TECHNICAL NOTE

DATE:	06 September 2023	**CONFIDENTIALITY:**	Confidential
SUBJECT:	Ammoniacal Nitrogen Trend Analysis		
PROJECT:	Nantycaws Landfill Site	**AUTHOR:**	Eileen Villaseñor / Melanie Wray
CHECKED:	Melanie Wray	**APPROVED:**	Mark Durham

INTRODUCTION

A Compliance Assessment Report Notice (CAR Notice NRW0041991) has been issued to CWM Environmental Ltd for their Nantycaws Landfill site in relation to control level breaches of Ammoniacal Nitrogen as N (NH3-N). The CAR Notice was the result of an assessment of the Q1 2023 (January to March) monitoring results and compliance notifications. A Schedule 6 Notification was submitted to Natural Resource Wales (NRW) on 14 February 2023 specifying an NH3-N result at monitoring point SW205 on 11 January 2023 as 4.06 mg/l. This result was an exceedance of the permitted emission limit of 1 mg/l and represents a non-compliance for the site.

This report reviews NH3-N concentrations at compliance monitoring points specified within permit EPR CP3735PB V004 to identify any trends in NH3-N concentrations and satisfy the requirements of the CAR Notice NRW0041991. Recommendations will also be provided for the ongoing 2023 monitoring programme.

SITE DESCRIPTION

Nantycaws Landfill site is situated approximately 8.0 km east of Carmarthen and 1.5 km south-east of Nantycaws. It is operated by CWM Environmental Ltd and only accepts non-hazardous waste. The site was developed in a northerly direction and comprises seven leachate cells (Figure 1) and has the following monitoring infrastructure as a requirement of permit EPR CP3735PB V004.

- 16 combined groundwater and gas monitoring boreholes
- 2 groundwater monitoring boreholes
- 5 under-drainage (UD) monitoring points
- 10 gas monitoring wells
- 6 leachate monitoring points
- 7 surface water monitoring locations

Compliance monitoring is based on “monthly” and “quarterly” monitoring suites that have been agreed with NRW and includes the analysis of NH3-N which has the following trigger levels (or compliance limits) under permit EPR CP3735PB V004 (Table 1).

Table 1 Compliance monitoring locations, frequencies, sources and NH3-N compliance limits

Monitoring Location	Monitoring Frequency	Source	NH3-N Compliance Limit (mg/l)
NACW227	Monthly / Quarterly	Groundwater	5.5
NACW228	Monthly / Quarterly	Groundwater	5.5
NACW212	Monthly / Quarterly	Groundwater	5.5
NACW203	Monthly / Quarterly	Groundwater	5.5

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Monitoring Location	Monitoring Frequency	Source	NH3-N Compliance Limit (mg/l)
BH3/4	Monthly / Quarterly	Groundwater	5.5
BH5/02	Monthly / Quarterly	Groundwater	5.5
BH208	Monthly / Quarterly	Groundwater	5.5
UD1	Monthly / Quarterly	Groundwater	5.5
UD2	Monthly / Quarterly	Groundwater	5.5
UD3	Monthly / Quarterly	Groundwater	5.5
UD4	Monthly / Quarterly	Groundwater	5.5
Leachate Holding Lagoon	Monthly	Leachate	3,640
Cell 1/2 Sump	Monthly / Quarterly	Leachate	3,640
Cell 3/4 Sump	Monthly / Quarterly	Leachate	3,640
Cell 5 Sump	Monthly / Quarterly	Leachate	3,640
Cell 6 Sump	Monthly / Quarterly	Leachate	3,640
Cell 7 Sump	Monthly / Quarterly	Leachate	3,640
SW205	Monthly / Quarterly	Surface Water	1.0
SW206	Monthly / Quarterly	Surface Water	1.0
NACW219	Quarterly	Groundwater	5.5
NACW229	Quarterly	Groundwater	5.5
BH3/2	Quarterly	Groundwater	5.5
BH3/3	Quarterly	Groundwater	5.5
BH3/5	Quarterly	Groundwater	5.5
BH3/6	Quarterly	Groundwater	5.5
BH3/8	Quarterly	Groundwater	5.5
BH3/9	Quarterly	Groundwater	5.5

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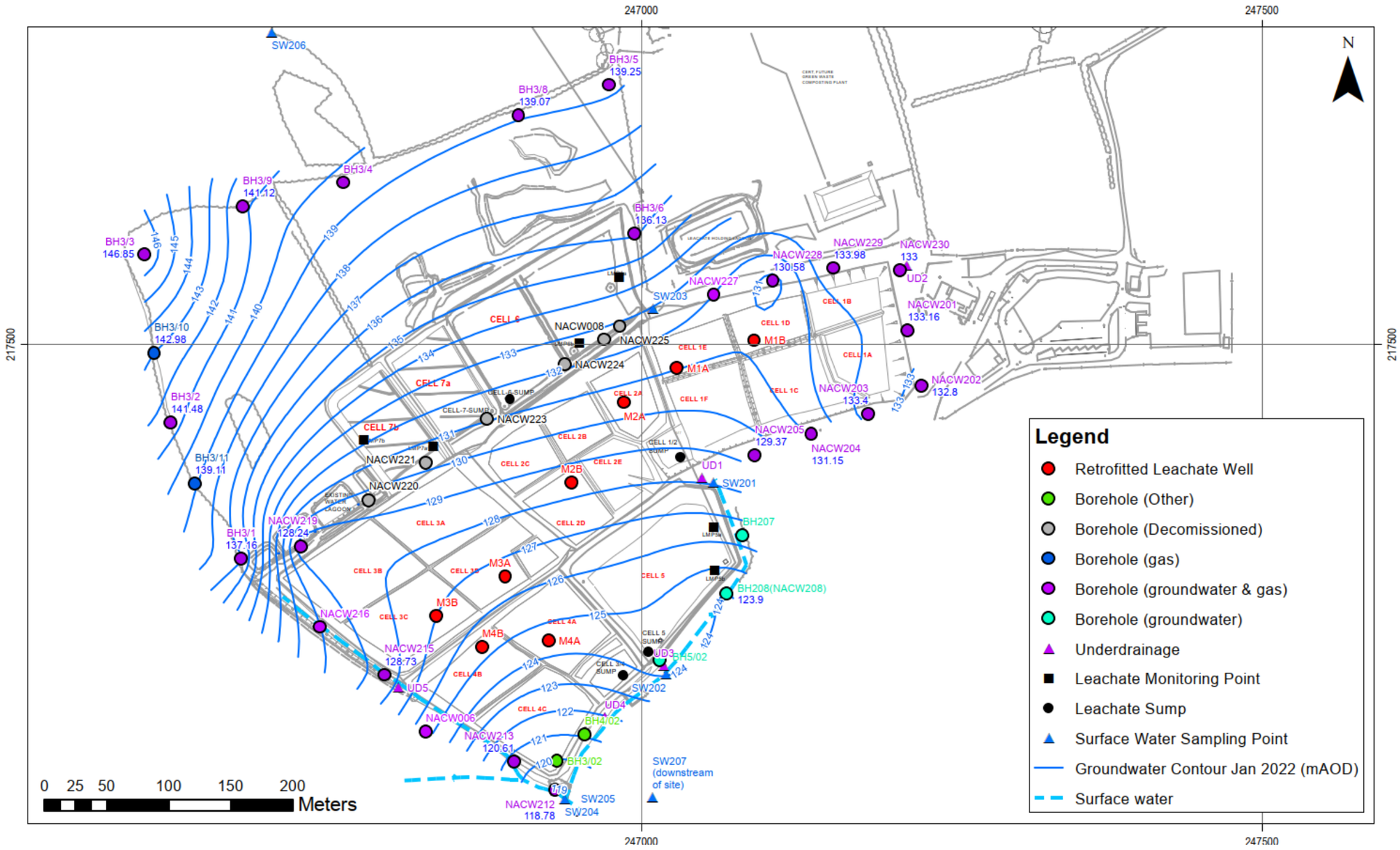
Figure 1 Nantycaws monitoring network – groundwater contours (mAOD) based on recorded groundwater levels from January 2022 monitoring programme.



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CONSULTATION

A summary of consultation to date with statutory and non-statutory bodies, and the data provided by each to supplement this report is provided below. A 2.5 km radial buffer was applied to the central most part of the landfill site (NGR SN 46903 17474) to define a groundwater catchment and any groundwater monitoring (level and quality) observation boreholes that are present in the area. The data request submitted in March 2023 to NRW is still considered appropriate for the purpose of this report.

NRW – via email 08 March 2023

A query was submitted to the Data Distribution team within NRW for groundwater level and groundwater quality data within a 2.5 km radius of the site in March 2023 following receipt of a CAR Notice for completing mecoprop trend analysis. Rain gauge data for the Llangenderine Rain gauge at NGR SN 45396 13553 and approximately 4 km south-west of the site was provided. Rainfall data was received 03/04/2023 and NRW confirmed that no groundwater level data was available within the specified search radius.

CWM Environmental (Landfill Operator) – via email 22 August 2023

WSP requested additional information on maintenance schedules and site restorations over the past 5 years. The following queries and answers (bold) were provided:

1 Can you provide site maintenance schedules including fertilizing/herbicide over the past 5 years? Any products used with high nitrate / nitrite content?

We (CWM) applied herbicide glyphosate (360 g/l) to a field in the northern end of the site in April 2022 and April 2023 – they are the only occasions since I (CWM representative) have been in position that they have been used.

2 Any locations on site that may have been used to store herbicides/pesticides that include nitrates/nitrites?

Herbicides have only been stored onsite for the last 12 months, prior to that there was no one on site qualified to handle them so we were not permitted to store. Storage is 1x5L container of glyphosate based weedkiller in a bunded coshh cupboard.

