1	2	1	5	1	3	1	1	5	1
Wetland ecological function - biodiversity	2	1	3	1	1	5	3	1	1	3
Wetland environmental drivers and stressors	3	4	5	1	1	2	2	5	2	3
Wetland ecosystem services	4	2	4	1	4	3	4	4	2	3
Wetland ecological functions - other	5	5	2	4	5	6	5	1	2	2
Wetland policy effectiveness	6	6	6	6	6	1	6	6	6	6

Table 9: *This table presents wetland indicator use across sectors and perspectives, detailing the weighted average scores for each indicator. Scores are color-coded: dark green (4.00), medium green (3.50-3.99), light green (3.00-3.49), and white (below 2.99). n=number of respondents from that sector/perspective.*

Indicator Type	ALL RESPONSES	Weighted Average by Sector / Perspective								
		ENGOs (n=21)	Consultants (n=14)	Regional Government (n=6)	Federal Government (n=4)	Provincial Government (n=8)	Forestry (n=3)	Energy (n=3)	Agriculture (n=3)	Academic (n=7)
Wetland area and landscape distribution	3.63	3.55	3.69	3.33	4.00	3.50	3.67	4.00	3.33	3.86
Wetland ecological function - biodiversity	3.57	3.70	3.38	4.00	4.00	3.29	3.00	4.00	4.00	3.57
Wetland environmental drivers and stressors	3.42	3.47	2.92	4.00	4.00	3.63	3.33	3.33	3.67	3.57
Wetland ecosystem services	3.41	3.55	3.23	4.00	3.67	3.50	2.33	3.69	3.67	3.57
Wetland ecological functions - other	3.39	3.40	3.54	3.67	3.33	3.13	2.67	4.00	3.67	3.71
Wetland policy effectiveness	2.93	2.89	2.69	3.00	3.00	3.75	1.67	3.33	3.00	3.00

Identified opportunities in terms of emerging wetland information

Survey respondents were given the opportunity to provide open comments on the following question:

Availability of information and information technology is rapidly changing. What do you believe to be the two most promising opportunities for you in terms of emerging wetland information?

Results:

> **High-quality wetland data from novel sources like satellite imagery and lidar, combined with broader accessibility for diverse applications, were identified as future opportunities.**

The survey results reveal a strong consensus among respondents regarding the promising opportunities in emerging wetland information. Participants highlighted several key areas where improvements can enhance wetland conservation efforts. There is a clear emphasis on creating user-friendly tools and leveraging advanced technologies to better understand and manage wetland ecosystems. Many respondents expressed the importance of integrating community involvement into conservation strategies, recognizing that public participation can significantly impact the effectiveness of monitoring and assessment initiatives.

Key themes shared by respondents included:

> **User-Friendly Tools:** Respondents shared the need for accessible interfaces and regularly updated data layers to support wetland conservation efforts. One comment noted the importance of "user-friendly interfaces."
>
> **Data Utilization**: High-resolution imagery, ground surveys, and eDNA were highlighted as vital for informed decision-making. A respondent mentioned, "Better data to inform conservation plans."
>
> **Mapping Technologies:** Improved remote sensing, including drones and satellite imagery, is sought for accurate wetland classification and condition assessment. Participants expressed excitement over "high-resolution ortho-photography and geo-mapping."
>
> **Community Involvement:** There is a strong desire for increased public participation, particularly through community-based science initiatives as well as via social media. One respondent noted the significance of "public involvement in monitoring."

Conservation Goals: Respondents aim to identify priority areas for conservation and promote the ecological value of wetlands, stating the need to raise awareness among developers and stakeholders.

Policy and Education: Suggestions included updating wetland policies and providing training to ensure local planners and landowners can easily access critical information.

Monitoring and Assessment: A comprehensive approach to inventory and regular updates was deemed essential for tracking wetland health and resilience against climate change.

Overall, the feedback underscores a collective vision for leveraging technology and community engagement to enhance wetland conservation efforts, ultimately aiming to ensure the long-term health and sustainability of these vital ecosystems.

Appendix

Appendix 1: Survey Design

ALBERTA BIODIVERSITY MONITORING INSTITUTE

ABMI Wetland Monitoring Survey

We're updating the wetland component of the ABMI's Ecosystem Health Monitoring Program and want to understand your wetland information needs!

