

Hydropower Analysis Report



Project name: Teebus Hydropower Scheme

Project number: 2026-01 Limitless

Client: Limitless Hydro

Designer: Marco van Dijk

Date analysed: 2026-09-16 14:20:23

Included sections

1. Site details
2. Hydrology / flow
3. Reservoir levels
4. Hydropower Station
5. Energy assessment

DISCLAIMER

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HYDROPOWER SITE DETAILS

Site / scheme name	: Teebus
Scheme type	: Reservoir release / dam retrofit
Analysis period	: 2000-01-01 to 2026-04-29
Data-quality assessment selected	: Yes
Selected data-quality checks	: Gap detection, Infilling, Consistency checks, Outlier detection
Notes	:

RESULTS

DATA QUALITY ASSESSMENT : Gap detection, Infilling, Consistency checks, Outlier detection

HYDROPOWER FLOW ANALYSIS

Station : Q1H014 - Teebus Canal From Ovis Tunnel @ Brakleegte

Input file : Q1H014_Daily_average_flow.txt

Data type : DA

Analysis period : 2000-01-01 to 2026-04-29

Record used start : 2000-01-01

Record used end : 2026-04-29

Days with valid flow : 9616 Data-quality assessment

Gap detection : 1 missing calendar day(s) within 2000-01-01 to 2026-04-29.

Infilling : short-gap infilling enabled. Missing gaps up to 7 days are linearly interpolated where bracketing values are available; longer gaps remain excluded.

Consistency checks : 0 negative value(s) detected.

Outlier detection : 0 value(s) beyond ± 3 standard deviations.

Infilling : 5 missing day(s) filled by linear interpolation over gaps up to 7 days.

SELECTED DESIGN FLOWS

Q10 : 36.593 m³/s

Q20 : 30.789 m³/s

Q30 : 28.546 m³/s

Q40 : 25.374 m³/s

Q50 : 22.487 m³/s

Q55 : 21.366 m³/s

Q60 : 20.607 m³/s

Q70 : 18.157 m³/s

Q75 : 16.039 m³/s

Q80 : 14.746 m³/s

Q85 : 10.694 m³/s

Q90 : 6.267 m³/s

Q95 : 0.000 m³/s

RESULTS

DATA QUALITY ASSESSMENT : Gap detection, Infilling, Consistency checks, Outlier detection

HYDROPOWER RESERVOIR LEVEL ANALYSIS

Station : D3R002 - Orange River @ Ruigtevallei

Input file : D3R002_Primary_data.txt

Analysis period : 2000-01-01 to 2026-04-29

Record used start : 2000-01-01

Record used end : 2026-04-08

Days with valid reservoir level : 9595

Full supply level : 1258.690 m a.s.l.

Mean reservoir level : 1255.788 m a.s.l.

Tailwater level : 1193.640 m a.s.l.

Minimum generation cutoff level : 1240.000 m a.s.l.

Days below operating/dead-storage : 0 Data-quality assessment cutoff

Gap detection : 49 missing calendar day(s) within 2000-01-01 to 2026-04-08.

Infilling : short-gap infilling enabled. Missing gaps up to 7 days are linearly interpolated where bracketing values are available; longer gaps remain excluded.

Consistency checks : 0 negative value(s) detected.

Outlier detection : 21 value(s) beyond ± 3 standard deviations.

Infilling : 49 missing day(s) filled by linear interpolation over gaps up to 7 days.

WATER-LEVEL DURATION VALUES

Q10 : 1258.616 m a.s.l.

Q20 : 1258.296 m a.s.l.

Q30 : 1257.829 m a.s.l.

Q40 : 1257.356 m a.s.l.

Q50 : 1256.800 m a.s.l.

Q60 : 1256.017 m a.s.l.

Q70 : 1254.875 m a.s.l.

Q80 : 1253.481 m a.s.l.

Q90 : 1250.721 m a.s.l.

Q95 : 1249.309 m a.s.l.

RESULTS

DATA QUALITY ASSESSMENT : Gap detection, Infilling, Consistency checks, Outlier detection

HYDROPOWER STATION PARAMETERS

Water density	: 1000.0 kg/m ³
Gravity	: 9.810 m/s ²
Number of penstocks	: 1
Penstock diameter option	: Fixed diameter
Fixed penstock diameter	: 5.334 m
Preferred penstock velocity	: 2.0 m/s
Penstock length	: 75395 m
Penstock roughness	: 0.0012 m
Secondary loss coefficient	: 9.5
Tailrace diameter	: 5.334 m
Tailrace length	: 7088 m
Tailrace loss coefficient	: 1.5
Number of turbines	: 4
Turbine efficiency	: 88.0%
Generator efficiency	: 96.0%
System efficiency	: 84.5%
Minimum operating flow	: 20% of turbine design flow

HYDROPOWER ENERGY ASSESSMENT

Hydrology flow record available : 2000-01-01 to 2026-04-29

Reservoir level record available : 2000-01-01 to 2026-04-08

Selected analysis period : 2000-01-01 to 2026-04-29

Analysis period days : 9616

Common flow/head usable days : 9595

Complete matched data : 99.78%

Flow short-gap infilled days : 5

Reservoir level short-gap infilled days : 49

Availability / maintenance factor : 92.6%

Highest annual energy option : Q20 (65374.4 MWh/a)