3 Surface water capture / runoff across the site?

All site surface water is directed to a surface water lagoon/settlement pond at the southern boundary of the site.

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STATISTICAL TREND ANALYSIS

ProUCL is a comprehensive statistical software package initially developed by the United States Environment Protection Agency (EPA). The software provides numerous statistical methods and graphical tools for the analysis of environmental datasets. ProUCL, using the Mann-Kendall (M-K) statistical test, has been used to identify trends in NH3-N concentrations at Nantycaws for groundwater, surface water, and leachate monitoring locations under the current permit (EPR CP3735PB V004, Table 1) between 2009 and 2023. The results of the analysis are provided in Appendix B. It should be noted that the M-K analysis includes results in 2023 only up to the month of June. It is expected that the full 2023 dataset will be screened accordingly in the quarterly and annual reports submitted to NRW.

The M-K trend analysis detects the presence of a monotonic tendency in a chronological series of a variable (NH3-N in this case). A monotonic trend identifies a variable that consistently increases (or decreases) through time but the trend may or may not be linear. It is used to assess whether a set of data values is increasing over time (positive trend) or decreasing over time (negative trend) and whether the trend in either direction is statistically significant. It is a nonparametric test which means it works for all distributions and it makes no assumption(s) about the underlying distribution of the data i.e., the data does not need to meet the assumption of normality. The level of significance represents the threshold for which the hypothesis that there is no trend is accepted. Therefore, the trend is statistically significant when the p-value is less than 0.05.

M-K TREND ANALYSIS RESULTS

The results of the M-K trend analysis, for compliance monitoring locations listed in Table 1, using the ProUCL software are summarised in Table 2 and Appendix B. The following summary should also be considered:

- NACW227 and UD2 were predominantly dry and NH3-N results of analysis are limited over the duration of the monitoring programme (2009 – 2023). No M-K trend can be identified for NACW227 and UD2.
- Insufficient evidence was available to obtain a trend for Cell 1/2 Sump, Cell 7 Sump, and BH3/8. NH3-N concentrations for these sites remained relatively consistent throughout the monitoring programme i.e., just above the laboratory limit of detection of <0.3 mg/l (2009 – 2010) and <0.2 mg/l (2010 – 2023). No breaches in the compliance limit occurred at these sites between January 2009 and June 2023.
- An increasing trend in NH3-N concentration was observed at UD4 and the Leachate Holding Lagoon. However, no breaches in the compliance limit occurred between January 2009 and June 2023.
- A decreasing trend was observed at several sites. A manual screen of the data indicates that the trend observed at 13 sites is due to the decrease in the limit of detection (LOD) concentration that occurred in 2010, which skews the data. However, the manual data screen indicates that the concentration remained relatively constant between 2009 and 2023 and therefore, no major increasing or decreasing trend is observed.
- For compliance monitoring locations where NH3-N concentrations have remained stable/consistent (i.e., results of analysis at laboratory limit of detection <0.3 mg/l and <0.2 mg/l) over the duration of the monitoring programme (2009 – 2023), no obvious increasing/decreasing trend has been identified.

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Table 2 Summary of M-K trend analysis for compliance monitoring locations at Nantycaws Landfill site

Monitoring Location	M-K Trend (ProUCL)	Approx p-value	Comments
NACW227	No trend generated*	0.2180	A minimum of 4 reported values are required to undertake an M-K trend analysis. Although there are 10 results for NACW227, 9 of the 10 are reporting the Limit of Detection (LOD) value as <0.2 mg/l and <0.16 mg/l and therefore, no trend analysis has been undertaken for NACW227. The sample location is frequently identified as dry and the result of analysis for March 2023 records a concentration of 1.98 mg/l and is below the Compliance Limit (CL) for this location.
NACW228	Decreasing trend**	0.0228	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. A manual screen of the data identified that this site breached the CL for NH3-N on two occasions (8.55 mg/l in December 2010 and 6.55 mg/l in July 2022). The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
NACW212	Decreasing trend**	0.0111	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
NACW203	Decreasing trend**	0.0035	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. On 4 occasions (March 2015, April 2017, July 2017 and October 2017) NH3-N was recorded at 2.16 mg/l and in December 2016 recorded at 3.35 mg/l. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
BH3/4	Decreasing trend	3.3720×10^{-4}	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD does not massively skew the trend analysis and concentrations are slightly higher from 2009-2017 compared to those from 2017-2023. A decreasing trend is observed in the manual data screen.
BH5/02	Decreasing trend**	0.0014	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
BH208	Decreasing trend**	0.0142	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
UD1	Decreasing trend	0.0027	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. A manual screen of the data identified that this site breached the CL for NH3-N on one occasion (9.19 mg/l in February 2019). The manual data screen indicates that the decrease in the LOD does not particularly skew the trend analysis and there are more data points above the LOD from 2009-2014 compared to the period between 2014 and 2023. An overall decreasing trend is observed in the manual data screen for UD1.

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Monitoring Location	M-K Trend (ProUCL)	Approx p-value	Comments
UD2	No trend generated*	0.1487	Insufficient evidence is available to identify a significant trend at the specified level of significance. The LOD decreased from <0.3 mg/l to <0.2 mg/l in July 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. In March 2019 a concentration of 5.3 mg/l was recorded however, the manual data screen indicates that concentrations remained relatively constant throughout the monitoring period (2009-2023). UD2 has frequently been recorded as dry throughout the monitoring period.
UD3	Decreasing trend**	0.0248	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
UD4	Increasing trend	0.0462	The analysis implies an increasing trend in NH3-N concentration. The LOD decreased from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme; however, the manual data screen indicates that this does not have an impact on the trend. No breaches in CL occurred between January 2009 and June 2023. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and in January 2014 a concentration of 4.6 mg/l was recorded. .
Leachate Holding Lagoon (LHL)	Increasing trend	6.773×10^{-10}	The analysis implies an increasing trend in NH3-N concentration. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that an increasing trend is observed with most of the data below 1,140 mg/l prior to June 2017 and the majority of the data slightly above this after June 2017. February 2021 recorded a concentration of 2,460 mg/l.
Cell 1/2 Sump	No trend generated*	0.2060	Insufficient evidence is available to identify a significant trend at the specified level of significance. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that concentrations remained relatively constant throughout the monitoring period (2009-2023).
Cell 3/4 Sump	Decreasing trend	8.460×10^{-16}	The analysis implies a decreasing trend in NH3-N concentration. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that a decreasing trend is observed throughout the monitoring period (2009-2023).
Cell 5 Sump	Decreasing trend	0.0131	The analysis implies a decreasing trend in NH3-N concentration. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that a decreasing trend is generally observed throughout the monitoring period (2009-2023). The concentrations after 2015 are generally lower with a couple of outliers in 2017 (April, July and October) and 2018 (January, April and July) recording a concentration of 2,454 mg/l.
Cell 6 Sump	Decreasing trend	6.1774×10^{-5}	The analysis implies a decreasing trend in NH3-N concentration. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that a decreasing trend is observed throughout the monitoring period (2009-2023).
Cell 7 Sump	No trend generated*	0.0741	Insufficient evidence is available to identify a significant trend at the specified level of significance. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that concentrations increased until January 2018 and then decreased between January 2018 and June 2023.
SW205a	Decreasing trend**	0.0113	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. A manual screen of the data identified that this site breached the CL for NH3-N on 9 occasions with values ranging between 1.11 mg/l (July 2012) and 4.06 mg/l (January 2023). The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.

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Monitoring Location	M-K Trend (ProUCL)	Approx p-value	Comments
SW206	Decreasing trend	3.5288×10^{-5}	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. A manual screen of the data identified that this site breached the CL for NH3-N on 3 occasions (1.3 mg/l in January 2010, 2.34 mg/l in October 2011, and 1.43 mg/l in April 2013). The manual data screen indicates that the decrease in the LOD does not particularly skew the trend analysis and there are more data points above the LOD before April 2013 compared to the period between 2013 and 2023. A decreasing trend is observed in the manual data screen.
NACW219	Decreasing trend**	0.0031	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. October 2018 recorded a concentration of 3.08mg/l. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
NACW229	Decreasing trend	0.0025	The analysis implies a decreasing trend in NH3-N concentration; however, this, in part, is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. A manual screen of the data identified that this site breached the CL for NH3-N on 2 occasions (11.6 mg/l in October 2010 and 6.42 mg/l in January 2011). The manual data screen indicates that the decrease in the LOD does not particularly skew the trend analysis and there are more data points above the LOD and CL before April 2011 compared to the period between 2011 and 2023. A decreasing trend is observed in the manual data screen.
BH3/2	Decreasing trend**	0.0074	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
BH3/3	Decreasing trend**	0.0006	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
BH3/5	Decreasing trend**	0.0002	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
BH3/6	Decreasing trend**	0.0046	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.
BH3/8	No trend generated*	0.0990	Insufficient evidence is available to identify a significant trend at the specified level of significance. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that concentrations remained relatively constant throughout the monitoring period (2009-2023). The LOD decreased from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme.

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Monitoring Location	M-K Trend (ProUCL)	Approx p-value	Comments
BH3/9	Decreasing trend**	0.0190	The analysis implies a decreasing trend in NH3-N concentration; however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The LOD has remained at <0.2 mg/l for the remainder of the monitoring programme. No breaches in CL occurred between January 2009 and June 2023. The manual data screen indicates that the decrease in the LOD skews the trend analysis. Concentrations remained relatively constant throughout the monitoring period (2009-2023) and therefore, no major increasing or decreasing trend is observed in the manual data screen.