Since 2007, the Alberta Biodiversity Monitoring Institute (ABMI) has focused on monitoring wetlands in Alberta through the Ecosystem Health Monitoring Program. **This program has collected baseline information from 1,700 wetland sites across the province. It is complemented by recent satellite-based wetland mapping efforts, including a public** Alberta-wide wetland class inventory.

After more than fifteen years, we are looking to refine our approach to wetland monitoring. We invite you to complete this survey to ensure your wetland information needs are considered.

The survey consists of 13 questions and is estimated to take 10-15 minutes to complete.

Getting to know you

1. Please indicate which perspective or sector best aligns with your profession or the type of organization you work for (select all that apply):

☐ Federal government

☐ Provincial government

☐ Local or regional government (e.g., city, county)

☐ Academic researcher (e.g., University of Alberta)

☐ Student

☐ Indigenous community representative

☐ NGOs/not-for-profit

☐ Energy sector

☐ Forestry sector

☐ Agriculture sector

☐ Consulting

☐ General public

☐ Other (please specify)

[   ]

Section 1: Understanding your data needs

2. Which currently available wetland evaluation or reporting products do you use? (check all that apply.)

☐ Environmental Reports (e.g., Condition of Environment Reports, Wetland Policy Performance Reports)

☐ Mapped Resources (e.g., Alberta Wetland Inventory, Map of potential wetland restoration sites, Map of high priority wetland conservation areas, Wetland Replacement Program priority maps, Watershed Resiliency and Restoration Program [WRRP] priority area maps)

☐ Communication and Outreach products (e.g., Wetland Replacement Program Fact Sheets, Wetland Atlas of Alberta)

☐ Scientific Research, Technical reports, and Publications (e.g., Peer-reviewed publications, Species at Risk Reports)

☐ Natural Resource Management and Conservation Reports and Plans (e.g., Carbon offsets reports, SARA Management Plans, Water storage reports)

Other (please specify)

[   ]

3. Please rate how helpful the following types of wetland information would be in your work:

	Very helpful	Moderately helpful	Slightly helpful	Not at all helpful	N/A or uncertain
Wetland inventory datasets (e.g., wetland mapping)	○	○	○	○	○
Abiotic wetland monitoring data (e.g., water chemistry, sedimentation)	○	○	○	○	○
Biological wetland data (e.g., biological species or communities)	○	○	○	○	○
Wetland indices (e.g., riparian health assessment, indices of biological integrity);	○	○	○	○	○
Environmental driver and human pressure datasets (e.g., human footprint, climate change, drought)	○	○	○	○	○
Cultural ecosystem / biocultural datasets (e.g., a Wetland Traditional Ecological Knowledge database)	○	○	○	○	○

Other (please specify)

[   ]

4. Is there any wetland information that is not currently collected or accessible that you wish you had? Please describe this additional wetland information.

[   ]

5. How do you foresee using information collected by a province-wide wetland monitoring program? (Select the frequency for each use case.)

	Frequently use	Sometimes use	Rarely use	Not at all	N/A (e.g. I don't do this type of work)
To compile data and generate reports	○	○	○	○	○
Monitoring compliance with legislation/policy	○	○	○	○	○
Compliance with Treaty rights	○	○	○	○	○
Informing land-use management decisions	○	○	○	○	○
Supporting education and outreach activities	○	○	○	○	○
Help in monitoring and reporting on sustainability goals/commitments	○	○	○	○	○
Keeping informed about Alberta's wetlands	○	○	○	○	○
Academic research	○	○	○	○	○

Other (please specify)

[   ]

Section 2: Current Use and Gaps in Existing Wetland Data

6. How do you use these currently available datasets or databases for wetland-related work? (Select all uses that apply for each.)