ENERGY ASSESSMENT RESULTS

Option	Qd	Installed	Average	Annual energy	Capacity factor	P90	P95
(-)	(m ³ /s)	(kW)	(kW)	(MWh/a)	(%)	(kW)	(kW)
Q10	36.593	11324.9	7939.8	64449.8	70.1	3309.8	0.0
Q20	30.789	11575.9	8053.7	65374.4	69.6	3309.8	0.0
Q30	28.546	11472.0	8053.6	65373.8	70.2	3309.8	0.0
Q40	25.374	11042.4	7956.8	64587.7	72.1	3309.8	0.0
Q50	22.487	10391.6	7723.3	62692.3	74.3	3309.8	0.0
Q55	21.366	10078.4	7588.8	61600.3	75.3	3309.8	0.0
Q60	20.607	9848.5	7478.2	60702.7	75.9	3309.8	0.0
Q70	18.157	9014.3	7012.6	56923.2	77.8	3309.8	0.0
Q75	16.039	8189.8	6491.1	52690.2	79.3	3309.8	0.0
Q80	14.746	7644.5	6115.0	49637.2	80.0	3309.8	0.0
Q85	10.694	5790.9	4722.4	38332.9	81.5	3309.8	0.0
Q90	6.267	3486.4	2893.9	23490.4	83.0	2731.3	0.0
Q95	0.000	0.0	0.0	0.0	0.0	0.0	0.0

