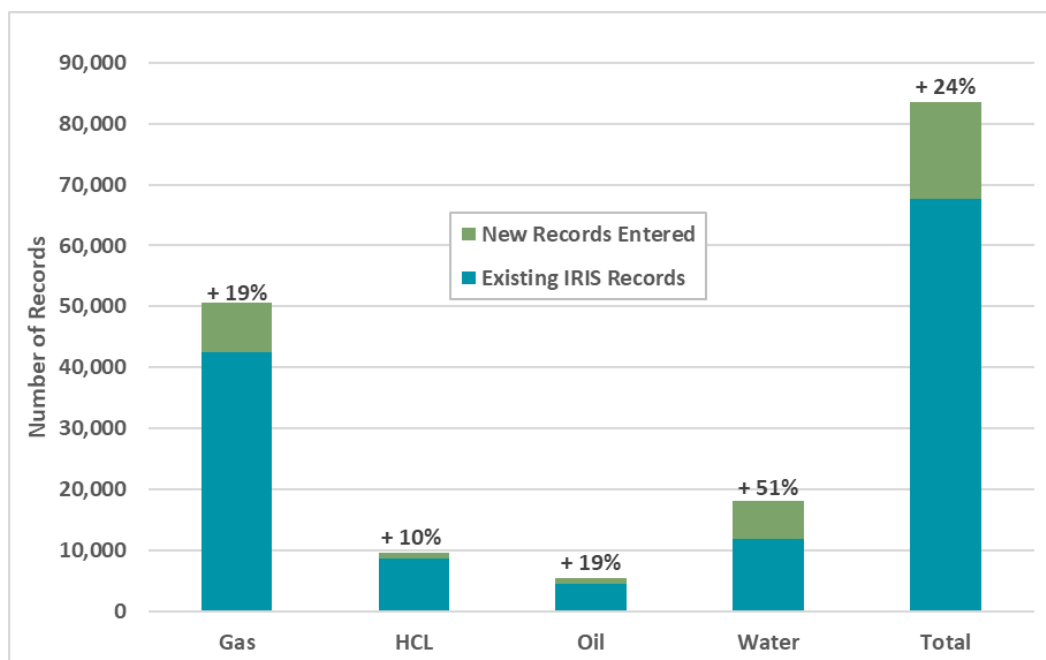


2022-23 Fluid Analysis Entry Project Summary

1.1 Executive Summary

A total of 15,951 legacy PDF gas, hydrocarbon liquids (HCL), oil and water analyses were added to the BC Energy Regulator's (BCER) public database--2,259 of which were from the Montney formation. This increased the total number of fluid analyses in the database by 24 per cent and the number of Montney records by seven per cent. A total of 63 per cent of new records were in formations encountered when drilling down to Montney depth. A significant number of existing database records, 12 per cent of all records, were not linked to a formation. A new text matching method was implemented to match pre-existing records to formations, decreasing the number of records without a formation match from 12 per cent to seven per cent of the total database. This method is planned to be formally implemented to the database at a future date. Legacy hardcopy records continue to be scanned and added to the eLibrary. The final section of this report discusses further work to be done, including further data entry and cleaning and refining of the data.

Figure 1: Additional Fluid Analysis Records by Fluid Type



1.2 Background and Results

Fluid analyses represent extremely valuable data for the BCER and for the industry. For example:

- Gas and HCL analyses are integral in the determination of the province's reserves.
- Oil and HCL analyses are used to determine the primary product of a producing well (oil or gas), which affects royalty calculations.
- Water analyses may be used for compatibility analyses to help inform proper disposal well use.
- Emerging resource and technology use – these analyses may assist in the exploitation of petrolithium, helium, hydrogen and other resources and CCS use.