* Insufficient evidence to suggest trend and no trend generated

** Decreasing trend result skewed by the decrease in the laboratory LOD concentration in May 2010

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Monthly water level data is available for SW205a from 2019 – 2023 and additional interpretation of NH3-N concentrations at the site have been undertaken. SW205a has breached the CL for NH3-N on 9 occasions (Table 2 and Figure 2) however, there is no obvious trend in why breaches in the CL for the site are occurring e.g., breaches occurring during winter/wetter months. The Client has specified that glyphosate was applied to a field in the northern end of the site in April 2022 and April 2023. Glyphosate is thought to bind tightly to soil, and it can persist in soil for up to 6 months depending on the climate and the type of soil[1]. No exceedance of the CL is recognised for either of those months. No CL breach was observed in subsequent months. The concentrations of NH3-N have consistently been below the CL (1.0 mg/l) between 2019 – 2023 with infrequent breaches in the CL occurring at this location.

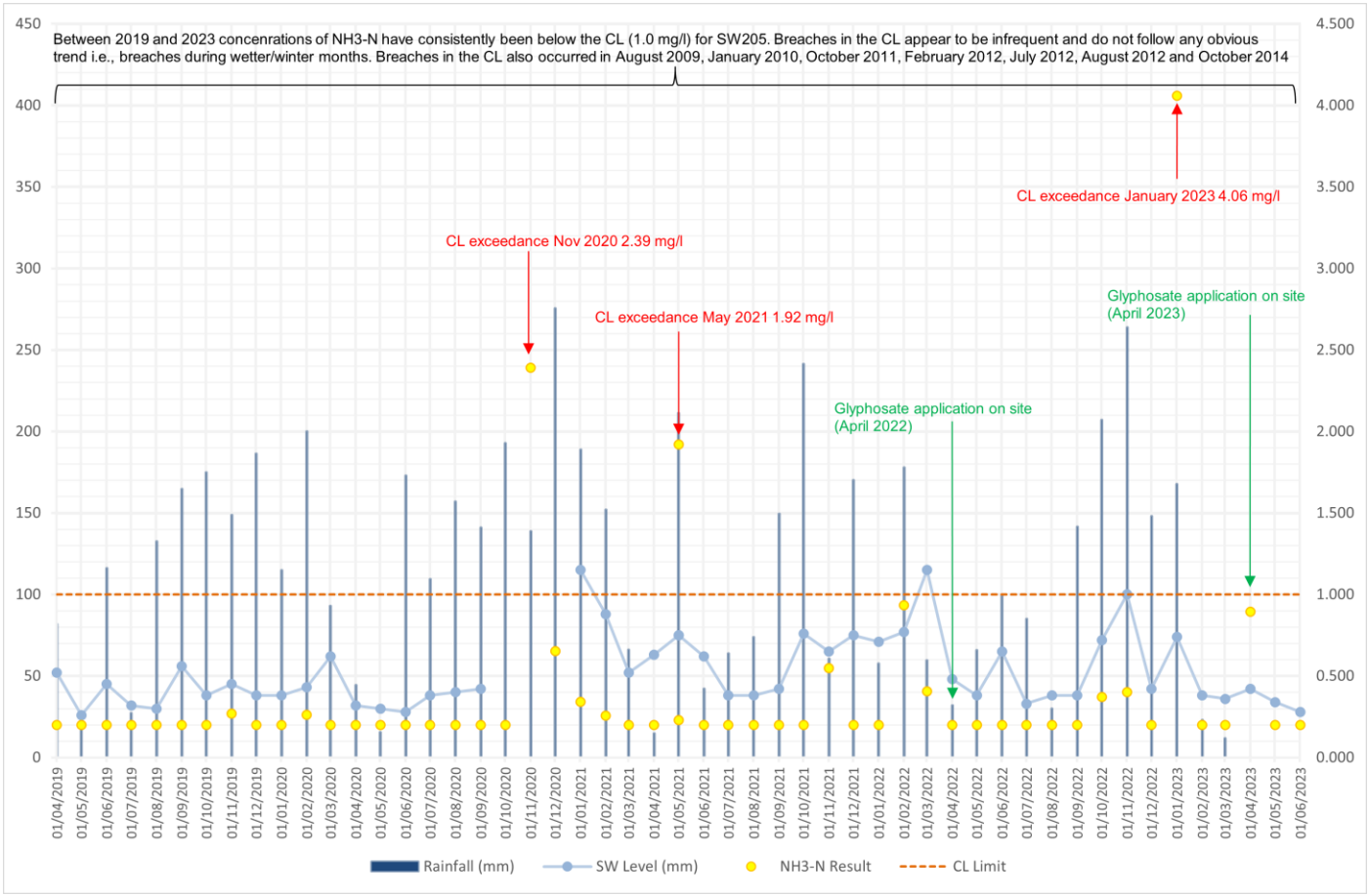

Figure 2 SW205a NH3-N concentrations vs. water level and rainfall (mm)

[1] http://npic.orst.edu/factsheets/glyphogen.html [accessed August 2023]

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CONCLUSIONS AND RECOMMENDATIONS

- The M-K analysis for SW205a implies a decreasing trend in NH3-N concentration however, this is due to the LOD decreasing from <0.3 mg/l to <0.2 mg/l in May 2010. The decrease in LOD skews the trend analysis. A manual screen of the data identified that SW205a breached the CL on 9 occasions.
- Additional interpretation of NH3-N concentrations at SW205a (Figure 2) does not show any obvious trend in CL breach which appear to be infrequent and do not occur at times of wetter/winter months or following application of glyphosate. Ongoing monitoring of NH3-N at SW205a will continue throughout the remainder of the monitoring programme.
- We recommend consultation with surrounding landowners for additional information relating to field spray schedules. This may provide additional clarification on why NH3-N concentrations are exceeding the CL at infrequent times of the year at specific locations.
- NACW227 and UD2 were predominantly dry and NH3-N results of analysis are limited over the duration of the monitoring programme (2009 – 2023). No M-K trend can be identified for NACW227 and UD2.
- The laboratory LOD for NH3-N was decreased from <0.3 mg/l to <0.2 mg/l in May 2010 which has skewed the trend analysis at some locations. For compliance monitoring locations where NH3-N concentrations have remained stable/consistent (i.e., results of analysis at laboratory limit of detection <0.3 mg/l and <0.2 mg/l) over the duration of the monitoring programme (2009 – 2023), no obvious increasing/decreasing trend has been identified (Table 1).

APPENDIX A – NRW CAR NOTICE

Compliance Assessment Report CAR_NRW0041991

Permit being assessed: CP3735PB.

For: Nantycaws Landfill EPR/CP3735PB, **held by:** CWM Environmental Ltd

At: Nantycaws Landfill Site Llanddarog Road , Nantycaws, Carmarthen, Carmarthenshire, SA32 8BG.

Type of assessment: Report/Data Review,

Reason: Routine.

On: 19/06/2023.

Parts of permit assessed: Please see details.

NRW Lead Officer: Michael Launder.

Report sent to: Darren Sanders, Composting Site Manager, on 11/07/2023.

1. Summary of our findings (full details in section 4)

Part of permitted activity assessed (compliance criteria)	Assessment result	Permit condition
IR3A - Emissions and monitoring - Emissions to water, air or land	C3 Minor	3.2 Emissions to groundwater
IR3A - Emissions and monitoring - Emissions to water, air or land	C3 Minor	3.2 Emissions to water, air or land

Result types are explained in more detail in the 'Important Information' section below.

Total non-compliances recorded	Total non-compliance score
2	8

How we use the non-compliance score to calculate your annual fee is explained in the 'Important Information' section below.

2. What action is required?

Criteria	Action needed	Complete by
IR3A	Operator to continue review of mecoprop trends across site monitoring network and submit to NRW.	Already completed
IR3A	Operator to provide review of ammoniacal nitrogen trends across site monitoring network and submit to NRW.	31/08/2023

Compliance criteria codes are listed in the 'Important information' section below.

3. What will happen next?

Any non-compliance we have identified and recorded on this form is an offence. It can result in criminal prosecution and/or suspension or revocation of your permit.

At this time, we do not intend to take any further action.

This statement does not stop us from taking additional enforcement action if further relevant information comes to light or offences continue.

4. Details of our assessment

The purpose of this Compliance Assessment Report (CAR) is an assessment of the Q1 2023 monitoring results and compliance notifications.

The quarterly monitoring data data specified in condition 3.6.1 Reporting was received from the operator.

Schedule 6 Notifications - Groundwater - Q1 January to March 2023

- A Schedule 6 notification submitted to NRW on 14 February 2023 gives the measured mecoprop result at monitoring point UD1 on 11 January 2023 as 0.0731 µg/l. This is an exceedance of the permitted emission limit of 0.000055 µg/l and represents a non-compliance with the environmental permit.
- A Schedule 6 notification submitted to NRW on 14 February 2023 gives the measured mecoprop result at monitoring point UD4 on 11 January 2023 as 0.0688 µg/l. This is an exceedance of the permitted emission limit of 0.000055 µg/l and represents a non-compliance with the environmental permit.
- A Schedule 6 notification submitted to NRW on 14 February 2023 gives the measured mecoprop result at monitoring point NACW203 on 12 January 2023 as 0.114 µg/l. This is an exceedance of the permitted emission limit of 0.000055 µg/l and represents a non-compliance with the environmental permit.
- A Schedule 6 notification submitted to NRW on 14 February 2023 gives the measured mecoprop result at monitoring point BH3/5 on 13 February 2023 as 0.0638 µg/l.

Compliance: The above results are in exceedance of the emission limits set in the permit for UD1, UD4 and NACW203. A non-compliance score of C3 against sub criteria E2 has been allocated to these breaches over the Q1 January to March reporting period.