STOCHASTIC PAIRED ENERGY ASSESSMENT

Method : Complete-year paired bootstrap

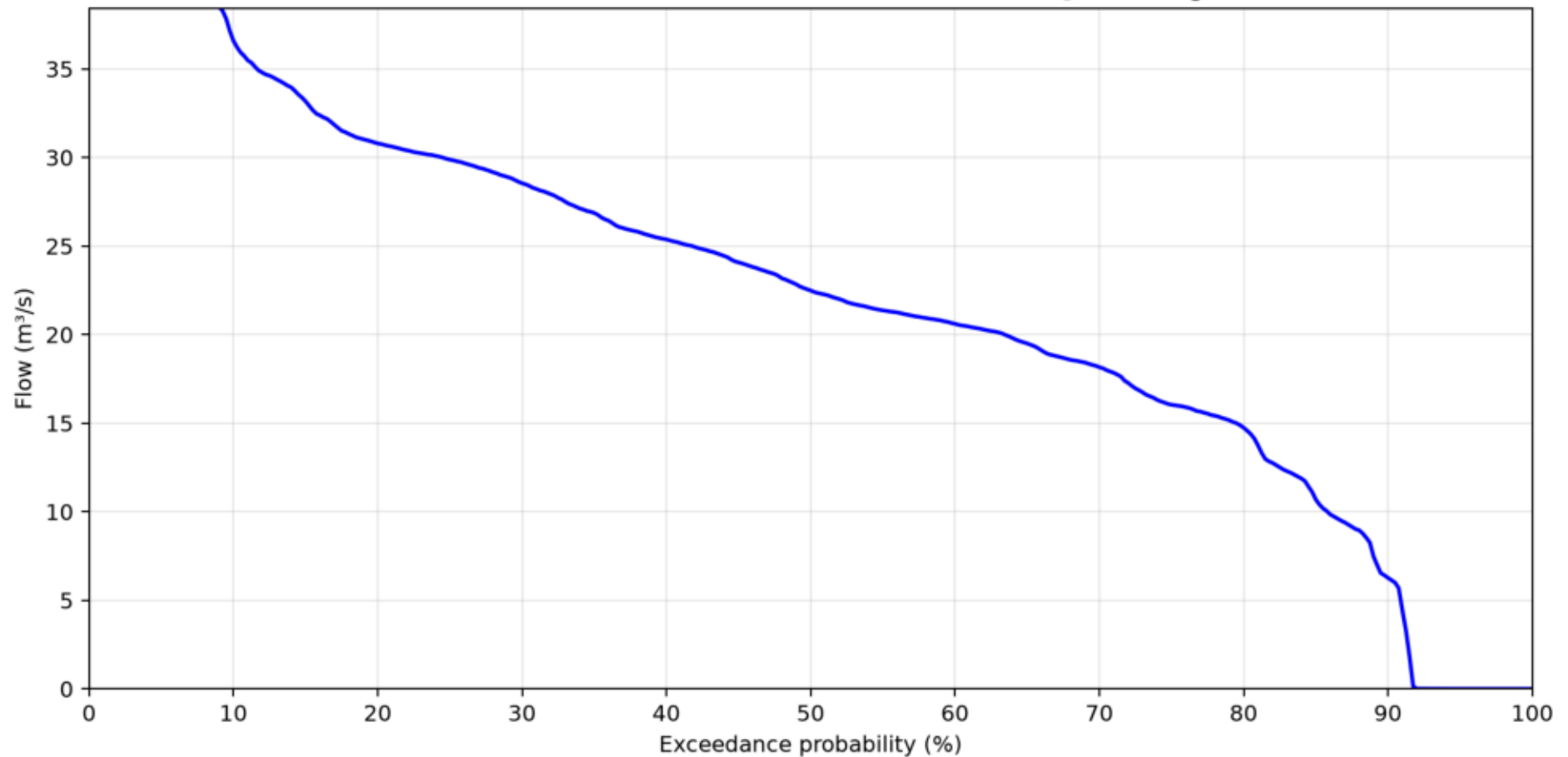
Synthetic sequences : 20

Sequence length : 25 years

Random seed : not specified

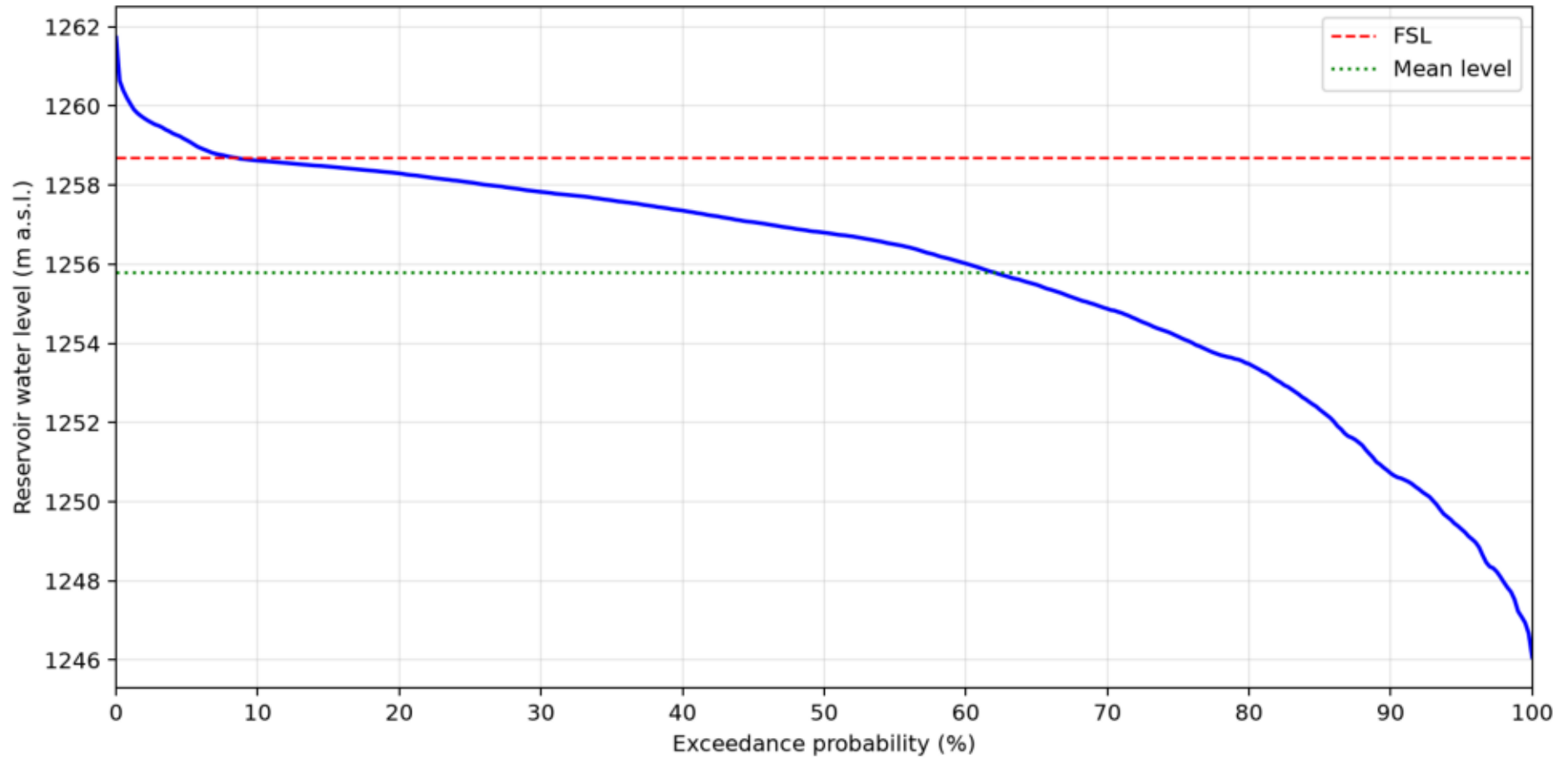
Option	Minimum	P05	Median	Mean	P95	Maximum
(-)	(MWh/a)	(MWh/a)	(MWh/a)	(MWh/a)	(MWh/a)	(MWh/a)
Q10	56576.5	59675.6	62308.1	62273.9	65586.5	65819.3
Q20	57205.4	60393.3	63216.3	63132.6	66513.9	66796.8
Q30	57168.7	60371.9	63205.1	63125.9	66516.9	66796.0
Q40	56537.6	59735.1	62401.6	62375.0	65646.7	66001.3
Q50	55074.9	58216.4	60536.1	60580.6	63589.7	64034.6
Q55	54256.3	57336.8	59483.0	59551.2	62400.9	62898.3
Q60	53594.7	56567.2	58605.7	58703.8	61400.6	61966.9
Q70	50610.0	53264.8	54936.2	55113.8	57326.5	58020.5
Q75	47249.4	49507.2	50996.3	51080.3	52847.8	53558.8
Q80	44737.8	46715.8	48088.7	48144.3	49632.2	50335.5
Q85	35197.7	36258.8	37224.4	37240.1	38269.7	38539.5
Q90	21993.2	22266.9	22859.6	22846.7	23416.8	23440.8
Q95	0.0	0.0	0.0	0.0	0.0	0.0

Hydropower Flow Duration Curve
Station: Q1H014 - Teebus Canal From Ovis Tunnel @ Brakleegte

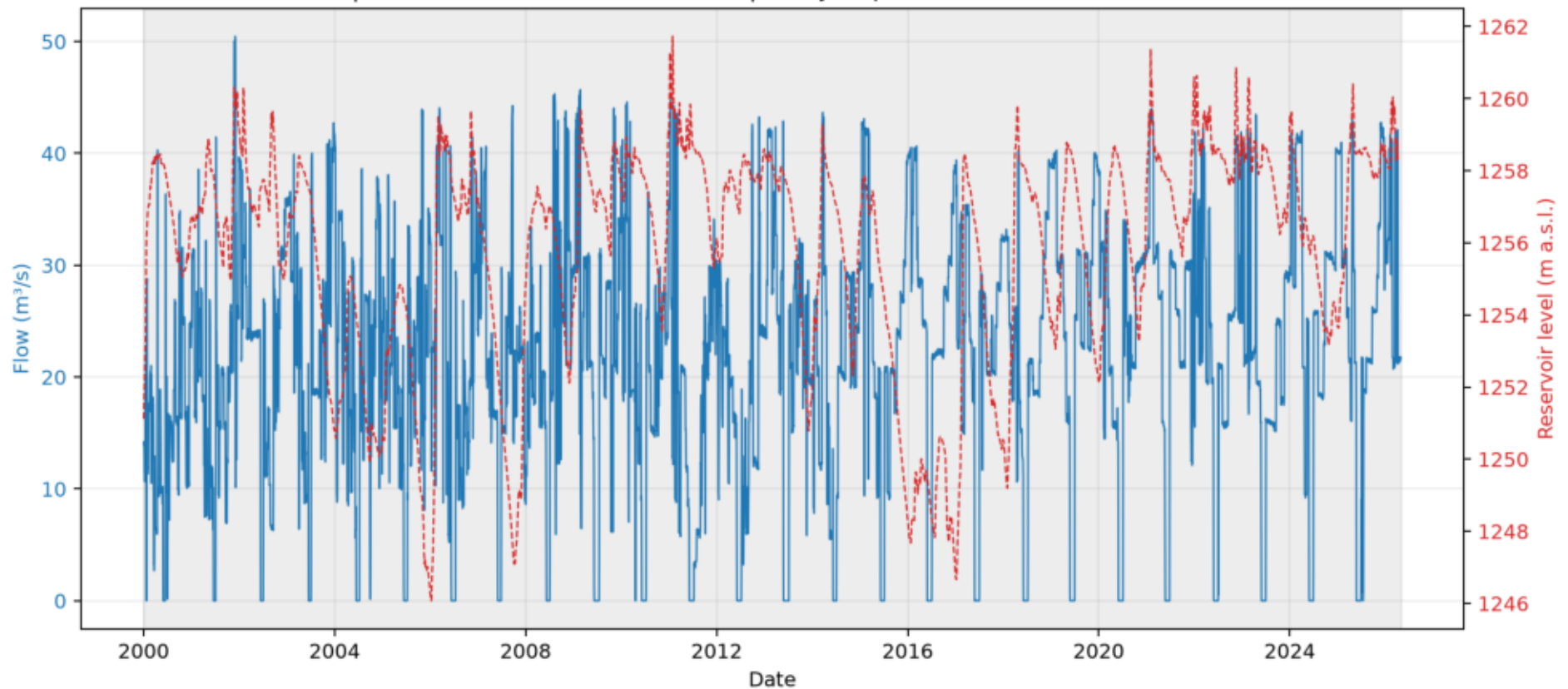


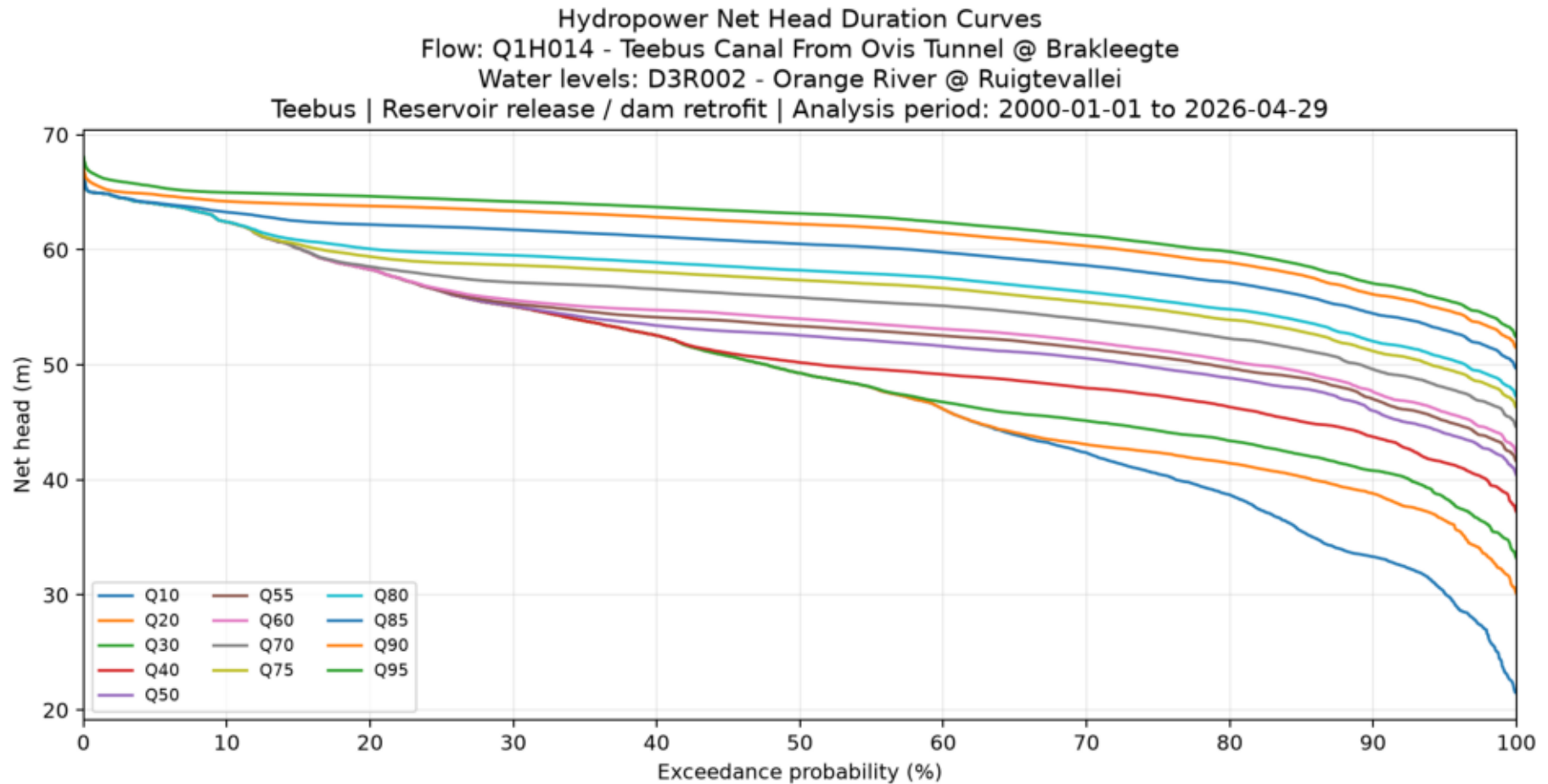
Reservoir Levels

Hydropower Reservoir Water Level Duration Curve
Station: D3R002 - Orange River @ Ruigtevallei



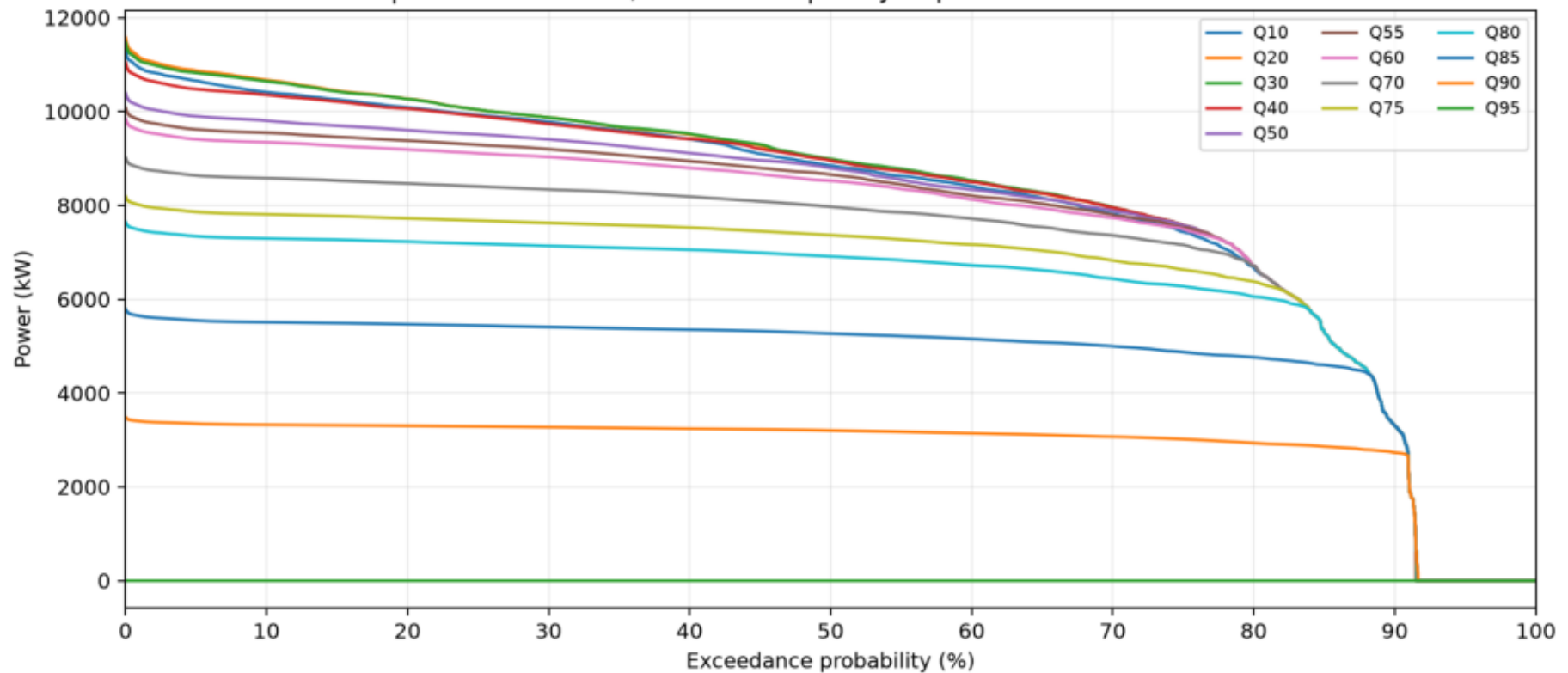
Hydropower Input Records and Analysis Period
Teebus | Reservoir release / dam retrofit | Analysis period: 2000-01-01 to 2026-04-29



