ASX ANNOUNCEMENT

12 November 2026

Bayan
Mining and Minerals Limited

BAYAN ACHIEVES UP TO 11.2X YTTRIUM PURITY UPGRADE IN COMPLETED UNIVERSITY OF QUEENSLAND RESEARCH PROGRAM

Highlights

- **Up to 11.2x increase in Yttrium purity upgrade in laboratory test work**: Phase 1 results significantly exceed earlier test work with a more than 5x upgrade in Yttrium Purity Increase Achieved (previously 2x Yttrium Purity Increase Achieved). This represents the strongest result recorded during the Phase 1 Research Program.
- **Phase 1 research program completed:** Nine (9) ion exchange column runs were completed by University of Queensland's ("UQ") Hydrometallurgy Research Group, led by Professor James Vaughan.
- **Critical technical milestone achieved:** Confirms that the yttrium separation mechanism covered by the Colorado School of Mines ("Mines") patent is effective on both clay-hosted and Mountain Pass bastnaesite mineralisation styles.
- **Capital-efficient alternative to traditional Yttrium enrichment flowsheets:** The technology can be designed to be integrated into an existing rare earth separation circuit without requiring a full redesign. This supports a capital-efficient pathway to a dedicated yttrium product stream, which is traditionally one of the most expensive stages in rare earth refining.
- **Defined pathway to commercially relevant feeds:** The next phase will test commercially relevant feed solutions and multi-cycle resin performance to establish a specific process flowsheet with complete mass balance and operating cost model, ahead of pilot-scale cyclic testing.
- **Significant increase in international yttrium prices**: Yttrium has experienced substantial international price appreciation following China's introduction of export controls in April 2025, highlighting tightening supply conditions and the strategic importance of alternative rare earth processing technologies. As of October 2026, yttrium oxide was reportedly trading at approximately US$765/kg outside China, underscoring the potential commercial relevance of Bayan's Yttrium Upgrade Technology in supporting diversified supply chains.
- **Yttrium – a critical material for semiconductors, aerospace and advanced technologies:** Yttrium is an important rare earth element used in semiconductor manufacturing equipment, high-performance thermal barrier coatings for jet

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engines and industrial gas turbines, advanced ceramics, lasers and specialised electronic applications. Growing strategic interest in secure rare earth supply chains highlights the potential importance of technologies capable of efficiently separating and upgrading yttrium from mixed rare earth streams.

- **Phase 2 planning:** Explore deploying the Yttrium Upgrade Technology in series to achieve higher yttrium purity in the output feed, establish a process flowsheet, mass balance and operating cost model to assess the economics of a pilot-scale program using commercial columns and define the scope of a Phase 2 program.

Bayan Mining and Minerals Ltd (ASX: BMM) ("BMM", "Bayan" or "the Company") is pleased to announce the final results of its Phase 1 Research Program at The University of Queensland ("UQ"), which tested Bayan's exclusively licensed and patented Yttrium Upgrade Technology from the Colorado School of Mines (the "Yttrium Upgrade Technology").

Chief Executive Officer, Nathan Kong commented:

"Completing nine column runs at UQ and recording a peak 11.2× yttrium purity upgrade is an encouraging technical outcome for Bayan. The program has identified two laboratory separation approaches that warrant further investigation and provides a stronger basis for designing the next stage of test work.

Now, that we better understand the mechanisms of the process across a range of conditions, we believe that the yttrium purity and concentration upgrade can be implemented in a commercial process.

The next phase moves the technology onto commercially relevant feeds and multi-cycle testing, building the flowsheet, mass balance and operating cost basis required to assess a pilot-scale program."

Completion of the Phase 1 Research establishes that the technology can upgrade yttrium solution purity through two distinct routes. Selective exclusion during loading delivered up to a 11.2x purity upgrade from typical heavy rare earth solutions, and selective stripping with weak acid delivering a 2.0x purity upgrade from a dilute heavy rare earth solution.

This is an important technical milestone, as it confirms that the separation mechanism covered by the Colorado School of Mines ("Mines") patent operates in both concentrated and dilute feed systems and on two commercially available resins. The technology has now proven effective on both clay-hosted and bastnaesite mineralisation styles, significantly broadening the range of rare earth projects to which it can be applied.

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Why Yttrium Matters

Yttrium is a rare earth element used in semiconductor manufacturing equipment, heat-resistant coatings for jet engineers and gas turbines. Global demand of yttrium is primarily driven by the semiconductor, aerospace and energy sectors. Global supply is highly concentrated with China as the primary producer. In April 2025, China placed export controls on yttrium which tightened supply[1]. As of October 2026, yttrium oxide was reported at approximately US$765/kg outside China[2]. Refer to figure 1.

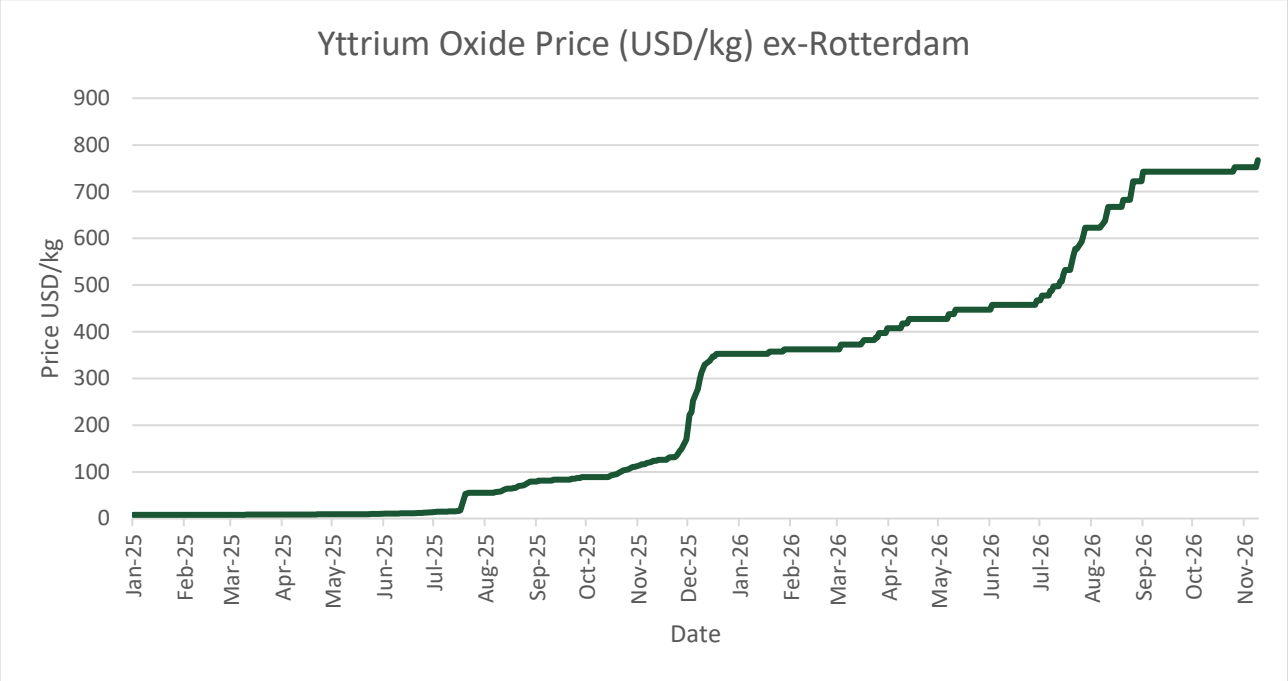


Figure 1: Yttrium oxide price (USD/kg) ex-Rotterdam price since January 2025.

Phase 1 Research Program

UQ's Hydrometallurgy Research Group completed nine (9) ion exchange column runs ("Runs") under the Phase 1 Research Program. Each Run involves passing a rare earth bearing solution through a column of IDA-functionalised resin, a step known as loading, then, acid is passed through the column releasing the rare earths from the resin, a step known as stripping or elution.

Runs 1 to 5 used a solution derived from a mixed rare earth hydroxide produced from Mary Kathleen tailings ("MK Liquor") doped with REE elements representative of an Australian clay-hosted rare earth deposit. Run 1 established the baseline, and Runs 2 to 5 added yttrium, samarium and gadolinium to the MK Liquor to test yttrium separation

[1] US Geological Survey, Mineral Commodity Summaries 2026 – Yttrium (February 2026)
[2] Asian Metal, Yttrium Oxide 99.999%min ex-Rotterdam USD/kg

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while varying loading and stripping temperature and flow rate. Run 6 used a dilute synthetic solution rich in mid and heavy rare earths, representative of a clay-hosted rare earth deposit. Runs 7 to 9 used a synthetic high samarium solution replicating the feed described in the Mines patent, with Runs 7 and 8 comparing the Amberlite IRC748 and Run 9, which was designed to confirm the understandings developed from the previous tests. The test was executed at a lower loading flow rate (0.75 BV/h compared with 2 BV/h and 5 BV/h for previous tests) on a larger 150 mL resin bed to increase the data refinement at process conditions.

Final Yttrium Separation and Upgrade Results

The final results confirm that IDA resins can upgrade yttrium purity through two routes, exclusion during loading in concentrated feed systems and selective stripping where yttrium breakthrough has not occurred during loading, The yttrium purity upgrade factor for each Run is summarised in Figure 2 and Table 1.

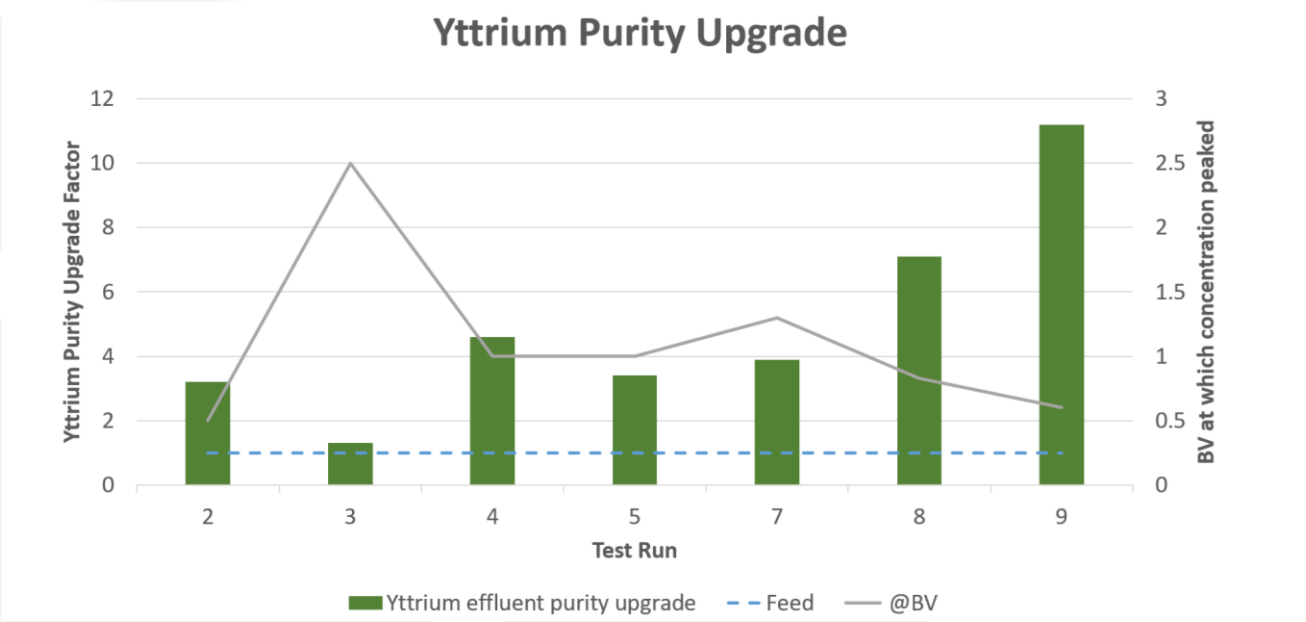


Figure 2: Yttrium purity upgrade factor (Y/TREE in effluent relative to feed Y/TREE) measured at the point where yttrium concentration peaked. Maximum concentration upgrade of 11.2 achieved in Test 9.

Selective stripping with weak acid

In Run 6 using a very dilute heavy RE solution, the high capacity of the resin relative to the low rare earth concentration meant all elements loaded onto the resin and no yttrium exclusion occurred during loading. Sequential stripping with weak acid (10 g/L HCl) then released yttrium preferentially, lifting yttrium from 44% of TREE in the feed to 87% of TREE in the eluate, a 2.0x purity upgrade. Stripping with stronger acid (100 g/L HCl)

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delivered a lower upgrade of 1.3x (Figure 3). With resin loaded using concentrated feeds, weak acid stripping produced yttrium purity upgrade factors ranging from 0.4x to 1.4x (Table 1).

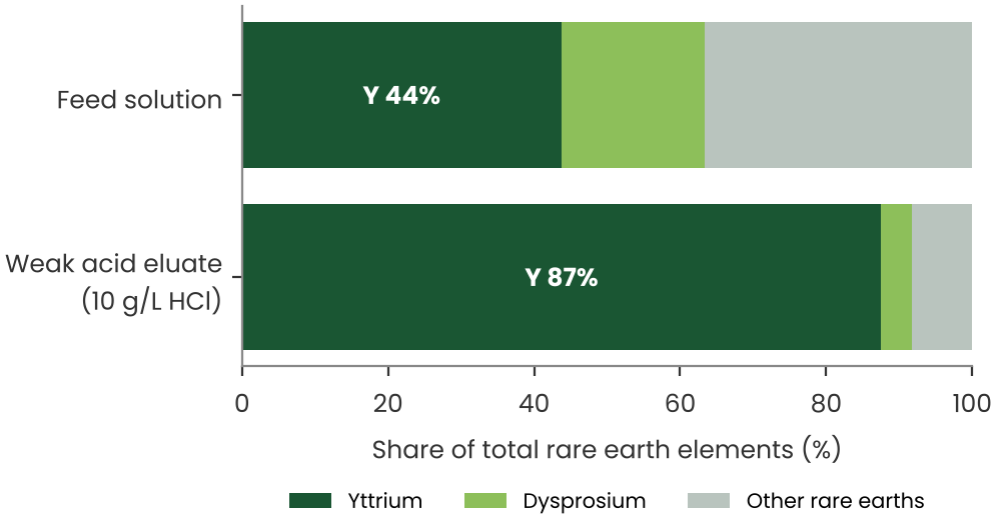


Figure 3: Run 6 rare earth composition of the feed solution and the weak acid (10 g/L HCl) eluate, showing yttrium increasing from 44% to 87% of TREE.

Run	Feed solution	Resin	Loading conditions	Y in feed (% TREE)	Peak Yttrium Purity Upgrade during loading	At BV
1	MK Liquor (baseline, no Y)	TP208	30 °C, 2 BV/h	-	-	-
2	MK Liquor + Y, Sm, Gd	TP208	30 °C, 2 BV/h	11.0%	3.2x	0.5
3	MK Liquor + Y, Sm, Gd	TP208	70°C, 5 BV/h	10.5%	1.3x	2.5
4	MK Liquor + Y, Sm, Gd	TP208	70°C, 2 BV/h	10.9%	4.6x	1.0
5	MK Liquor + Y, Sm, Gd	TP208	70°C, 2 BV/h	10.7%	3.4x	1.0
6	Dilute HREE synthetic	TP208	70°C, 2 BV/h	43.7%	-	-
7	High Sm synthetic (patent)	IRC748	70°C, 2 BV/h	7.5%	3.9x	1.3
8	High Sm synthetic (patent)	TP208	70°C, 2 BV/h	7.5%	7.1x	0.83
9	High Sm synthetic (patent)	TP208	30°C 2 BV/h	6.5%	11.2x	0.6

Table 1: Summary of yttrium purity upgrade factors (Y/TREE at shown BV relative to feed Y/TREE).

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Building a Commercially Viable Alternative to Traditional Solvent Extraction

Traditional yttrium enrichment flowsheets rely on solvent extraction to separate yttrium from the other rare earths. Bayan's Yttrium Upgrade Technology potentially offers a more capital-efficient pathway to an enriched yttrium product stream, using established ion exchange technology and commercially available IDA resins, and it can be designed to integrate into an existing rare earth separation circuit without requiring a full redesign.

The technology aims to simplify yttrium separation in a REE flowsheet. In Y+HRE circuits with high yttrium content, upgrading yttrium ahead of SX reduces the mass of material the SX circuit must process. This creates potential to reduce the number of mixer-settler cells and the solvent inventory needed to separate yttrium from the heavy rare earths thus potentially lowering the capital intensity for the REE flowsheet.

For mixed rare earth (MRE) solutions from leach circuits, the technology offers a route to recover yttrium earlier in the flowsheet. In a conventional refinery, yttrium travels with the other rare earths through each SX split before reaching the final Y+HRE circuit. Removing yttrium upstream lowers the rare earth load on every downstream SX stage, with potential savings in organic flow, stage count and the metal inventory held within the circuit.

Early recovery also gives MRE producers a pathway to an yttrium-enriched product ahead of full SX separation. The benefit is greatest where yttrium forms a large share of the feed, such as xenotime and certain ionic clay deposits.

Next Steps

Following completion of Phase 1 Research, the Company and UQ have identified the following next steps for the Yttrium Upgrade Technology.

- Source mixed rare earth carbonate (MREC) and heavy rare earth concentrate feeds from Australian and international developers to test the technology across a wider range of ore types.
- Evaluate resin cyclic performance over a minimum of 10 loading and stripping cycles using process solutions derived from actual rare earth feed, including resin characterisation for fouling (SEM-EDS, FTIR and total exchange capacity testing).
- Determine the best operating conditions for the process by refining the test program to quantify the effects of feed concentration, feed rate and pH during loading, and the effect of acid concentration and feed rate during stripping to maximise yttrium purity.
- Run tests to confirm the efficacy of these conditions under real process conditions.

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- Explore deploying the Yttrium Upgrade Technology in series to achieve higher yttrium purity in the output feed.
- Establish a process flowsheet, mass balance and operating cost model to assess the economics of a pilot-scale program using commercial columns.
- Define the scope of a Phase 2 Research Program with UQ based on the Phase 1 results.

For further information, please contact:

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Authorised for release by the Board of Bayan Mining and Minerals Limited

-ENDS-

About Bayan's Rare Earth Processing Technology Portfolio

Bayan holds the exclusive license to four rare earth processing technologies originally developed by the Colorado School of Mines comprising of:

- Advanced Systems and Methods for Leaching Rare Earths from Ore (bastnaesite single-stage HCI leach) (US12442059),
- Compounds, Methods, and Systems for Beneficiation of Rare Earth Elements by Flotation and Gravity concentration (US20220040707),
- Upgrade of Yttrium in a Mixed Rare Earth Stream Using Iminodiacetic Acid Functionalized Resin (US10696562B2), and
- Beneficiation of Rare Earth Elements Bearing Ancylite (US10618058).

Bayan intends to systematically develop and commercialise these patents and technologies for Bayan's resource assets, third-party rare-earth resources and downstream applications.

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Competent Persons Statement

The information in this release that relates to metallurgical test work results is based on information compiled by Professor James Vaughan, a Competent Person who is a Member of the Australasian Institute of Mining and Metallurgy (AusIMM). The AusIMM is a Joint Ore Reserves Committee (JORC) Code 'Recognised Professional Organisation' (RPO). An RPO is an accredited organisation to which the Competent Person under JORC Code Reporting Standards must belong to report Exploration Results, Mineral Resources, or Ore Reserves through the ASX. Professor Vaughan is a consultant of the Company. Professor Vaughan has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the JORC 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Professor Vaughan consents to the inclusion in the release of the matters based on his information in the form and context in which it appears.

Other than the correction to the yttrium concentration figure set out in this announcement, the Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcements.

The Company confirms that the form and context in which the Competent Persons' findings are presented have not been materially modified from the original market announcements.

Forward-looking Statements

Certain statements included in this release constitute forward-looking information. Statements regarding BMM's plans with respect to its mineral properties and programs are forward-looking statements. There can be no assurance that BMM's plans for development of its mineral properties will proceed as currently expected. There can also be no assurance that BMM will be able to confirm the presence of additional mineral resources, that any mineralisation will prove to be economic or that a mine will successfully be developed on any of BMM's mineral properties. The performance of BMM may be influenced by a number of factors which are outside the control of the Company and its Directors, staff, and contractors.

These statements include, but are not limited to statements regarding future production, resources or reserves and exploration results. All such statements are subject to certain risks and uncertainties, many of which are difficult to predict and generally beyond the control of the Company, that could cause actual results to differ materially from those expressed in, or implied or projected by, the forward-looking information and statements.

There is no certainty that the research program will achieve its technical objectives, result in pilot-scale development, or ultimately support a commercially viable processing operation.

The Company confirms that it is not currently aware of any environmental restrictions or requirements that would impede the continuation of planned activities.

Except for statutory liability which cannot be excluded, each of BMM, its officers, employees and advisors expressly disclaim any responsibility for the accuracy or completeness of the material contained in these forward-looking statements and excludes all liability whatsoever (including in negligence) for any loss or damage which may be suffered by any person as a consequence of any information in forward-looking statements or any error or omission. BMM undertakes no obligation to update publicly or release any revisions to these forward-looking statements to reflect events or circumstances after today's date or to reflect the occurrence of unanticipated events other than required by the Corporations Act and ASX Listing Rules. Accordingly, you should not place undue reliance on any forward-looking statement.

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Appendix A: Ion Exchange Run Conditions and Feed Compositions

All Runs used a 100 mL resin bed (measured in the Na^+ form) with feed adjusted to pH 4, other than Run 9, which used a 150 mL resin bed.

Run	Resin	Loading temp (°C)	Loading flow (BV/h)	Loading time (h)	Stripping temp (°C)	Stripping flow (BV/h)	Stripping acid, g/L HCl (time, h)
1	Lewatit TP208	30	2	26	30	2	1 (2), 10 (2), 100 (7)
2	Lewatit TP208	30	2	10	30	2	1 (3), 10 (3), 100 (2)
3	Lewatit TP208	70	5	20	70	5	1 (3), 10 (3), 100 (2)
4	Lewatit TP208	70	2	10	70	2	10 (3), 100 (2)
5	Lewatit TP208	70	2	5	30	2	10 (1), 100 (2)
6	Lewatit TP208	70	2	9	30	2	10 (1), 100 (2)
7	Amberlite IRC748	70	2	3	30	2	10 (2), 20 (1), 100 (1)
8	Lewatit TP208	70	2	3	30	2	10 (2), 20 (1), 100 (1)
9	Lewatit TP208	30	0.75	2	30	2	2 (2), 10 (1), 100 (1)

Table A1: Loading and stripping conditions for each Run.

Run	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)	Dy (g/L)	Y (% TREE)
1	10.35	0.07	7.25	1.77	0.65	0.09	-	-	-
2	4.83	0.46	3.24	1.82	0.33	0.18	1.34	-	11.0%
3	4.91	0.47	3.32	1.83	0.33	0.18	1.30	-	10.5%
4	4.70	0.45	3.37	1.73	0.32	0.22	1.32	-	10.9%
5	5.00	0.46	3.47	1.82	0.33	0.27	1.36	-	10.7%
7	0.26	2.91	0.20	0.85	-	9.51	1.15	0.57	7.5%
8	0.29	2.74	0.21	0.84	-	9.38	1.13	0.57	7.5%
9	0.45	3.11	0.34	0.81	-	11.10	1.15	0.69	6.5%

Table A2: Feed solution composition for Runs 1 to 5 and 7 to 9 (g/L).

Ce	Gd	La	Nd	Pr	Sm	Y	Eu
5.9	12.6	3.7	12.9	3.5	7.0	85.7	1.1
Tb	Dy	Ho	Er	Tm	Yb	Lu	Y (% TREE)
5.2	38.5	6.2	8.2	1.8	2.9	0.7	43.7%

Table A3: Feed solution composition for Run 6, dilute heavy rare earth synthetic solution (mg/L).

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Appendix B: Concentrations of Rare Earths in Loading Effluent and Stripping Eluate

Normalized effluent concentrations using TP208 IDA resin during Run 1 loading (Baseline – MK liquor) at 30 °C, 2 Bv/h (a normalised concentration of 1.0 means the effluent concentration is the same as the feed solution concentration).

Bv	Ce	Gd	La	Nd	Pr	Sm	Tb
0	0.09	0.00	0.00	0.00	0.00	0.00	0.00
3	0.83	0.72	0.86	0.79	0.79	0.67	0.77
4	0.92	0.79	0.94	0.88	0.88	0.79	0.88
5	0.92	0.79	0.94	0.89	0.89	0.79	0.89
6	0.93	0.79	0.94	0.88	0.90	0.80	0.88
7	0.97	0.84	0.99	0.92	0.93	0.84	0.92
8	0.95	0.81	0.96	0.90	0.91	0.82	0.89
9	0.95	0.82	0.96	0.90	0.93	0.83	0.91
11	1.01	0.87	1.04	0.97	0.98	0.83	1.10
13	0.89	0.86	0.91	0.86	0.86	0.82	1.09
15	0.79	0.90	0.83	0.88	0.88	0.93	1.07
17	0.76	0.86	0.78	0.80	0.81	0.79	0.89
19	0.76	0.88	0.78	0.79	0.81	0.81	1.05
21	0.79	0.90	0.79	0.82	0.82	0.86	1.07
23	0.81	0.88	0.81	0.84	0.85	0.85	0.90
25	0.81	0.91	0.81	0.85	0.85	0.86	1.08
27	0.81	0.88	0.80	0.84	0.85	0.84	1.04
29	0.83	0.90	0.82	0.86	0.87	0.86	1.07
31	0.77	0.94	0.77	0.80	0.81	0.91	1.11
33	0.87	0.89	0.87	0.90	0.91	0.85	1.04
35	0.78	0.89	0.77	0.81	0.82	0.86	0.94
37	0.89	0.86	0.88	0.92	0.93	0.83	0.91
39	0.99	0.91	0.99	1.03	1.03	0.88	1.08
41	0.91	0.89	0.89	0.95	0.96	0.86	1.05
43	0.95	0.89	0.94	1.00	1.00	0.85	1.05
45	1.03	0.88	1.01	1.07	1.09	0.85	1.05
47	0.81	0.92	0.79	0.84	0.85	0.89	1.09
49	0.80	0.94	0.78	0.83	0.84	0.91	1.12
51	0.85	0.87	0.84	0.89	0.90	0.84	0.91
53	0.82	0.87	0.80	0.85	0.86	0.84	1.01

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Stripping eluate concentrations in solution using different eluent acid concentrations for Run 1 (Baseline – MK liquor) at 30 °C, 2 Bv/h.

HCl concentration in eluent	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Tb (g/L)
1 g/L HCl	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1	0.54	0.00	0.36	0.07	0.03	0.00	0.00
	2	0.62	0.00	0.42	0.09	0.03	0.00	0.00
	3	0.69	0.00	0.46	0.07	0.03	0.00	0.00
	4	0.64	0.00	0.44	0.08	0.03	0.00	0.00
10 g/L HCl	5	6.03	0.04	3.36	1.05	0.39	0.05	0.00
	6	6.94	0.05	3.11	1.42	0.49	0.07	0.01
	7	7.44	0.05	2.93	1.71	0.59	0.10	0.01
	8	4.46	0.03	1.52	1.13	0.39	0.08	0.00
100 g/L HCl	9	2.13	0.02	0.67	0.59	0.19	0.05	0.00
	9.5	0.42	0.00	0.11	0.12	0.04	0.01	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Normalized effluent concentrations in TP208 IDA resin during loading for Run 2 (MK liquor + Y, Sm, Gd) at 30 °C, 2 Bv/h (Light green rows represent the 2 Bv used in the calculation for Y purity upgrade).

Bv	Ce	Gd	La	Nd	Pr	Sm	Y
0	0.00	0.00	0.01	0.00	0.00	0.00	0.00
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.03
1.5	0.60	0.72	0.77	0.63	0.63	0.54	0.89
2	0.75	0.77	0.82	0.71	0.70	0.65	0.94
3	0.76	0.77	0.83	0.72	0.71	0.65	0.90
4	0.78	0.79	0.85	0.74	0.73	0.68	0.96
5	0.81	0.82	0.88	0.78	0.77	0.72	0.95
6	0.82	0.83	0.89	0.79	0.78	0.73	0.94
7	0.77	0.78	0.83	0.74	0.73	0.68	0.89
8	0.85	0.84	0.89	0.81	0.81	0.76	0.94
9	0.74	0.73	0.78	0.72	0.72	0.67	0.85
10	0.75	0.75	0.79	0.73	0.72	0.67	0.82
11	0.77	0.78	0.82	0.75	0.75	0.70	0.88
12	0.92	0.92	0.97	0.90	0.89	0.85	1.00
13	0.85	0.85	0.89	0.83	0.82	0.78	0.92
14	0.95	0.94	0.99	0.93	0.93	0.87	1.00
15	0.95	0.94	0.98	0.93	0.92	0.87	1.00
16	0.70	0.69	0.73	0.68	0.68	0.67	0.80
17	0.97	0.97	1.01	0.96	0.96	0.93	1.02
18	0.89	0.87	0.91	0.88	0.88	0.85	0.93
19	0.81	0.80	0.83	0.80	0.80	0.77	0.81
20	0.82	0.81	0.84	0.81	0.82	0.78	0.84

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Stripping eluate concentrations using different eluent acid concentrations for Run 2 (MK liquor + Y, Sm, Gd) at 30 °C, 2 Bv/h. (Light green rows represent dilute acid strip concentrations= used in the calculation for Y purity upgrade).

HCl concentration	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)
1 g/L HCl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.25	2.13	0.12	1.41	0.78	0.09	0.05	0.52
	2.50	0.97	0.07	0.64	0.36	0.05	0.03	0.18
	3.75	0.62	0.02	0.16	0.09	0.02	0.01	0.06
	5.00	0.33	0.02	0.16	0.09	0.02	0.01	0.06
	6.25	0.18	0.02	0.12	0.06	0.01	0.01	0.04
	7.50	0.12	0.01	0.08	0.04	0.01	0.00	0.03
	8.75	0.11	0.01	0.07	0.04	0.01	0.00	0.03
	10.00	0.08	0.01	0.05	0.03	0.01	0.00	0.02
	11.25	0.08	0.01	0.05	0.03	0.01	0.00	0.02
	12.50	0.07	0.01	0.05	0.03	0.00	0.00	0.02
	13.75	0.06	0.01	0.04	0.02	0.00	0.00	0.01
	15.00	0.07	0.01	0.04	0.02	0.00	0.00	0.02
10 g/L HCl	16.25	0.07	0.01	0.05	0.03	0.00	0.00	0.02
	17.50	0.06	0.01	0.04	0.02	0.00	0.00	0.02
	18.75	0.09	0.01	0.06	0.03	0.01	0.01	0.02
	20.00	1.50	0.08	1.02	0.52	0.06	0.06	0.34
	21.25	1.54	0.11	1.05	0.53	0.08	0.08	0.35
	22.50	1.57	0.11	1.07	0.54	0.08	0.08	0.35
	23.75	1.64	0.11	1.10	0.57	0.08	0.08	0.36
	25.00	1.63	0.11	1.08	0.56	0.08	0.08	0.36
	26.25	1.79	0.11	1.15	0.61	0.08	0.08	0.37
	27.50	1.71	0.12	1.06	0.59	0.09	0.09	0.35
	28.75	1.68	0.12	1.02	0.59	0.09	0.09	0.31
	30.00	1.65	0.13	0.94	0.59	0.10	0.10	0.28
100 g/L HCl	31.25	0.19	0.02	0.11	0.07	0.01	0.01	0.03
	32.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	33.75	0.05	0.01	0.02	0.02	0.00	0.00	0.01
	35.00	7.99	0.84	3.11	3.46	0.63	0.41	0.45
	36.25	0.21	0.02	0.05	0.12	0.02	0.02	0.01

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Normalized effluent concentrations in TP208 IDA resin during loading for Run 3 (MK liquor + Y, Sm, Gd) at 70 °C, 5 Bv/h. (Light green rows represent the 2 Bv used in the calculation for Y purity upgrade).

Bv	Ce	Gd	La	Nd	Pr	Sm	Y
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50	0.54	0.56	0.68	0.47	0.45	0.31	0.77
3.75	0.59	0.59	0.70	0.53	0.52	0.35	0.76
5	0.64	0.63	0.75	0.58	0.57	0.43	0.78
10	0.75	0.72	0.83	0.71	0.70	0.52	0.81
20	0.94	0.89	0.96	0.92	0.92	0.76	0.89
30	0.97	0.94	0.98	0.96	0.97	0.84	0.94
40	0.95	0.94	0.94	0.94	0.95	0.89	1.00
50	1.00	0.98	1.00	0.99	0.99	0.85	0.97
100	1.01	1.00	1.01	1.01	1.02	0.84	0.99

Stripping eluate concentrations using different eluent acid concentrations for Run 3 (MK liquor + Y, Sm, Gd) at 70 °C, 5 Bv/h. (Light green rows represent dilute acid strip concentrations= used in the calculation for Y purity upgrade).

HCl concentration	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)
1 g/L HCl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.25	0.21	0.02	0.14	0.08	0.01	0.01	0.06
	2.50	0.03	0.00	0.02	0.01	0.00	0.00	0.01
	3.75	0.09	0.01	0.06	0.03	0.01	0.00	0.02
	5.00	0.07	0.01	0.05	0.03	0.00	0.00	0.02
	6.25	0.14	0.01	0.09	0.05	0.01	0.00	0.03
	7.50	0.13	0.01	0.09	0.05	0.01	0.00	0.03
	8.75	0.15	0.01	0.10	0.05	0.01	0.01	0.03
	10.00	0.10	0.01	0.07	0.03	0.01	0.00	0.02
	11.25	0.13	0.01	0.09	0.05	0.01	0.00	0.03
	12.50	0.11	0.01	0.07	0.04	0.01	0.00	0.02
	13.75	0.11	0.01	0.07	0.04	0.01	0.00	0.02
	15.00	0.13	0.01	0.09	0.05	0.01	0.00	0.03
10 g/L HCl	16.25	1.25	0.10	0.72	0.46	0.07	0.04	0.39
	17.50	1.63	0.10	0.76	0.66	0.07	0.04	0.54
	18.75	0.85	0.15	0.37	0.38	0.10	0.06	0.38
	20.00	0.95	0.13	0.40	0.44	0.08	0.05	0.39
	21.25	1.66	0.20	0.68	0.78	0.12	0.09	0.57

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HCl concentration	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)
	22.50	1.76	0.16	0.71	0.83	0.10	0.07	0.60
	23.75	1.05	0.20	0.41	0.51	0.12	0.09	0.42
	25.00	1.05	0.10	0.40	0.52	0.06	0.05	0.44
	26.25	1.60	0.18	0.59	0.81	0.11	0.09	0.54
	27.50	1.78	0.21	0.63	0.93	0.13	0.11	0.61
	28.75	1.53	0.18	0.51	0.83	0.11	0.10	0.50
	30.00	1.43	0.19	0.46	0.80	0.12	0.11	0.46
100 g/L HCl	31.25	0.05	0.01	0.01	0.03	0.01	0.00	0.02
	32.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	33.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	36.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Normalized effluent concentrations in TP208 IDA resin during loading for Run 4 (MK liquor + Y, Sm, Gd) at 70 °C, 2 Bv/h. (Light green rows represent the 2 Bv used in the calculation for Y purity upgrade).

Bv	Ce	Gd	La	Nd	Pr	Sm	Y
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.04	0.04	0.32	0.01	0.01	0.01	1.01
1.5	0.48	0.50	0.74	0.35	0.28	0.25	0.87
2	0.61	0.61	0.77	0.53	0.43	0.43	0.82
4	0.63	0.61	0.76	0.57	0.49	0.49	0.78
8	0.73	0.69	0.83	0.68	0.61	0.62	0.81
16	0.88	0.82	0.94	0.86	0.78	0.81	0.85
20	0.98	0.92	1.01	0.96	0.95	0.91	0.91

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Stripping eluate concentrations using different eluent acid concentrations for Run 4 (MK liquor + Y, Sm, Gd) at 70 °C, 2 Bv/h. (Light green rows represent dilute acid strip concentrations= used in the calculation for Y purity upgrade).

HCl concentration	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)
10 g/L HCl	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.5	0.00	0.01	0.00	0.00	0.01	0.00	0.02
	1.0	0.92	0.05	0.69	0.32	0.05	0.03	0.14
	1.5	1.30	0.08	0.97	0.45	0.07	0.05	0.21
	2.0	1.32	0.10	0.99	0.45	0.08	0.06	0.23
	6.0	1.61	0.07	1.07	0.55	0.07	0.04	0.21
100 g/L HCl	6.5	5.36	0.47	3.23	1.89	0.36	0.26	1.58
	7.0	11.89	1.55	4.99	5.26	0.98	0.84	4.16
	7.5	14.34	2.09	5.10	7.03	1.27	1.28	4.18
	8.0	10.37	1.59	3.18	5.52	1.06	1.10	2.73
	10.0	0.50	0.10	0.09	0.30	0.06	0.07	0.17

Normalized effluent concentrations using TP208 IDA resin during loading for Run 5 (MK liquor + Y, Sm, Gd) at 70 °C, 2 Bv/h. (Light green rows represent the 2 Bv used in the calculation for Y purity upgrade).

Bv	Ce	Gd	La	Nd	Pr	Sm	Y
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.0	0.11	0.11	0.52	0.00	0.05	0.02	1.04
1.5	0.51	0.52	0.74	0.35	0.33	0.30	0.86
2.0	0.64	0.68	0.85	0.58	0.55	0.52	0.91
2.5	0.64	0.60	0.74	0.53	0.54	0.50	0.77
3.0	0.64	0.61	0.76	0.55	0.54	0.52	0.78
3.5	0.67	0.64	0.79	0.58	0.59	0.54	0.81
4.0	0.69	0.63	0.78	0.58	0.58	0.54	0.78
4.5	0.68	0.65	0.80	0.60	0.60	0.56	0.79
5.0	0.70	0.66	0.79	0.61	0.63	0.57	0.79
5.5	0.75	0.69	0.85	0.66	0.65	0.61	0.84
6.0	0.73	0.69	0.83	0.65	0.64	0.62	0.81
6.5	0.81	0.76	0.91	0.72	0.72	0.68	0.89
7.0	0.76	0.71	0.86	0.69	0.68	0.64	0.82
7.5	0.84	0.78	0.93	0.76	0.76	0.71	0.88
8.0	0.81	0.76	0.90	0.73	0.74	0.69	0.85

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Bv	Ce	Gd	La	Nd	Pr	Sm	Y
8.5	0.82	0.74	0.88	0.73	0.71	0.68	0.83
9.0	0.81	0.75	0.89	0.75	0.77	0.69	0.84
9.5	0.86	0.80	0.94	0.80	0.77	0.75	0.87
10.0	0.87	0.80	0.94	0.81	0.81	0.77	0.90

Stripping concentrations in solution using different acid concentrations for Run 5 (MK liquor + Y, Sm, Gd) at 30 °C, 2 Bv/h. (Light green rows represent dilute acid strip concentrations= used in the calculation for Y purity upgrade).

HCl concentration	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)
10 g/L HCl	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.0	0.93	0.06	0.66	0.27	0.04	0.05	0.30
	1.5	1.35	0.07	0.97	0.41	0.06	0.06	0.44
	2.0	1.47	0.07	1.03	0.46	0.07	0.06	0.50
100 g/L HCl	2.5	1.38	0.12	0.93	0.43	0.07	0.06	0.46
	3.0	1.50	0.13	0.96	0.47	0.07	0.07	0.50
	3.5	2.04	0.19	1.22	0.68	0.11	0.09	0.65
	4.0	12.04	1.27	5.34	5.34	0.97	0.85	2.09
	4.5	10.70	1.10	4.29	4.95	0.90	0.82	1.40
	5.0	5.36	0.55	2.05	2.55	0.45	0.45	0.58
	5.5	2.45	0.25	0.91	1.13	0.20	0.20	0.26
	6.0	0.96	0.10	0.35	0.41	0.07	0.08	0.10

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Effluent metal concentrations in TP208 IDA resin during loading for Run 6 (HREE mix synthetic solution) at 70 °C, 2 Bv/h. (Light green rows represent the 2 Bv used in the calculation for Y purity upgrade).

Bv	Ce (mg/L)	Gd (mg/L)	La (mg/L)	Nd (mg/L)	Pr (mg/L)	Sm (mg/L)	Y (mg/L)	Eu (mg/L)	Tb (mg/L)	Dy (mg/L)	Ho (mg/L)	Er (mg/L)	Tm (mg/L)	Yb (mg/L)	Lu (mg/L)
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	0.21	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.0	0.10	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.0	0.10	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.5	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.0	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.0	0.10	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0	0.21	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.0	0.21	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.0	0.52	0.00	0.31	0.10	0.10	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.0	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.0	8.25	0.84	3.76	3.45	0.63	0.63	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.0	7.49	0.73	3.43	3.12	0.73	0.52	1.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.0	9.88	1.04	4.47	4.16	0.83	0.62	1.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0	8.64	0.83	3.96	3.64	0.73	0.62	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0	1.77	0.10	1.25	0.52	0.21	0.10	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0	2.09	0.21	1.57	0.63	0.21	0.10	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0	2.10	0.21	1.47	0.63	0.21	0.10	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0	1.55	0.10	1.14	0.52	0.21	0.10	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Stripping eluate concentrations using different eluent acid concentrations for Run 6 (HREE mix synthetic solution) at 30 °C, 2 Bv/h. (Light green rows represent dilute acid strip concentrations used in the calculation for Y purity upgrade factor).

HCl concentration	Bv	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Pr (g/L)	Sm (g/L)	Y (g/L)	Eu (g/L)	Tb (g/L)	Dy (g/L)	Ho (g/L)	Er (g/L)	Tm (g/L)	Yb (g/L)	Lu (g/L)
10 g/L HCl	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
	2.0	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.05	0.02	0.03	0.01	0.01	0.00
100 g/L HCl	2.5	0.01	0.03	0.02	0.02	0.00	0.01	0.78	0.00	0.02	0.18	0.04	0.05	0.01	0.02	0.00
	3.0	0.05	0.10	0.04	0.08	0.02	0.03	0.38	0.00	0.04	0.33	0.05	0.06	0.01	0.02	0.00
	3.5	0.15	0.46	0.07	0.56	0.10	0.21	0.44	0.03	0.11	0.99	0.07	0.07	0.01	0.02	0.00
	4.5	0.02	0.04	0.01	0.05	0.01	0.03	0.04	0.00	0.01	0.08	0.01	0.01	0.00	0.00	0.00
	5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Normalised effluent concentrations during loading for Run 7 (high samarium synthetic solution, Amberlite IRC748) at 70 °C, 2 BV/h. A value of 1.0 means the effluent concentration equals the feed concentration.

BV	Ce	Gd	La	Nd	Sm	Y	Dy	Yb
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.83	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
1.00	0.00	0.01	0.01	0.01	0.00	0.09	0.02	0.02
1.17	0.18	0.41	0.46	0.21	0.15	1.62	0.51	0.65
1.33	0.64	0.99	1.19	0.59	0.46	2.12	1.15	1.44
1.50	0.74	0.90	1.06	0.65	0.56	1.27	0.96	1.12
1.67	0.78	0.86	1.00	0.69	0.62	1.11	0.90	1.02
1.83	0.79	0.86	0.98	0.71	0.64	1.07	0.89	1.00
2.00	0.78	0.83	0.93	0.71	0.65	1.00	0.85	0.93
2.50	0.75	0.85	0.85	0.78	0.73	0.98	0.86	0.82
3.00	0.75	0.85	0.83	0.78	0.75	0.97	0.85	0.79
3.50	0.75	0.82	0.83	0.76	0.73	0.94	0.81	0.79
4.00	0.80	0.81	0.88	0.76	0.72	0.90	0.80	0.83
4.50	0.78	0.82	0.85	0.77	0.74	0.93	0.82	0.80
5.00	0.79	0.85	0.86	0.80	0.77	0.97	0.85	0.81
5.50	0.84	0.81	0.91	0.76	0.74	0.90	0.81	0.85
6.00	0.85	0.80	0.92	0.76	0.73	0.88	0.80	0.85

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Stripping eluate concentrations using different eluent acid concentrations for Run 7 (Amberlite IRC748) at 30 °C, 2 BV/h.

HCl	BV	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Sm (g/L)	Y (g/L)	Dy (g/L)	Yb (g/L)
10 g/L HCl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.50	0.00	0.03	0.00	0.00	0.05	0.01	0.01	0.00
	1.00	0.03	0.25	0.03	0.00	1.68	0.14	0.06	0.00
	1.50	0.04	0.28	0.03	0.00	2.18	0.13	0.06	0.00
	2.00	0.03	0.22	0.02	0.00	2.74	0.08	0.05	0.00
	2.50	0.04	0.73	0.03	0.00	2.24	0.07	0.07	0.00
	3.00	0.03	0.95	0.02	0.00	3.07	0.04	0.05	0.00
	3.50	0.04	0.52	0.02	0.00	1.79	0.03	0.06	0.00
20 g/L HCl	4.00	0.08	0.85	0.04	0.00	3.26	0.04	0.11	0.00
	4.50	0.05	0.97	0.02	0.00	4.13	0.02	0.07	0.00
	5.00	0.04	1.13	0.01	0.00	5.46	0.01	0.05	0.00
	5.50	0.04	0.85	0.01	0.00	4.83	0.00	0.05	0.00
100 g/L HCl	6.00	0.05	0.61	0.01	0.00	4.38	0.00	0.05	0.00
	6.50	0.05	0.69	0.01	0.00	6.29	0.00	0.04	0.00
	7.00	0.03	0.45	0.00	0.00	6.07	0.00	0.02	0.00
	7.50	0.00	0.26	0.00	0.00	3.65	0.00	0.00	0.00
	8.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00

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Normalised effluent concentrations during loading for Run 8 (high samarium synthetic solution, Lewatit TP208) at 70 °C, 2 BV/h. A value of 1.0 means the effluent concentration equals the feed concentration.

BV	Ce	Gd	La	Nd	Sm	Y	Dy	Yb
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.67	0.00	0.01	0.02	0.00	0.00	0.09	0.01	0.03
0.83	0.15	0.47	0.55	0.17	0.10	2.83	0.66	0.77
1.00	0.59	1.04	0.96	0.67	0.53	1.67	1.14	0.88
1.17	0.62	0.93	0.85	0.71	0.61	1.30	0.96	0.70
1.33	0.63	0.87	0.80	0.71	0.64	1.13	0.86	0.60
1.50	0.63	0.86	0.77	0.73	0.68	1.06	0.83	0.54
1.67	0.64	0.84	0.75	0.74	0.69	1.00	0.80	0.50
1.83	0.64	0.82	0.75	0.74	0.70	0.98	0.78	0.47
2.00	0.64	0.91	0.74	0.83	0.78	1.07	0.85	0.46
2.50	0.64	0.88	0.74	0.80	0.77	1.02	0.82	0.43
3.00	0.65	0.84	0.75	0.77	0.74	0.99	0.77	0.42
3.50	0.66	0.81	0.75	0.74	0.71	0.93	0.74	0.41
4.00	0.67	0.83	0.76	0.77	0.73	1.03	0.77	0.40
4.50	0.69	0.97	0.77	0.91	0.86	1.13	0.90	0.40
5.00	0.70	0.93	0.78	0.87	0.83	1.07	0.86	0.40
5.50	0.70	0.98	0.79	0.92	0.89	1.11	0.90	0.40
6.00	0.72	0.92	0.80	0.89	0.84	1.04	0.85	0.40

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Stripping eluate concentrations using different eluent acid concentrations for Run 8 (Lewatit TP208) at 30 °C, 2 BV/h.

HCl	BV	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Sm (g/L)	Y (g/L)	Dy (g/L)	Yb (g/L)
10 g/L HCl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.50	0.02	0.22	0.02	0.05	0.67	0.09	0.04	0.00
	1.00	0.08	0.82	0.06	0.18	2.41	0.53	0.14	0.00
	1.50	0.09	0.91	0.07	0.20	2.62	0.47	0.16	0.00
	2.00	0.10	1.05	0.07	0.21	3.09	0.28	0.17	0.00
	2.50	0.10	1.17	0.06	0.22	3.54	0.24	0.18	0.00
	3.00	0.09	1.04	0.06	0.22	3.29	0.22	0.18	0.01
	3.50	0.09	1.06	0.05	0.22	3.51	0.20	0.18	0.01
20 g/L HCl	4.00	0.09	1.04	0.05	0.22	3.59	0.18	0.18	0.01
	4.50	0.09	1.01	0.05	0.22	3.67	0.16	0.18	0.01
	5.00	0.09	0.84	0.05	0.22	3.25	0.14	0.17	0.01
	5.50	0.08	0.71	0.04	0.22	2.90	0.12	0.17	0.01
100 g/L HCl	6.00	0.10	1.13	0.05	0.27	4.87	0.12	0.20	0.01
	6.50	0.16	1.39	0.07	0.60	6.87	0.13	0.27	0.02
	7.00	0.15	1.19	0.05	0.59	7.37	0.07	0.23	0.01
	7.50	0.12	0.99	0.04	0.59	8.28	0.04	0.16	0.01
	8.00	0.08	0.66	0.02	0.52	8.36	0.01	0.08	0.00

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Normalised effluent concentrations during loading for Run 9 (high samarium synthetic solution, Lewatit TP208) at 30 °C, 1 BV/h. A value of 1.0 means the effluent concentration equals the feed concentration.

BV	Ce	Gd	La	Nd	Sm	Y	Dy	Yb
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.56	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.02
0.63	0.05	0.28	0.23	0.04	0.03	4.37	0.79	2.49
0.69	0.37	1.08	1.26	0.29	0.27	2.44	1.84	2.25
0.75	0.89	1.21	1.21	0.80	0.69	1.18	1.30	0.99

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Stripping eluate concentrations using different eluent acid concentrations for Run 9 (Lewatit TP208) at 30 °C, 2 BV/h.

HCl	BV	Ce (g/L)	Gd (g/L)	La (g/L)	Nd (g/L)	Sm (g/L)	Y (g/L)	Dy (g/L)	Yb (g/L)
10 g/L HCl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 g/L HCl	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100 g/L HCl	2.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.44	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	2.63	0.00	0.01	0.00	0.00	0.04	0.02	0.00	0.00
	2.81	0.00	0.01	0.00	0.00	0.04	0.03	0.00	0.00
	3.00	0.05	0.28	0.05	0.08	0.51	0.17	0.09	0.00

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Appendix C: JORC Table 1

JORC Code, 2012 Edition – Table 1

Section 1 Sampling Techniques and Data
(Criteria in this section apply to all succeeding sections.)

Criteria	JORC Code explanation	Commentary
Sampling techniques	• *Nature and quality of sampling (eg cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.* • *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* • *Aspects of the determination of mineralisation that are Material to the Public Report.* • *In cases where 'industry standard' work has been done this would be relatively simple (eg 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (eg submarine nodules) may warrant disclosure of detailed information.*	• Sampling techniques are not relevant for this announcement as it relates to hydrometallurgical test work on rare earth liquor samples with known geochemical properties. • Rare earth solutions for Runs 1 to 5 were derived from a mixed rare earth hydroxide sample generated in a previous UQ project ("Previous UQ Project"). Details of how the rare earth hydroxide sample was generated are published in Vaughan, J., Guan, Y., Loureiro Gontijo, V. L., and Sultana, U. (2024). Mary Kathleen tailings derived rare earth concentrate via double salt precipitation and caustic conversion. Southern African Rare Earths 2nd International Symposium 2024, Swakopmund, Namibia, 19-20 June 2024. Johannesburg, South Africa. Southern African Institute of Mining and Metallurgy. • For this study the mixed rare earth hydroxide was leached in hydrochloric acid, pH adjusted to 4 and filtered. The resulting solution was used as the baseline solution for Run 1. For Runs 2 to 5, the solution was diluted and spiked with yttrium, samarium and gadolinium nitrate salts. • For Run 6, a synthetic solution was prepared from ICP-OES single element rare earth standard solutions to simulate a Western Australian clay-hosted rare earth deposit. For Runs 7 to 9, a synthetic high samarium solution was prepared from rare earth nitrate salts to replicate the feed described in US Patent 10,696,562 B2.
Drilling techniques	• *Drill type (eg core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (eg core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).*	• No drilling results are being reported.
Drill sample recovery	• *Method of recording and assessing core and chip sample recoveries and results assessed.* • *Measures taken to maximise sample recovery and ensure representative nature of the samples.* • *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.*	• No drilling results are being reported.
Logging	• *Whether core and chip samples have been geologically and geotechnically logged to a*	• Logging details are not relevant for this announcement as it relates to

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	level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies. • *Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.* • *The total length and percentage of the relevant intersections logged.*	hydrometallurgical testwork on synthetic rare earth liquor samples.
Sub-sampling techniques and sample preparation	• *If core, whether cut or sawn and whether quarter, half or all core taken.* • *If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.* • *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* • *Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.* • *Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling.* • *Whether sample sizes are appropriate to the grain size of the material being sampled.*	• Details of the sub-sampling techniques for the Mary Kathleen Tailings are not available and not relevant to the current study.
Quality of assay data and laboratory tests	• *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* • *For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* • *Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established.*	• Aqueous samples were analysed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) (Agilent, model 5110). • Calibration curve is prepared using Agilent single element standards in 5% HNO3 solution. In total 6 points are prepared to fit the curve, which is calibrated with R^2 > 0.999. • Samples were diluted in 5% HNO_3 solution to fit in the calibration range for the instrument. • Internal standard is run together with samples and adjusts the samples ICP results according to the internal standard. • Every 30 samples run in the ICP-OES, quality control samples are run, which are within +/- 5%. • The raw ICP data was normalized for variations in sodium content, which helps minimize error associate with dilution.
Verification of sampling and assaying	• *The verification of significant intersections by either independent or alternative company personnel.* • *The use of twinned holes.* • *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* • *Discuss any adjustment to assay data.*	• No drilling results are being reported. Verification of significant intersections and the use of twinned holes are not applicable to the bench-scale metallurgical test work disclosed in this announcement. • Primary run data, feed compositions, flow rates, temperatures, and rare earth concentrations in the loading effluent and stripping eluate were generated and recorded by UQ's Hydrometallurgy Research Group under the Phase 1 Research Program, and reviewed by Professor James Vaughan, the Competent Person, prior to inclusion in this announcement. • No adjustments have been made to the

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		assay data presented in this announcement other than normalisation of raw ICP data for sodium content.
Location of data points	• *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* • *Specification of the grid system used.* • *Quality and adequacy of topographic control.*	• No applicable to reporting of bench-scale metallurgical test-work of synthetic REE liquor.
Data spacing and distribution	• *Data spacing for reporting of Exploration Results.* • *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* • *Whether sample compositing has been applied.*	• Not applicable. The Phase 1 Research Program test work is metallurgical bench-scale ion-exchange testing on liquor feedstocks (the Mary Kathleen baseline liquor and synthetic mixed/heavy rare earth solutions), not spatially distributed exploration sampling, so data spacing, grade continuity and compositing concepts do not apply.
Orientation of data in relation to geological structure	• *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* • *If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	• Not applicable. No samples were collected from drill holes.
Sample security	• *The measures taken to ensure sample security.*	• Mary Kathleen Tailings are stored in a designated certified radionuclide storage room at UQ's Hydrometallurgy laboratory.
Audits or reviews	• *The results of any audits or reviews of sampling techniques and data.*	• No audits or reviews are currently being performed.

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Section 2 Reporting Exploration Results
(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
Mineral tenement and land tenure status	• *Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* • *The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area.*	• Not applicable.
Exploration done by other parties	• *Acknowledgment and appraisal of exploration by other parties.*	• No previous work was conducted on Mary Kathleen tailings for the purposes of rare earth hydrometallurgical testwork using resin-ion exchange.
Geology	• *Deposit type, geological setting and style of mineralisation.*	• Not applicable. This announcement reports metallurgical bench-scale test work on rare earth liquor derived from Mary Kathleen tailings, spiked with yttrium, samarium and gadolinium for Runs 2 to 5, and on synthetic rare earth solutions for Runs 6 to 9. This is not a geological resource or deposit disclosure.

Drill hole Information	• *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:*
	  ○ *easting and northing of the drill hole collar*
	  ○ *elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar*
	  ○ *dip and azimuth of the hole*
	  ○ *down hole length and interception depth*
	  ○ *hole length.*
	• *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.*
		• No drilling results are being reported.

Data aggregation methods	• *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.* • *Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.* • *The assumptions used for any reporting of metal equivalent values should be clearly stated.*	• No aggregation or cut-offs applied.

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Criteria	JORC Code explanation	Commentary
Relationship between mineralisation widths and intercept lengths	• *These relationships are particularly important in the reporting of Exploration Results.* • *If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.* • *If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').*	• No drilling results are being reported.
Diagrams	• *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views.*	• No maps and sections were included in the announcement as it relates to laboratory results.
Balanced reporting	• *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.*	• The announcement reports yttrium purity upgrade factors for Runs 2 to 8, including results where yttrium was depleted rather than enriched (upgrade factor below 1.0), and corrects a previously reported yttrium concentration figure.
Other substantive exploration data	• *Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations, geophysical survey results, geochemical survey results, bulk samples – size and method of treatment, metallurgical test results, bulk density, groundwater, geotechnical and rock characteristics, potential deleterious or contaminating substances.*	• The metallurgical results for the test work are disclosed in the body of this announcement and in Appendices A and B.
Further work	• *The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or large-scale step-out drilling).* • *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.*	• The Company plans to test commercially relevant feed solutions, evaluate resin performance over multiple loading and stripping cycles, and develop a process flowsheet, mass balance and operating cost model to assess a pilot-scale program.

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