In accordance with NRW's non-compliance scoring guidance, the non-compliance scores for the groundwater breaches during Quarter 1 2022 reporting period have been consolidated into one non-compliance score.

BH3/5 does not have an emission limit for mecoprop and a Schedule 6 notification was not required for this result, however the detection of mecoprop in this upgradient well does provide useful context for consideration in the ongoing monitoring exercise to determine the source of downgradient exceedances.

Since the issue of the most recent permit variation (CP3735PB/V004) in 2009, the list of hazardous substances has been updated, and mecoprop removed from the list. The operator may wish to initiate a variation of the permit to revise the monitoring tables to reflect this change.

Schedule 6 Notifications - Surface Waters

A Schedule 6 notification submitted to NRW on 14 February 2023 gives the measured Ammoniacal Nitrogen results at monitoring point SW205 on 11 January 2023 as 4.06 mg/l. This is an exceedance of the permitted emission limit of 1 mg/l and represents a non-compliance with the environmental permit.

Compliance: The above result is in exceedance of the emission limits set in the permit for SW205. A non-compliance score of C3 against sub criteria E2 has been allocated to this breach over the Q1 January to March reporting period.

Action: Operator to provide review of ammoniacal nitrogen trends across site monitoring network and submit to NRW.

If you have any queries about this report, or to discuss completion of any actions, please contact the NRW Officer named above.

Important information

Legal status of this report

Your permit is issued to you under the Environmental Permitting Regulations. You have a responsibility to comply with the conditions of your permit and prevent pollution/harm of the environment. You must also ensure that you comply with any other relevant legislation that may apply to your site's operations.

This report explains the findings of our assessment and any action you are required to take. We categorise non-compliance using our guidance for assessing non-compliance at regulated sites.

When we find potential non-compliance/s we will normally give you advice on how to maintain compliance.

To correct non-compliance, we may:

- require you to take specific actions
- issue a notice
- review the conditions of your permit.

Any advice and guidance we give will be without prejudice to any other enforcement response that we consider may be required.

Assessment results and non-compliance categories (used in section 1):

Assessment result	Description
Assessed (A)	Assessed or assessed in part, no evidence of non-compliance found
Action only (X)	Action only relating to the activity assessment
Ongoing (O)	Ongoing non-compliance, not scored

Non-compliance category	Description	Score
C1 Major	Potential to have a major, serious, persistent and/or extensive impact or effect on the environment, people and/or property	60
C2 Significant	Potential to have a significant impact or effect on the environment, people and/or property	31
C3 Minor	Potential to have a minor or minimal impact or effect on the environment, people and/or property	4
C4 No environmental impact	Non-compliance at a regulated site that cannot foreseeably have any impact on the environment, people and/or property	0.1

How we use assessment scores

The number and severity of non-compliances recorded in a year will affect your annual subsistence fee the following year. A non-compliance factor is added to your site's Operator

Performance Risk Appraisal (OPRA) score when we calculate your fee to reflect the additional resource we use to assess permit compliance.

If your assessment result in Section 1 is suspended, what does this mean?
In line with our guidance, we may suspend scores for up to six months to allow time for remedial action to be taken. Suspended scores will be re-instated if the action is not completed.

Full list of Industry compliance criteria (used in section 1 and 2):

1. Management
- IR1A – General management
- IR1B – Finance (only applicable to Landfill)
- IR1C – Energy efficiency
- IR1D - Efficient use of raw materials
- IR1E - Avoidance, recovery and disposal of wastes produced by the activities
- IR1F - Multiple operator installations

2. Operations
- IR2A – Permitted activities
- IR2B – The site
- IR2C – Operating techniques
- IR2D – Technical requirements
- IR2E – Improvement programme
- IR2F – Pre-operational conditions
- IR2G – Landfill engineering (only applicable to Landfill)
- IR2H – Waste acceptance (only applicable to Landfill)
- IR2I – Leachate levels (only applicable to Landfill)
- IR2J – Closure and aftercare (only applicable to Landfill)
- IR2K – Landfill gas management (only applicable to Landfill)

3. Emission and Monitoring
- IR3A – Emissions to water, air or land
- IR3B – Emissions of substances not controlled by emission limits
- IR3C – Odour
- IR3D – Noise and vibration
- IR3E – Monitoring
- IR3F – Pests
- IR3G – Air quality management plans
- IR3H – Monitoring for the purposes of the Industrial Emissions Directive (this heading includes Large Combustion Plants)
- IR3I – Fire

4. Information
- IR4A – Records
- IR4B – Reporting
- IR4C – Notification

Enforcement response
Any non-compliance with a permit condition is an offence and we may take legal action against you. Action we take can include prosecution, serving a notice on you and/or

suspension or revocation of your permit. See our Enforcement and Sanctions Guidance for further information.

Data protection notice

You should make sure that anyone named in this report knows that the information it contains will be processed by Natural Resources Wales to fulfil its regulatory and monitoring functions and to maintain the relevant public register(s).

We may also use and/or disclose the report in connection with:

- offering or providing you with our literature or services relating to environmental matters
- consulting with the public, public bodies and other organisations (e.g. Health and Safety Executive, local authorities) on environmental issues
- carrying out statistical analysis, research and development on environmental issues
- providing public register information to enquirers
- investigating possible breaches of environmental law
- assessing customer service satisfaction and improving our service
- Freedom of Information Act or Environmental Information Regulations requests.

We may also pass it on to our agents or representatives to do these things on our behalf.

Disclosure of information – this report will be available to view on-line

If you think this report contains commercially confidential information that should not be placed on our public register, you must contact your local Natural Resources Wales office within **fifteen working days** of receiving this report, using the contact details in the accompanying email or letter. You must give a full explanation of why it should not be added to our public register, including specifying which information is commercially confidential. We will assess your request and respond to you within twenty working days to let you know if we agree to your request.

What do I do if I disagree with the report or have a complaint?

If you disagree with this compliance assessment report, you should contact the lead officer without delay to discuss your concerns.

If you are unable to resolve the issue with the lead officer or their line manager you should contact our Customer Contact team on 0300 065 3000 (Monday to Friday 08:00 to 18:00), or email enquiries@naturalresourceswales.gov.uk for details of how to raise your dispute further through our Complaints and Commendations procedure.

If you are dissatisfied with our response, you can contact the Public Services Ombudsman for Wales by phone on 0300 7900203 or by email at ask@ombudsman.wales

Welsh Language Standards

We are committed to establishing Natural Resources Wales as a naturally bilingual organisation. We will provide compliance reports in your preferred language.

APPENDIX B – MANN KENDALL TREND ANALYSIS

Results

Mann Kendall Trend Graphs

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 12:29:54	
From File	LHL.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

NH3N Result (mg/l)

General Statistics

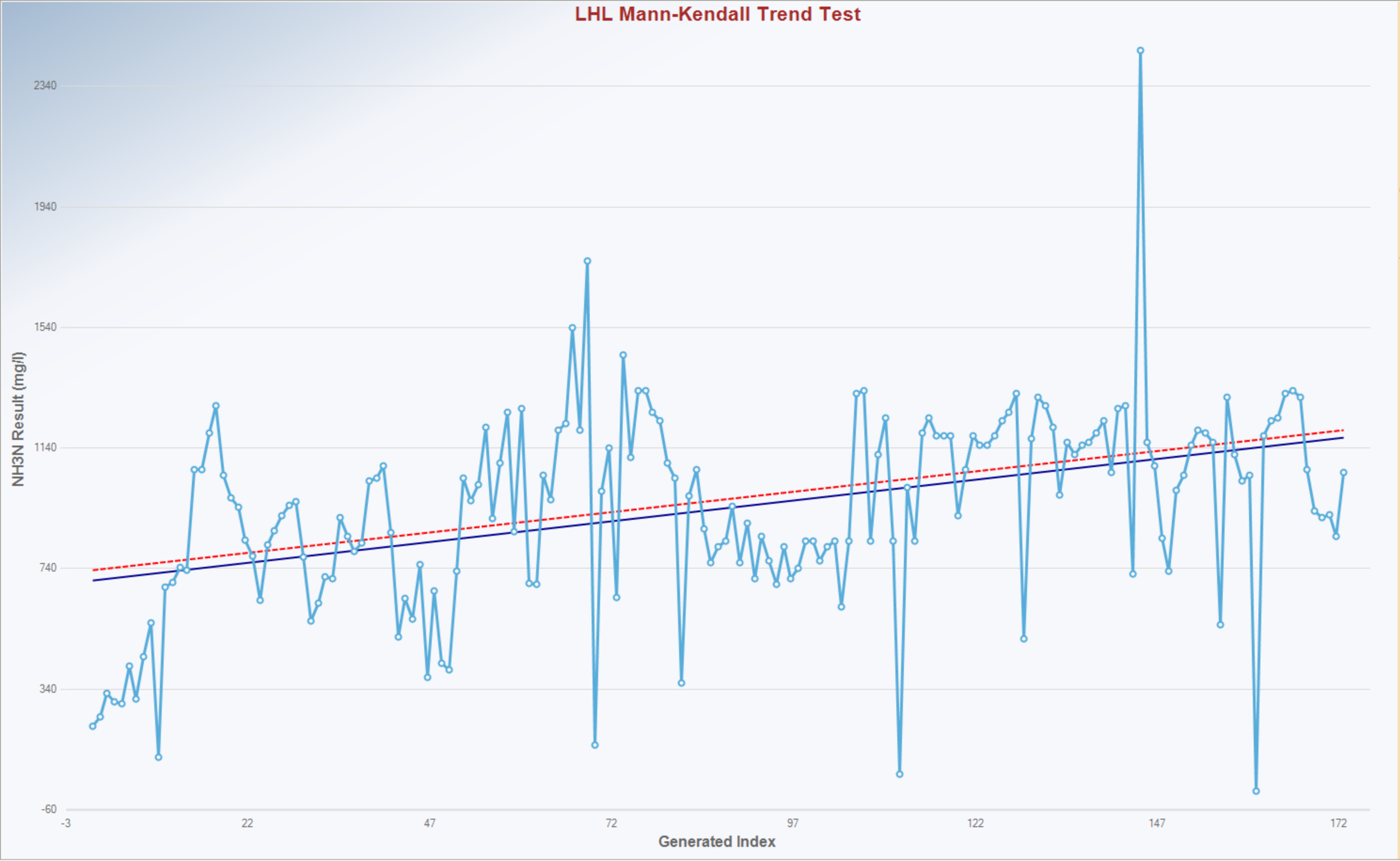
Number or Reported Events Not Used	0
Number of Generated Events	173
Number Values Reported (n)	173
Minimum	1.46
Maximum	2460
Mean	938.3
Geometric Mean	837.6
Median	968
Standard Deviation	327.9
Coefficient of Variation	0.349

Mann-Kendall Test

M-K Test Value (S)	4617
Critical Value (0.05)	1.645
Standard Deviation of S	761.6
Standardized Value of S	6.061
Approximate p-value	6.773E-10

Statistically significant evidence of an increasing trend at the specified level of significance.

LHL Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	173
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	761.6182
Standardized Value of S	6.0608
M-K Test Value (S)	4,617
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.0000

OLS Regression Line (Blue)

OLS Regression Slope	2.7615
OLS Regression Intercept	698.0896

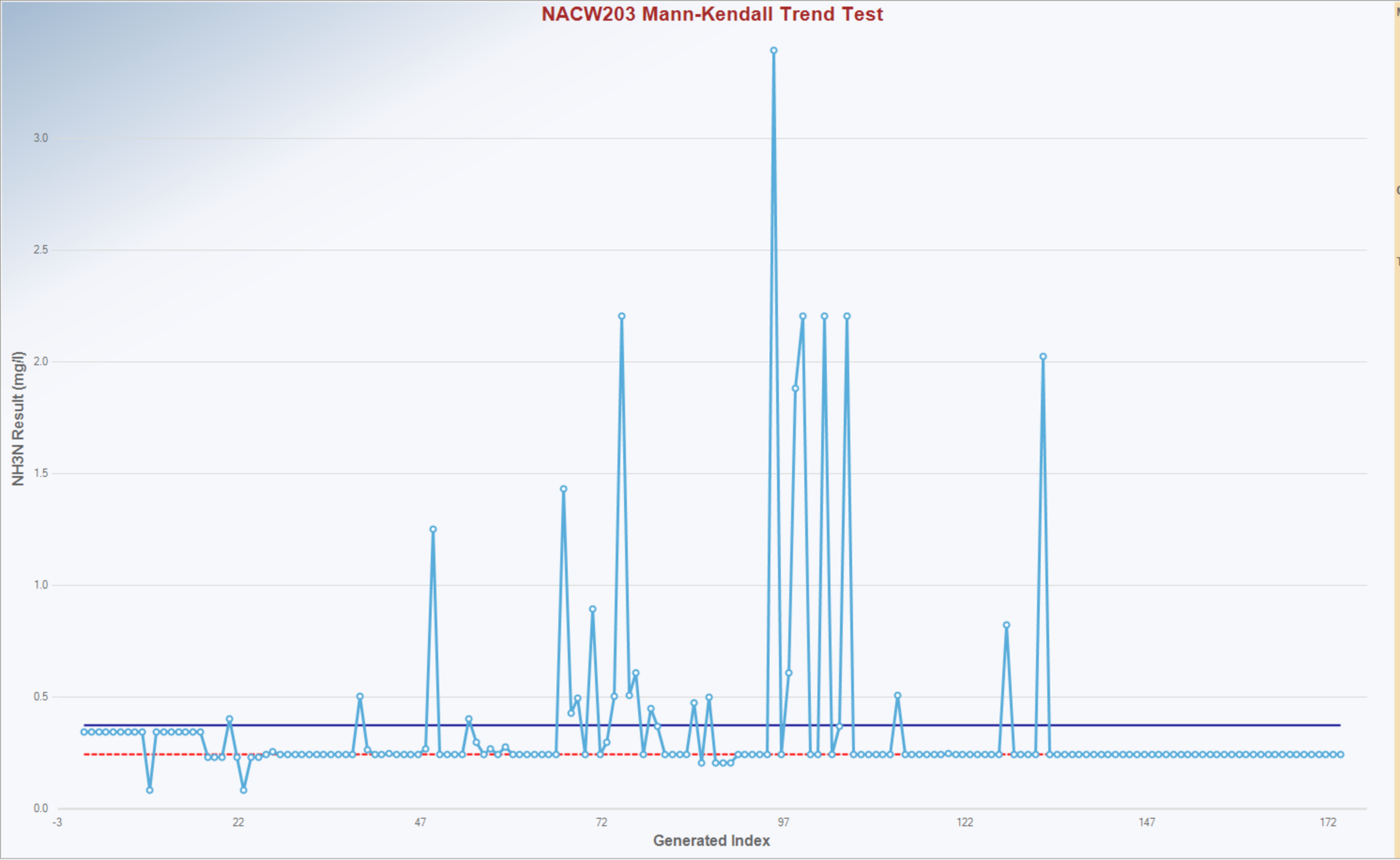
Theil-Sen Trend Line (Red)

Theil-Sen Slope	2.6969
Theil-Sen Intercept	733.3659

Statistically significant evidence of an increasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 13:34:34							
4			From File	NACW203.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	174							
14			Number Values Reported (n)	174							
15			Minimum	0.04							
16			Maximum	3.352							
17			Mean	0.33							
18			Geometric Mean	0.249							
19			Median	0.2							
20			Standard Deviation	0.434							
21			Coefficient of Variation	1.313							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-1780							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	660.2							
27			Standardized Value of S	-2.695							
28			Approximate p-value	0.00352							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

NACW203 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	174
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	660.1621
Standardized Value of S	-2.6948
M-K Test Value (S)	-1,780
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0035

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.3306

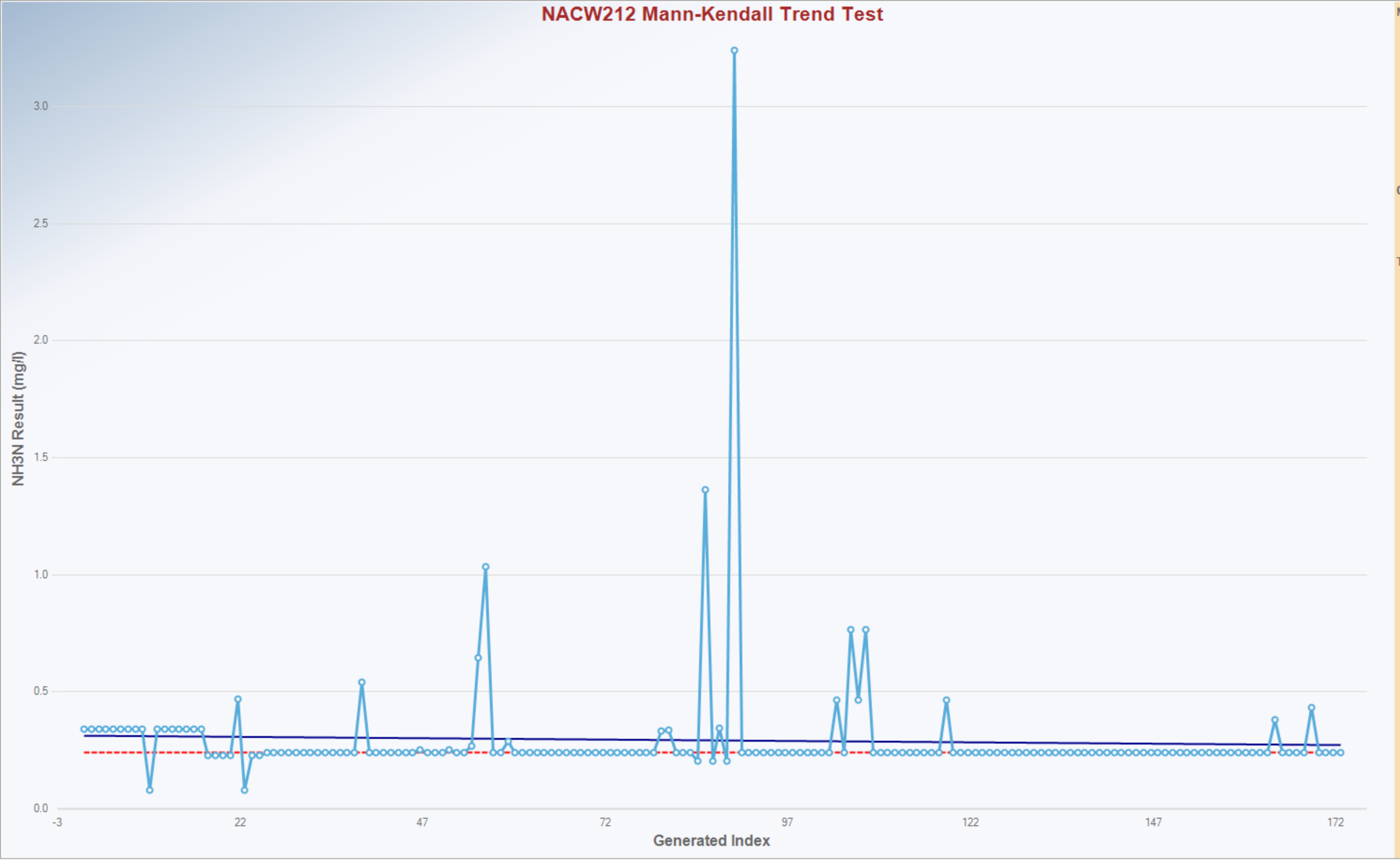
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 13:40:25							
4			From File	NACW212.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	173							
14			Number Values Reported (n)	173							
15			Minimum	0.04							
16			Maximum	3.204							
17			Mean	0.255							
18			Geometric Mean	0.224							
19			Median	0.2							
20			Standard Deviation	0.261							
21			Coefficient of Variation	1.026							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-1364							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	595.7							
27			Standardized Value of S	-2.288							
28			Approximate p-value	0.0111							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

NACW212 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	173
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	595.6834
Standardized Value of S	-2.2881
M-K Test Value (S)	-1,364
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0111

OLS Regression Line (Blue)

OLS Regression Slope	-0.0002
OLS Regression Intercept	0.2746

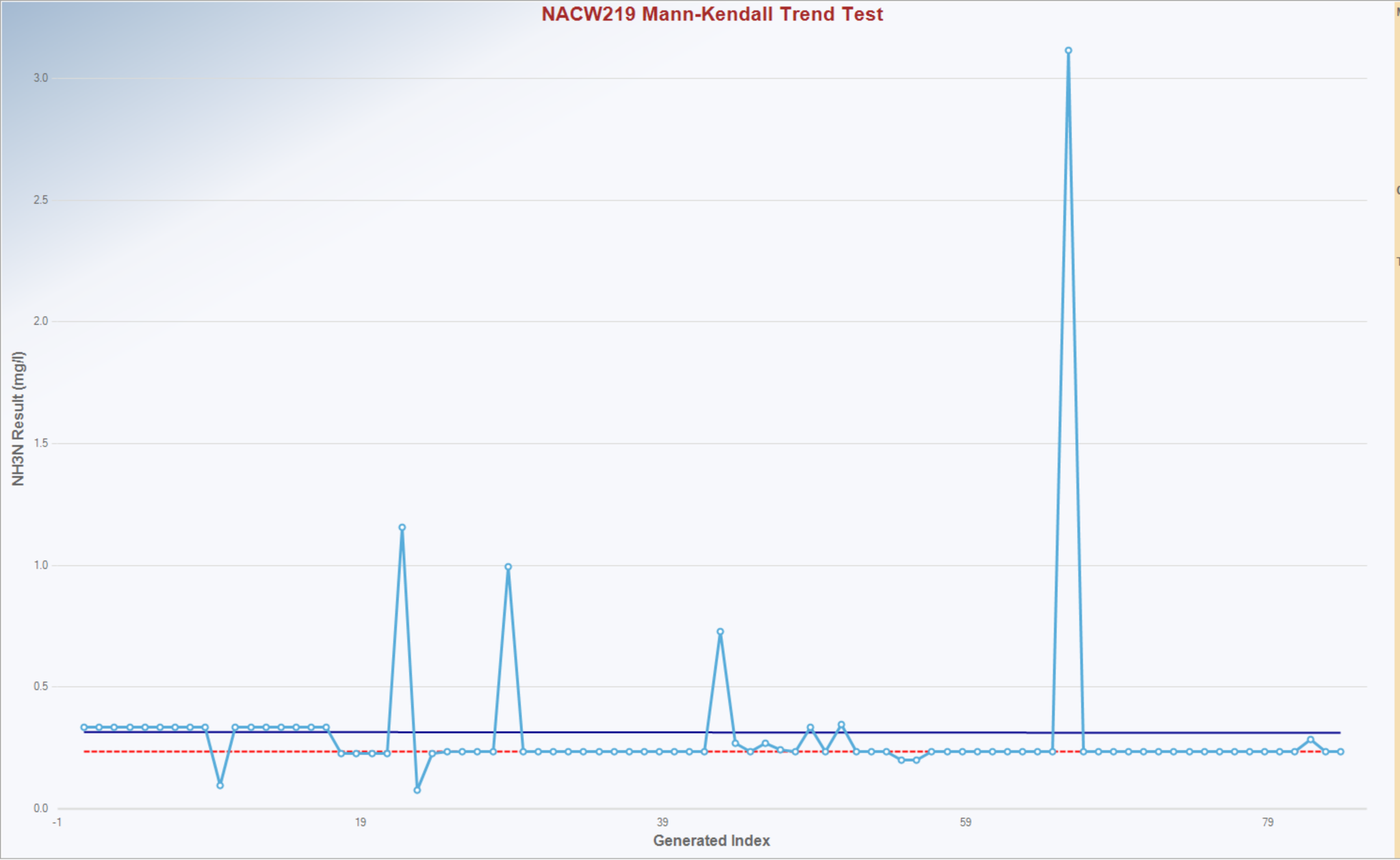
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 13:43:56							
4			From File	NACW219.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	84							
14			Number Values Reported (n)	84							
15			Minimum	0.04							
16			Maximum	3.08							
17			Mean	0.278							
18			Geometric Mean	0.23							
19			Median	0.2							
20			Standard Deviation	0.342							
21			Coefficient of Variation	1.228							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-631							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	230.3							
27			Standardized Value of S	-2.736							
28			Approximate p-value	0.00311							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

NACW219 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	84
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	230.3020
Standardized Value of S	-2.7355
M-K Test Value (S)	-631
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0031

OLS Regression Line (Blue)

OLS Regression Slope	-0.0001
OLS Regression Intercept	0.2809

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

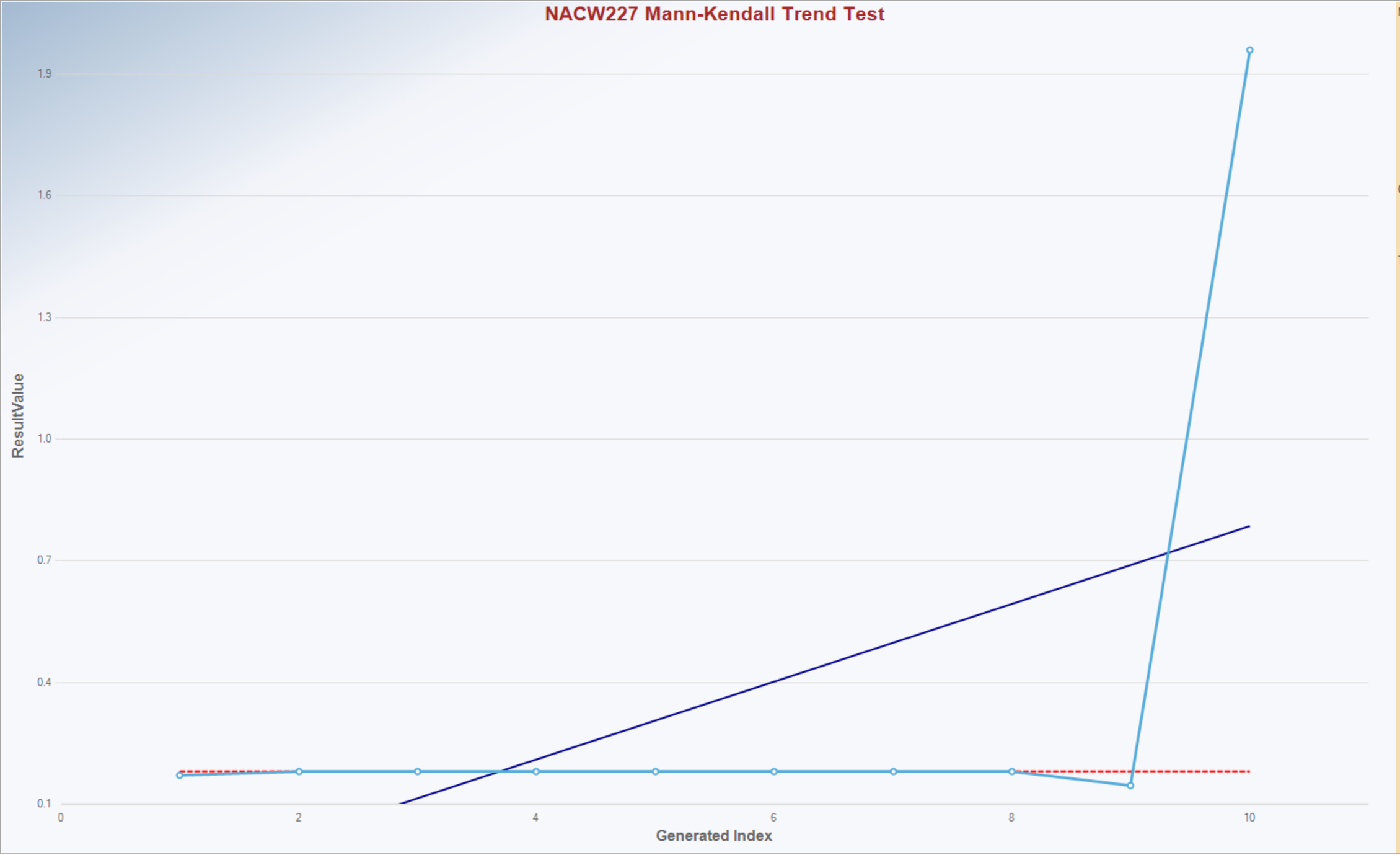
Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 13:47:11	
From File	NACW227.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

ResultValue	
General Statistics	
Number or Reported Events Not Used	0
Number of Generated Events	10
Number Values Reported (n)	10
Minimum	0.165
Maximum	1.98
Mean	0.374
Geometric Mean	0.245
Median	0.2
Standard Deviation	0.565
Coefficient of Variation	1.512
Mann-Kendall Test	
M-K Test Value (S)	8
Tabulated p-value	0.242
Standard Deviation of S	8.981
Standardized Value of S	0.779
Approximate p-value	0.218

Insufficient evidence to identify a significant trend at the specified level of significance.

NACW227 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	10
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	8.9815
Standardized Value of S	0.7794
M-K Test Value (S)	8
Tabulated p-value	0.2420
Approximate p-value	0.2179

OLS Regression Line (Blue)

OLS Regression Slope	0.0962
OLS Regression Intercept	-0.1553

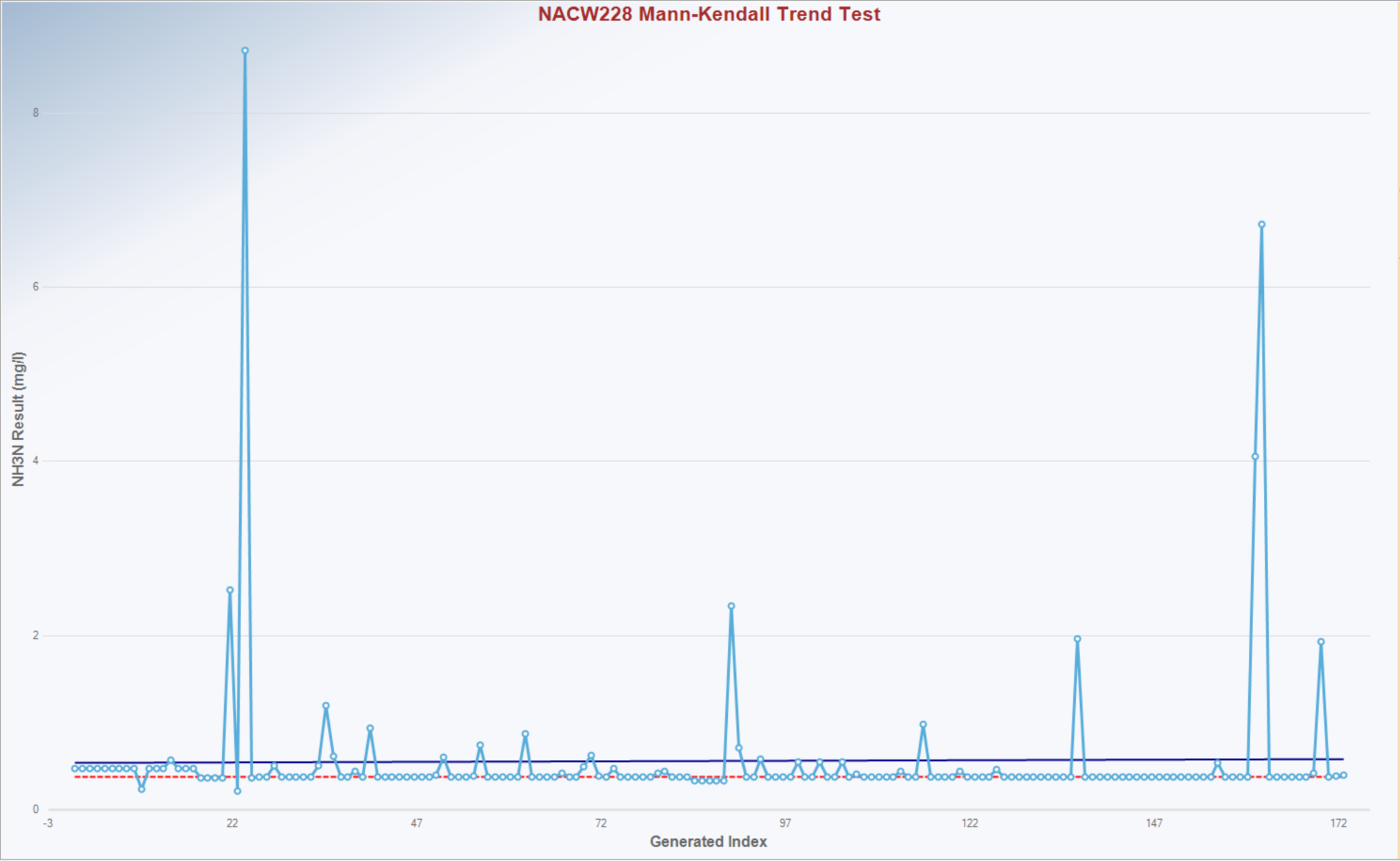
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Insufficient statistical evidence of a significant trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 13:53:32							
4			From File	NACW228.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	173							
14			Number Values Reported (n)	173							
15			Minimum	0.04							
16			Maximum	8.55							
17			Mean	0.39							
18			Geometric Mean	0.252							
19			Median	0.2							
20			Standard Deviation	0.881							
21			Coefficient of Variation	2.26							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-1335							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	667.5							
27			Standardized Value of S	-1.999							
28			Approximate p-value	0.0228							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

NACW228 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	173
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	667.4891
Standardized Value of S	-1.9985
M-K Test Value (S)	-1,335
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0228

OLS Regression Line (Blue)

OLS Regression Slope	0.0002
OLS Regression Intercept	0.3691

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 13:52:19	
From File	NACW229.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

NH3N Result (mg/l)

General Statistics

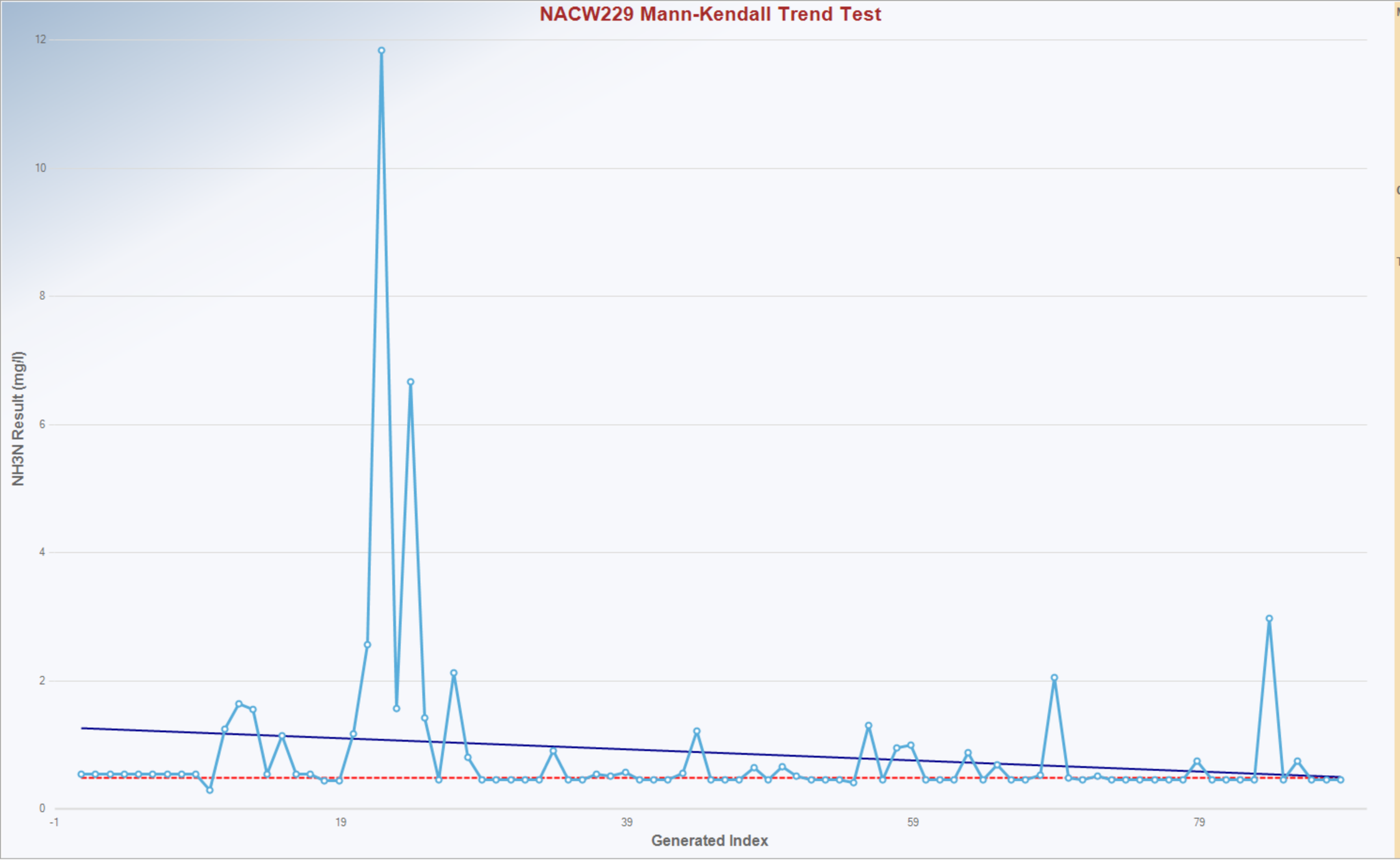
Number or Reported Events Not Used	0
Number of Generated Events	89
Number Values Reported (n)	89
Minimum	0.04
Maximum	11.6
Mean	0.638
Geometric Mean	0.343
Median	0.232
Standard Deviation	1.419
Coefficient of Variation	2.226

Mann-Kendall Test

M-K Test Value (S)	-756
Critical Value (0.05)	-1.645
Standard Deviation of S	269.4
Standardized Value of S	-2.802
Approximate p-value	0.00254

Statistically significant evidence of a decreasing trend at the specified level of significance.