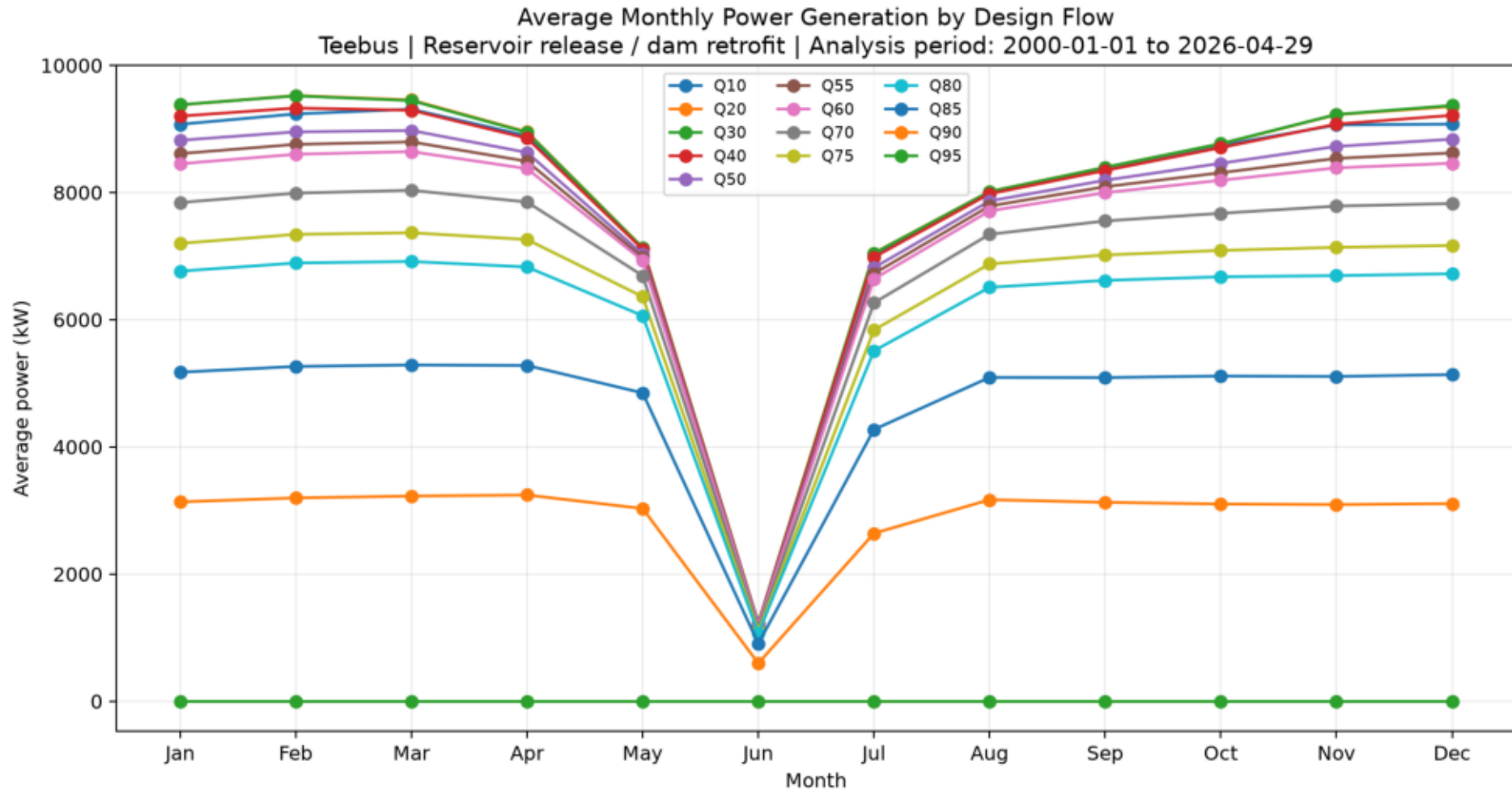


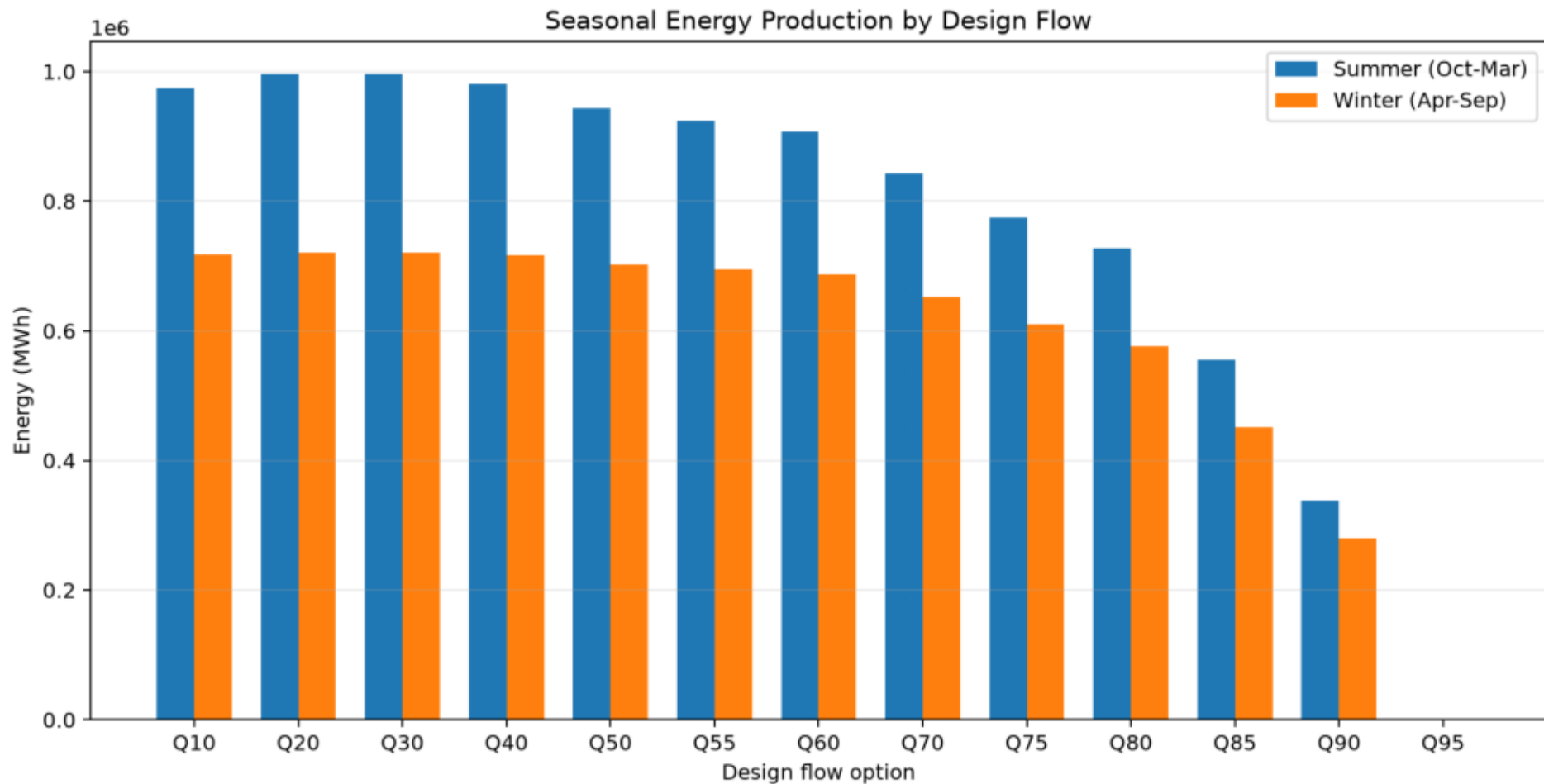
Qx represents the flow equalled or exceeded x% of the time.

Hydropower Power Duration Curves
Flow: Q1H014 - Teebus Canal From Ovis Tunnel @ Brakleegte
Water levels: D3R002 - Orange River @ Ruigtevallei
Teebus | Reservoir release / dam retrofit | Analysis period: 2000-01-01 to 2026-04-29

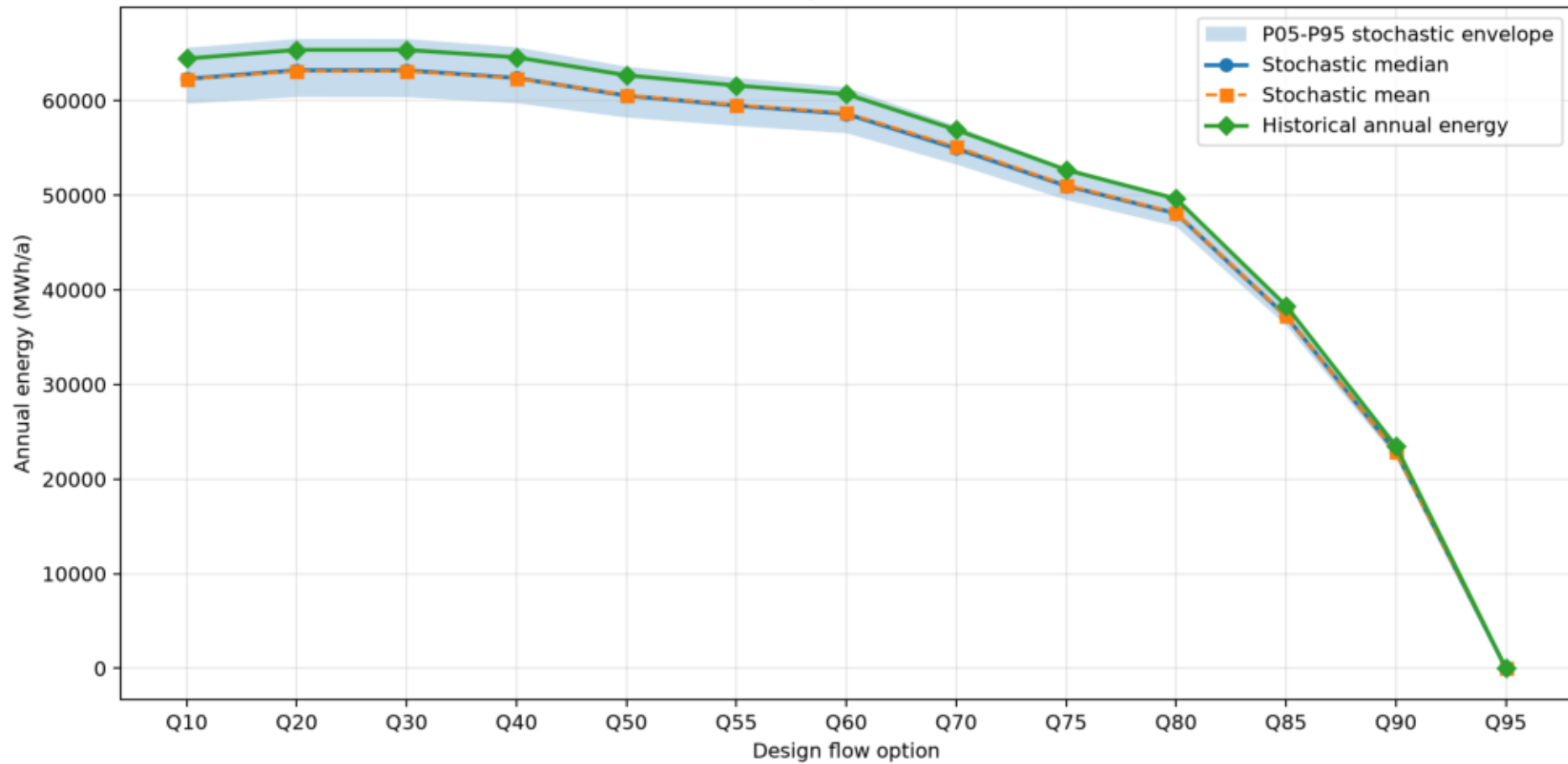


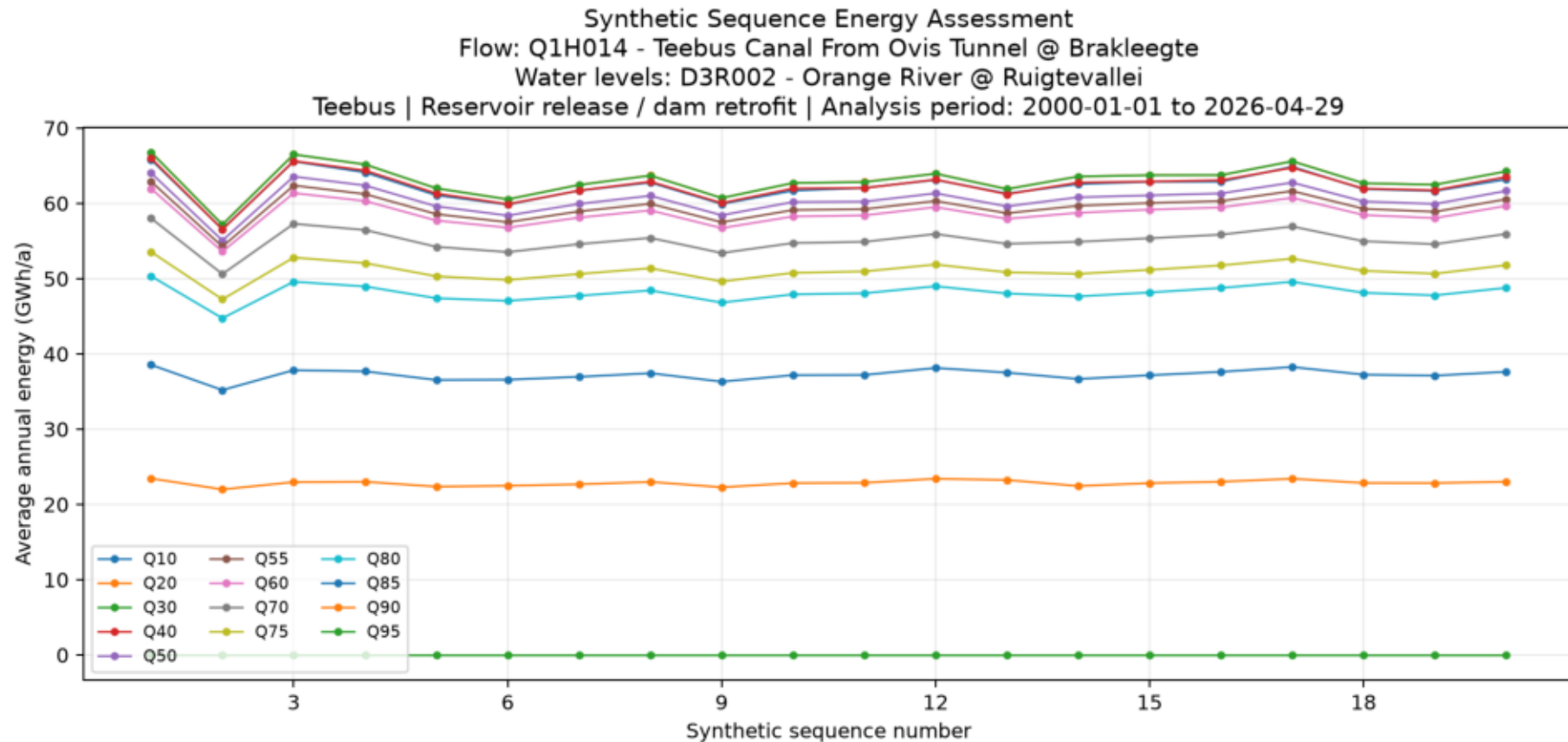
Px represents the power equalled or exceeded x% of the time.





Paired Stochastic Hydropower Energy Assessment
Q1H014





Method: Complete-year paired bootstrap | Synthetic sequences: 20 | Sequence length: 25 years | Random seed: not specified
Paired flow and reservoir-level observations are resampled together.