	To compile data, generate reports, and/or monitor compliance/commitments	Informing land-use management decisions	For academic research	Education, outreach, and/or keeping informed about Alberta's wetlands	NA (I am unfamiliar with/don't use this dataset/database)
ABMI Biodiversity Intactness Index	☐	☐	☐	☐	☐
ABMI biological monitoring data (invertebrates, vascular plants, other vertebrates)	☐	☐	☐	☐	☐
ABMI Human Footprint Products	☐	☐	☐	☐	☐
ABMI wetland habitat data (e.g., bathymetry, water	☐	☐	☐	☐	☐

chemistry, site disturbance)					
ABMI Wetland Inventory	☐	☐	☐	☐	☐
ACIMS (Alberta Conservation Information Management System) data	☐	☐	☐	☐	☐
Alberta Geological Survey Permafrost classification model for Northern Alberta	☐	☐	☐	☐	☐
Alberta Merged Wetland Inventory	☐	☐	☐	☐	☐
Alberta Vegetation Inventory	☐	☐	☐	☐	☐
Bow River Region Wetland Inventories	☐	☐	☐	☐	☐
CABIN database (Canadian Aquatic Biomonitoring Network)	☐	☐	☐	☐	☐
Canadian National Wetlands Inventory	☐	☐	☐	☐	☐
Cumulative Environmental Management Association (CEMA) data (e.g., the Guideline for wetland establishment on reclaimed oil sands leases guide)	☐	☐	☐	☐	☐
Ducks Unlimited Canada boreal wetland inventory	☐	☐	☐	☐	☐
Ducks Unlimited Canada data (e.g., waterfowl population modeling results)	☐	☐	☐	☐	☐
Environment and Climate Change Canada (ECCC) waterfowl and habitat survey data or reports	☐	☐	☐	☐	☐
FWMIS database (Fish and Wildlife Management	☐	☐	☐	☐	☐

Information System)					
Oil Sands Data Catalogue	☐	☐	☐	☐	☐
Prairie Habitat Joint Venture information	☐	☐	☐	☐	☐

7. How often would you like wetland information to be updated? (For example, every two years, every five years, etc.)

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8. Are there any key gaps in existing wetland information or monitoring datasets from question 6 that would help you in your work? For example, is the dataset outdated, does the accuracy need refinement, or are there missing baseline/historic datasets? Please specify which dataset.

┌─────────────────────────────┐
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9. Which level of classification do you want wetland information summarized at? (select all that apply.)

☐ Wetland vs. upland

☐ Peatland vs. non-peatland

☐ Wetland class (i.e., bog, fen, swamp, marsh, shallow open water)

☐ Wetland form (e.g., forested, shrubby, open)

☐ Wetland type (e.g., water permanence, rich vs. poor fen)

☐ Other (please specify)

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10. Are the following geographic boundaries or scales useful for your wetland information needs.

	Useful	Not useful	N/A (e.g. not sure)
Provincial	○	○	○
Watersheds	○	○	○
Natural Regions	○	○	○
Land-use planning framework areas	○	○	○
Municipalities/counties	○	○	○
Traditional/ancestral territories	○	○	○
Treaty areas	○	○	○
Quarter section	○	○	○
Individual wetland	○	○	○

Other (please specify)

11. Please rank the extent to which you would use each of the following indicators in your wetland work:

	Definitely would use	Probably would use	Probably wouldn't use	Definitely wouldn't use	N/A (e.g. unsure)
Wetland policy effectiveness (e.g., wetland area loss, replacement funds collected and spent, timelines for regulatory review)	○	○	○	○	○
Wetland ecosystem services (e.g., ecological function from a human value or use perspective)	○	○	○	○	○
Wetland ecological function - biodiversity (e.g., species or taxonomic group)	○	○	○	○	○
Wetland ecological functions - other (e.g., hydrology, water quality, biogeochemical processes)	○	○	○	○	○
Wetland area and landscape distribution	○	○	○	○	○
Wetland environmental drivers and stressors (e.g., fire, climate, human footprint)	○	○	○	○	○

Other (please specify)

12. Availability of information and information technology is rapidly changing. What do you believe to be the two most promising opportunities for you in terms of emerging wetland information?

13. Are there any additional comments or feedback you would like to provide about your wetland information needs or the ABMI's Ecosystem Health Monitoring Program?

Section 3: Optional Contact Information

14. Please share your contact information so we can include you in future discussions about ABMI's wetland program. Providing contact information is optional but helpful for interpreting responses. We encourage all participants to at least record their organization/affiliation and to add full contact details if they feel comfortable.

Name:

Email:

Organization/affiliation: