come directly from industry and Matrix for AEP/AER consideration. Task 7 is addressed via this document.

4 CONCLUSIONS

General conclusions supported by the results of the AEP/AER/AGS meeting (Appendix A), jurisdictional water management review (Appendix B), and industry meeting (Appendix C) are as follows:

- Definition of ANSW needs to be workable with AEP's *Water for Life* strategic goals of healthy ecosystems, safe drinking water, and reliable water supplies for sustainable economy.

- Definition of ANSW must consider water-short areas of the province, the importance of Neogene/Quaternary aquifers and the depth of HQNS groundwater.

- The depth of 150 m below ground surface (bgs) is an important threshold to AER because wells drilled deeper than 150 m bgs require the owner to comply with AER licensing regulations. Complying with AER regulations beyond 150 in depth requires significant expenditure and generally renders water wells economically impractical for the general public. Aquifers below 150 m bgs generally have low interaction with surface water.

- Although no jurisdictions were found to have a directly analogous concept of a comprehensive ANSW definition, the United States Environmental Protection Agency (USEPA) and the State of Wyoming have regulations most similar in concept. The USEPA and Wyoming both introduce the concept of "economically and technologically impractical." The USEPA enacts a similar concept to ANSW that includes aquifer exemptions for industry use, whereas, Wyoming introduces the concept of classifying aquifers based on characteristics of local hydrogeology.

- PTAC industry representatives support a refined definition of ANSW, but suggest that in cases with unique circumstances, a risk-based methodology could be proposed to enable discretion of the Director. This approach would effectively capture most scenarios given the widely diverse hydrological and hydrogeological conditions across the province.

5 RECOMMENDATIONS

The following recommendations are made based on the information provided in this report:

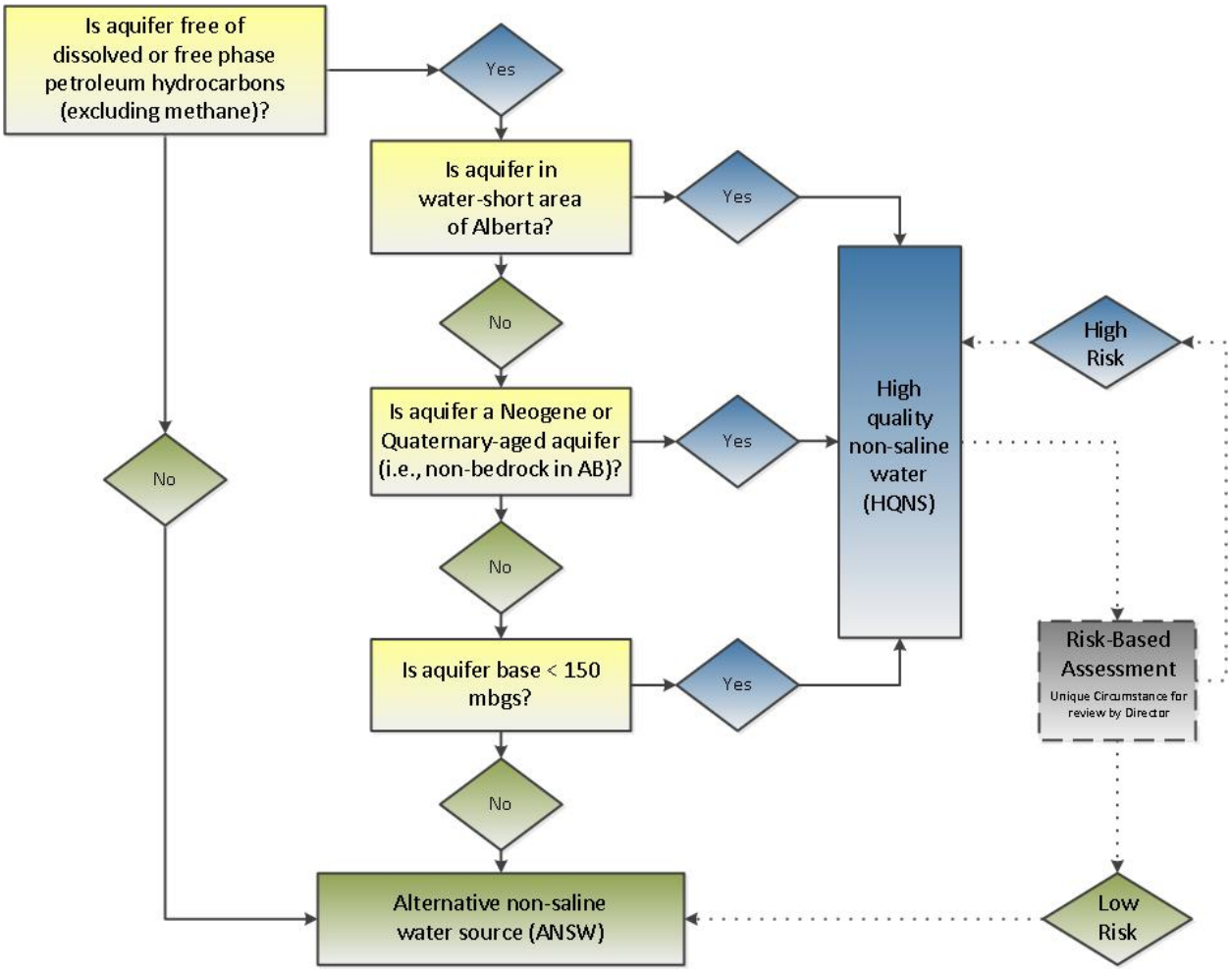
5.1 Primary Recommendation

- A consistently applied decision framework is recommended to define ANSW; the decision framework recognizes that some groundwater is economically and technologically impractical to use

for drinking water and livestock watering purposes, and as such, could serve as an ANSW groundwater source. Figure A illustrates the recommended decision framework which:

- is in alignment with AEP's *Water for Life* strategic goals by identifying groundwater to support a sustainable economy whilst maintaining drinking water and aquatic life requirements
- considers water-short areas of the province
- recognizes the importance of unconsolidated (Neogene/Quaternary) aquifers to surface water interactions
- applies the important AER depth threshold of 150 m bgs
- allows for unique circumstances to be considered using a risk-based approach

FIGURE A Recommended Decision Framework to Define Alternative Non-saline Groundwater Sources



It is recommended that in some unique circumstances, the proponent would have the ability to demonstrate to the Director that a proposed water source could be considered as ANSW through a risk-based approach.

The risk-based approach shown in Figure A (grey box) should address the following questions:

- Are there current users of the aquifer?
- How likely is aquifer to be used by other users in the future?
- Are there other shallower and more suitable aquifers available to other users?
- Is the aquifer directly connected to surface water?
- Are significant aquitards present above aquifer to limit hydraulic connectedness to surface?

A "low risk" categorization would be reserved for aquifers that:

- Are overlain by other aquifers capable of supplying groundwater for domestic/livestock use.
- Are not currently used for domestic or livestock purposes.
- Are unlikely to be used in the future for domestic and livestock purposes because of remoteness or presence of other more suitable options.
- Have a sourcing location that is suitable distance from aquifer sub-crop.
- Are overlain by a suitable aquitard limiting connectedness to surface water.

Fundamental to the risk-based approach and the decision framework proposed above is the axiom that effective management of groundwater shall consider local and sub-regional hydrogeology characteristics. Consequently, AEP and AER, with the support of AGS, could explore and consider the feasibility of defining groundwater management zones within the province based on hydrogeology and aquifer dynamics (versus basing these zones on watershed boundaries). Groundwater management zones could be considered in future regulatory documents and may facilitate more effective management of Alberta's *Water for Life* strategic goals. Furthermore, the concept of groundwater management zones is common in many other jurisdictions.

It is noted that support for the concept of groundwater management zones in Alberta is not unanimous across PTAC industry representatives that contributed to this project.

5.2 Secondary Recommendation

- PTAC industry representatives suggest the following water sources could be considered by AEP and AER (upon further vetting) as ANSW and added to the "alternatives" list provided in AEP's *Water Conservation Policy for Upstream Oil and Gas Operation*s (AEP 2016):
  - Impacted non-saline groundwater (for example, contaminated groundwater including but not limited to landfill leachate and acid rock drainage).

- Surface water runoff from regulated upstream petroleum sites that does not meet criteria for environmental release provided in Energy Resources Conservative Board Directive 055 (ERCB 2001).
- Previously disposed produced water.
- Wastewater that would otherwise be disposed.

6 REFERENCES

Alberta Environment and Parks (AEP). 2016. *Water Conservation Policy for Upstream Oil and Gas Operations*. October 2016.

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