Historically, the BCER received fluid analysis in paper hardcopy format and manually keyed values (43 – 86 per analysis) into a database, until the implementation of an eSubmission system in 2015. Gas analysis was a priority over other fluid types for manual entry, however, large data gaps resulted from limited staff resources. The BCER records group has been and continues to scan and enter legacy hard copy records, including fluid analyses, into the eLibrary. While these scanned eLibrary PDF records are accessible internally and externally, the information contained in the pdfs does not exist in an easy-to-use database format. Automated optical character recognition for population of fluid analysis records into the database was investigated, however, the variety of formats and image qualities made this impractical.

An internal project during late 2021 identified fluid analysis deficiencies and initiated a process to manually populate electronic records from well files. A BCER project was identified and funded for an external vendor to complete this work.

Records for the Montney formation are considered the most valuable, as the Montney contains approximately 90 per cent of the province's remaining gas reserves and is the source of approximately 90 per cent of B.C.'s production.

Table 1: Additions to Database

Analysis Type	Pre-Existing Records in Database	Pre-Existing Montney Records in Database	Records Entered	Montney Records Entered	Total Records	Total Montney Records	% Increase in Total Records	% Increase in Montney Records
Gas	42,529	15,665	8,084	1,055	50,613	16,720	19%	7%
HCL	8,670	7,543	889	188	9,559	7,731	10%	2%
Oil	4,498	1,568	858	34	5,356	1,602	19%	2%
Water	11,904	6,486	6,120	982	18,024	7,468	51%	15%
Total	67,601	31,262	15,951	2,259	83,552	33,521	24%	7%

As shown in Figure 1 and Table 1, while about half of the added records were gas analyses, the water analysis database saw the largest relative increase in number of records, both in general and for the Montney, with increased record counts of 51 per cent and 15 per cent, respectively. Gas, HCL and Oil records saw more modest but significant relative increases

of 19 per cent, 10 per cent and 19 per cent respectively. Montney gas and water records saw moderate increases of seven per cent and 15 per cent respectively, while Montney HCL and Oil records only increased by a minor two per cent.

1.3 Fluid Records by Geological Grouping

During this review, it was discovered a significant amount of pre-existing fluid analysis records (6.6 per cent) do not have a formation noted, as shown in the tables and figures of this section. These records are nearly useless for analysis when source formation is unknown. The formation data field in the database is a free form text field where an operator can enter any text. Proper formations have been identified in two ways:

- Match the fluid analysis interval to completion event interval. This is done automatically and populates the formation for the public fluid analysis data in the Data Centre (PKA Data Downloads).
- For the purpose of this report, a text matching formula was used to convert the free form text field into a recognized formation name. The free form fields were searched for text matching a recognized formation or compound formation. For example, many of the free form fields were variations of Montney, such as “Northern Montney A” which was matched to the Montney.
 - Note this may not properly match compound formations if they were not entered by the operator in a similar format to BCER compound formations. These are often matched with a single formation rather than the compound formation.
 - Eg. “BALDONNEL&CHARLIE” is recognized as just “CHARLIE LAKE”
 - Typos, misspellings and unofficial abbreviations are not recognized.

Figure 2 and table 2 below, show the number of records that were not able to be matched to a formation. These records are broken down into “Null Formation”, where the operator did not enter anything into the free form formation field or “unknown formation”, where the entered text was not able to be matched to a BCER formation. The majority of cases are the former rather than the latter.

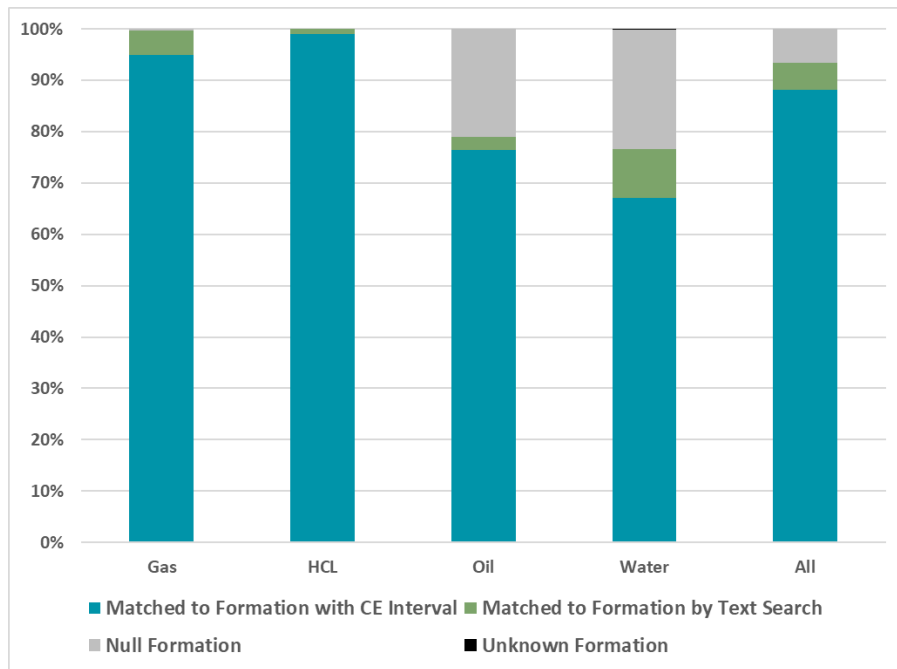


Figure 2: Additional Fluid Analysis Records by Geological Age Grouping

Table 2: Fluid Analysis Records – Matched, Null and Unknown Formations

Type	Total	Matched to Formation with CE Interval	Matched to Formation by Text Search	Null Formation	Unknown Formation
Gas	50,613	48,062	2,424	108	19
HCL	9,464	9,367	96	0	1
Oil	5,356	4,094	135	1,124	3
Water	18,024	12,080	1,714	4,212	18
All	83,457	73,603	4,369	5,444	41

Note the large number of records with unknown formation when viewing the per cent increase in records by geological group in the remainder of this section, as the true increase is likely lower due to the unaccounted-for contribution of the records with unknown formations. This is particularly true in the case of oil and water records, where records with unknown formations make up 21 per cent and 24 per cent of database records, respectively.

As shown in Table 3 and Figure 3, most of the additional records (85 per cent) were for non-Montney formations. This is reasonable, as most records missing from the database predate Montney development.

Table 3: Fluid Analysis Additions by Geological Grouping

Above the Montney

		Cretaceous	Jurassic	Triassic (Non-Montney)	Montney	Deeper Than Montney	Unknown Formation
All Fluids	Additions	3,197	1,039	5,842	2,383	3,489	
	Existing	7,917	2,123	12,024	32,933	7,025	5,579
	Total	11,114	3,162	17,866	35,316	10,514	
	% Increase	+ 40%	+ 49%	+ 49%	+ 7%	+ 50%	
Gas	Additions	1,939	631	2,909	1,158	1,446	
	Existing	7,531	1,800	10,259	16,524	6,289	126
	Total	9,470	2,431	13,168	17,682	7,735	
	% Increase	+ 26%	+ 35%	+ 28%	+ 7%	+ 23%	
HCL	Additions	100	125	390	191	83	
	Existing	17	110	317	8,076	54	96
	Total	117	235	707	8,267	137	
	% Increase	+ 588%	+ 114%	+ 123%	+ 2%	+ 154%	
Oil	Additions	160	46	522	37	93	
	Existing	227	122	961	1,671	390	1,127
	Total	387	168	1,483	1,708	483	
	% Increase	+ 70%	+ 38%	+ 54%	+ 2%	+ 24%	
Water	Additions	998	237	2,021	997	1,867	
	Existing	142	91	487	6,662	292	4,230
	Total	1,140	328	2,508	7,659	2,159	
	% Increase	+ 703%	+ 260%	+ 415%	+ 15%	+ 639%	

Figure 3: Additional Fluid Analysis Records by Geological Age Grouping

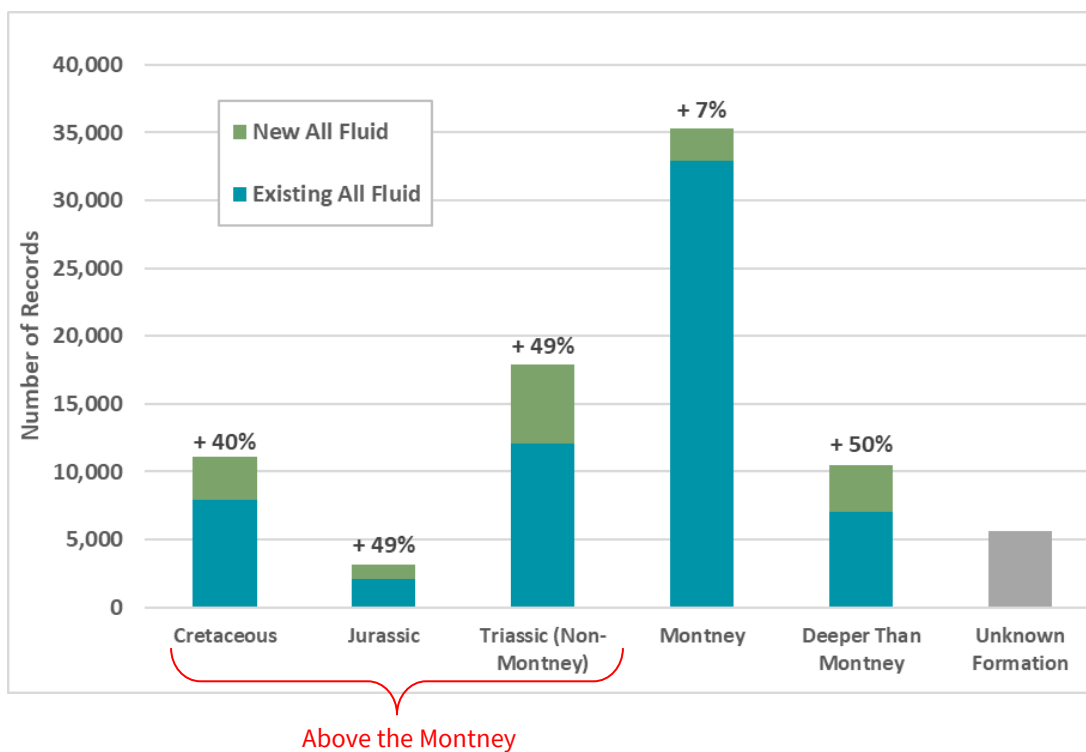


Figure 4: Additional Gas Analysis Records by Geological Age Grouping

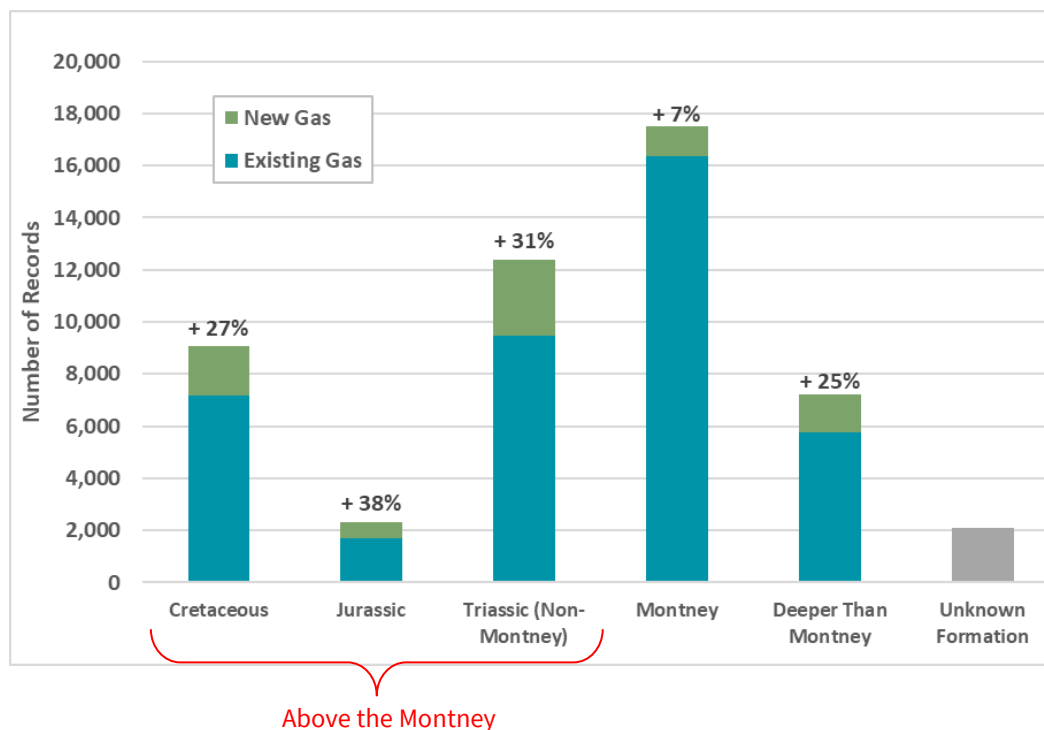
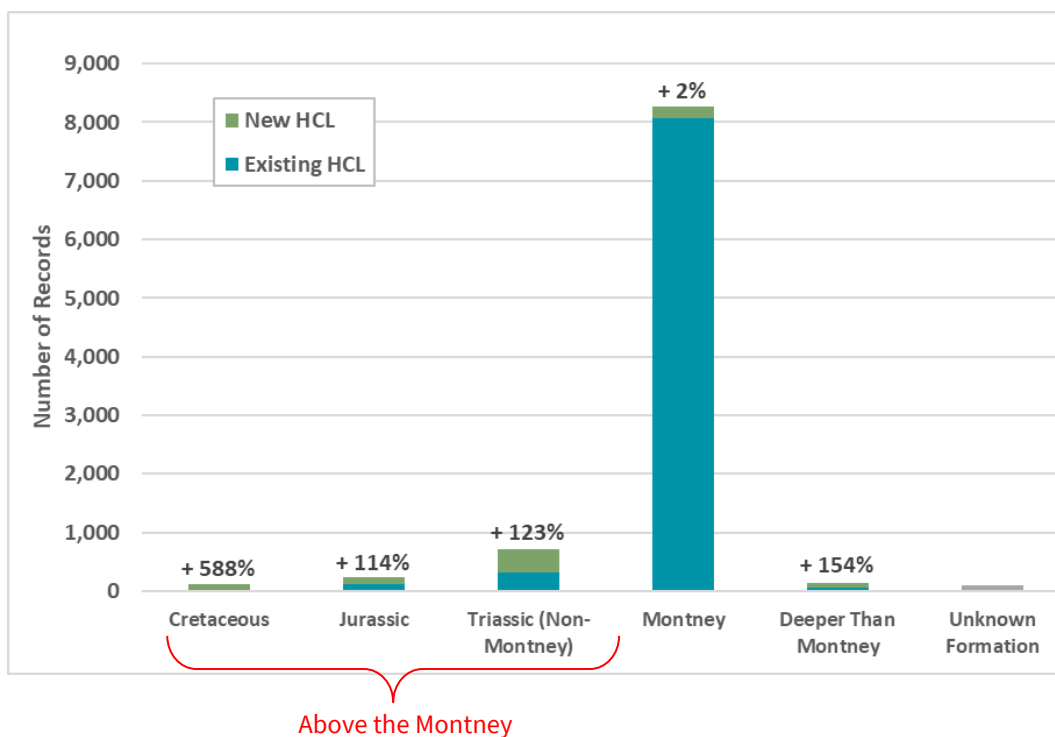


Figure 5: Additional HCL Analysis Records by Geological Age Grouping



As shown in Figure 5, the vast majority (94 per cent) of the BCER's existing HCL records were in the Montney. While the Montney saw only a minor two per cent relative increase in record count, 21 per cent of added HCL records were in the Montney. All other geological groupings saw a significant relative increase in record count, ranging from 116 per cent in the Jurassic formations to 556 per cent in Cretaceous formations.

The high relative increases seen in Figures 6 and 7 below should be viewed with the context that a significant amount of database records are from unknown formations for oil and water and thus, the relative increase is likely highly overstated.

Figure 6: Additional Oil Analysis Records by Geological Age Grouping

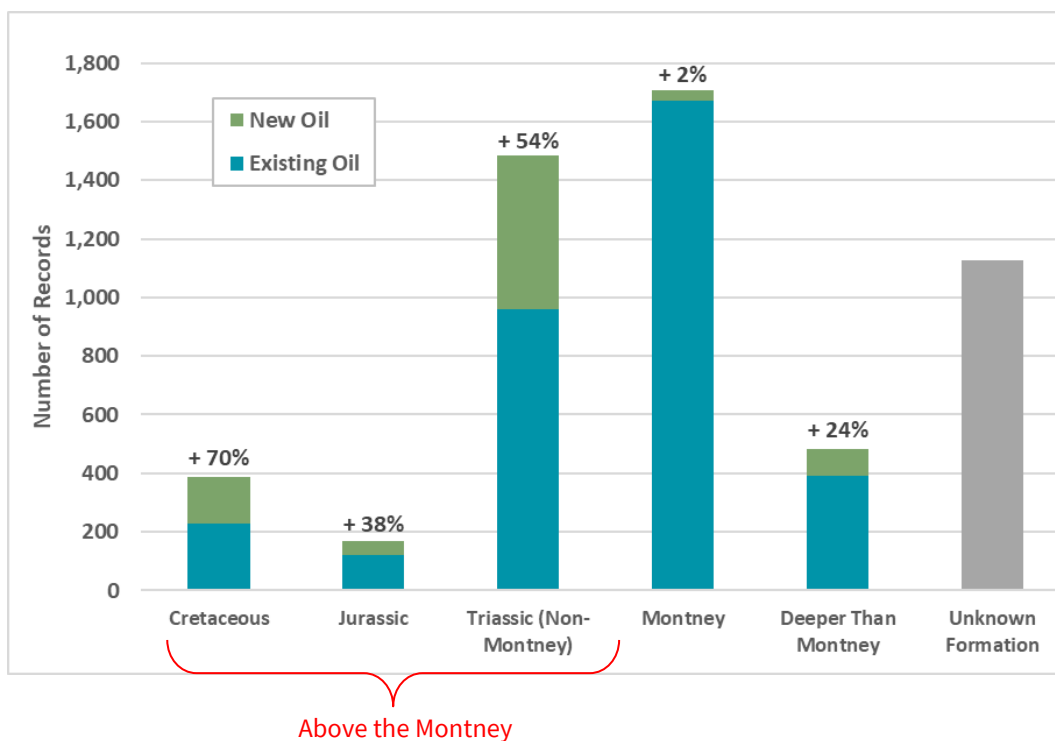
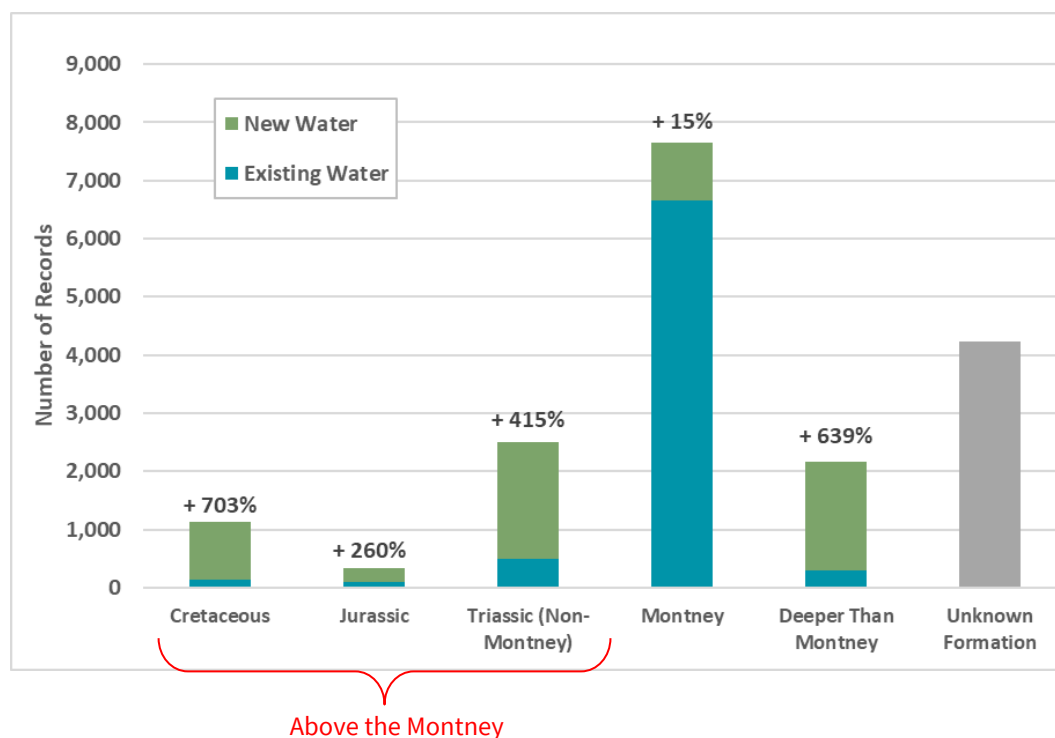


Figure 7: Additional Water Analysis Records by Geological Age Grouping



1.4 Future Work

1.4.1 Additional Data Entry

The BCER records group continues to scan additional pre-eSubmission legacy files prior to 2014. The remaining amount of files to be scanned is unknown, however, it can be estimated. There are a total of 23,762 wells drilled prior to 2014, and 16,726 of those have had their physical well file scanned, leaving an estimated 7,036 remaining well files to be scanned. Of the pre-2014 well files that have been scanned, on average they contain 0.7 water analyses, 0.2 oil analyses, 1.3 gas/HCL analyses, totalling 2.3 analyses per well. Consequently, there are a predicted 15,850 remaining analyses to be scanned.

The BCER plans to complete another data entry project, tentatively planned for 2025, subject to the rate at which legacy hardcopies are scanned and uploaded. The process of entering records into the database is anticipated to take less time in the subsequent project iteration, given the significantly enhanced guidance accumulated from this current phase.

1.4.2 Data Cleaning

At the end of the project, several errors were identified and corrected by the data entry contractor. However, there are a handful of errors that remain and have been flagged. They are usually related to unusual units or setups of old (pre-1980), unstandardized records. There are likely additional errors yet to be identified and corrected. This work will be pursued in Fall 2023.

1.4.3 Records with Unknown Formation

As discussed at the start of section 1.4, there are a significant number of analyses that are not tied to a formation. The text matching solution prepared for the purpose of this report has been queued as a database improvement. Additionally, further avenues can be explored to determine formation for records with NULL formation, such as attempting to match to a formation using tops depths and test interval. Additionally, a future requirement for PAS file submissions to include an official formation may be added.

1.4.4 Next Steps

- **Unknown formation text matching currently in queue for database improvements**
- **Data cleaning to be done in Fall 2023**
- **Additional data entry project, to be done when sufficient new records are added to the eLibrary**

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