NACW229 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	89
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	269.4030
Standardized Value of S	-2.8025
M-K Test Value (S)	-756
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0025

OLS Regression Line (Blue)

OLS Regression Slope	-0.0087
OLS Regression Intercept	1.0276

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2320

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 10:03:45	
From File	SW205a.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

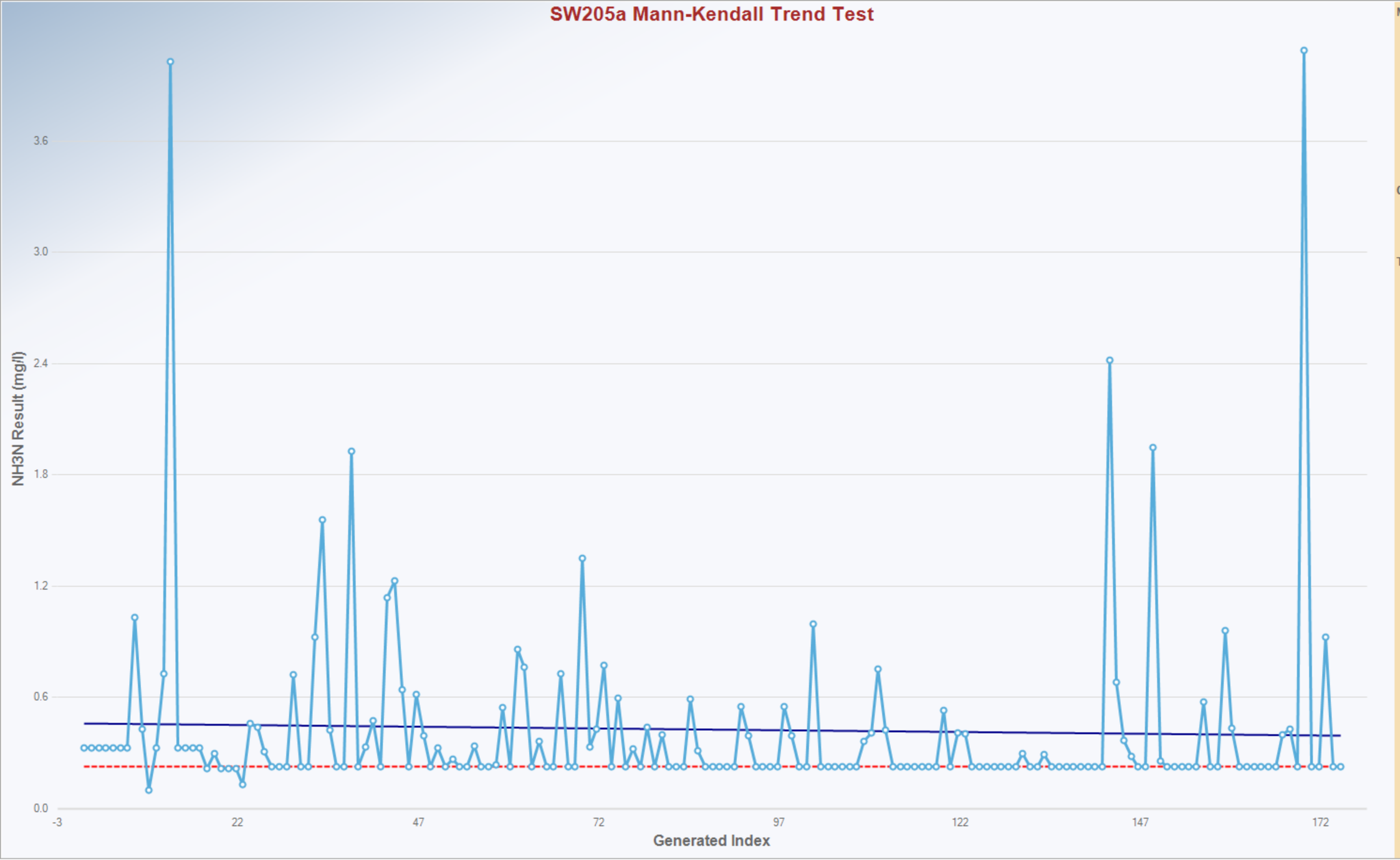
NH3N Result (mg/l)

General Statistics	
Number or Reported Events Not Used	0
Number of Generated Events	175
Number Values Reported (n)	175
Minimum	0.07
Maximum	4.06
Mean	0.397
Geometric Mean	0.295
Median	0.2
Standard Deviation	0.509
Coefficient of Variation	1.282

Mann-Kendall Test	
M-K Test Value (S)	-1638
Critical Value (0.05)	-1.645
Standard Deviation of S	717.8
Standardized Value of S	-2.281
Approximate p-value	0.0113

Statistically significant evidence of a decreasing trend at the specified level of significance.

SW205a Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	175
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	717.7962
Standardized Value of S	-2.2806
M-K Test Value (S)	-1,638
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0113

OLS Regression Line (Blue)

OLS Regression Slope	-0.0004
OLS Regression Intercept	0.4303

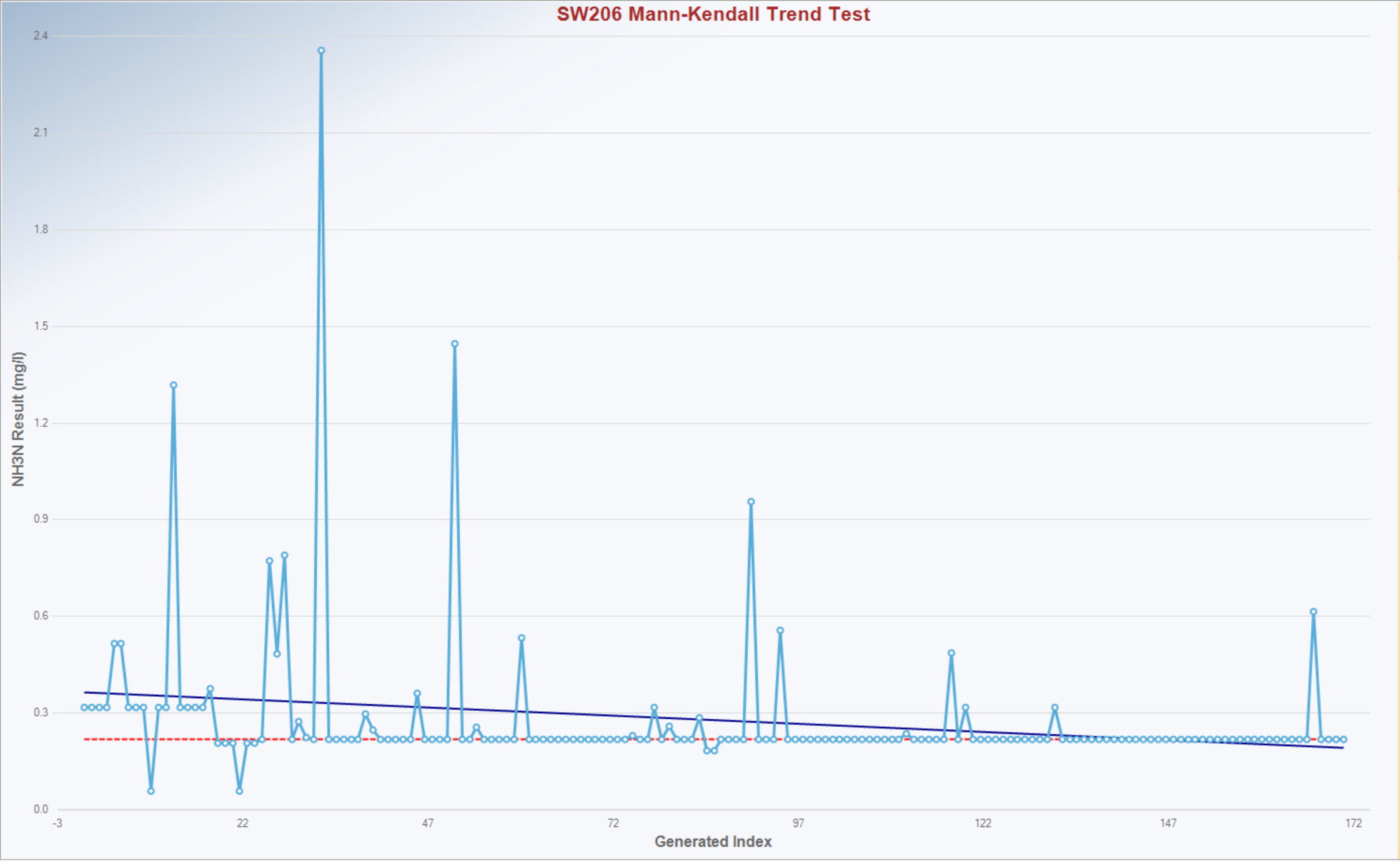
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 10:23:15	
From File	SW206.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	
NH3N Result (mg/l)		
General Statistics		
Number or Reported Events Not Used	0	
Number of Generated Events	171	
Number Values Reported (n)	171	
Minimum	0.04	
Maximum	2.34	
Mean	0.261	
Geometric Mean	0.228	
Median	0.2	
Standard Deviation	0.228	
Coefficient of Variation	0.875	
Mann-Kendall Test		
M-K Test Value (S)	-2372	
Critical Value (0.05)	-1.645	
Standard Deviation of S	596.6	
Standardized Value of S	-3.974	
Approximate p-value	3.5288E-5	
Statistically significant evidence of a decreasing		
trend at the specified level of significance.		

SW206 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	171
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	596.5780
Standardized Value of S	-3.9743
M-K Test Value (S)	-2,372
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0000

OLS Regression Line (Blue)

OLS Regression Slope	-0.0010
OLS Regression Intercept	0.3475

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 23/08/2023 17:52:28	
From File	UD1.xls	
Full Precision	ON	
Confidence Coefficient	0.9500000	
Level of Significance	0.0500000	

NH3-N Result (mg/l)

General Statistics

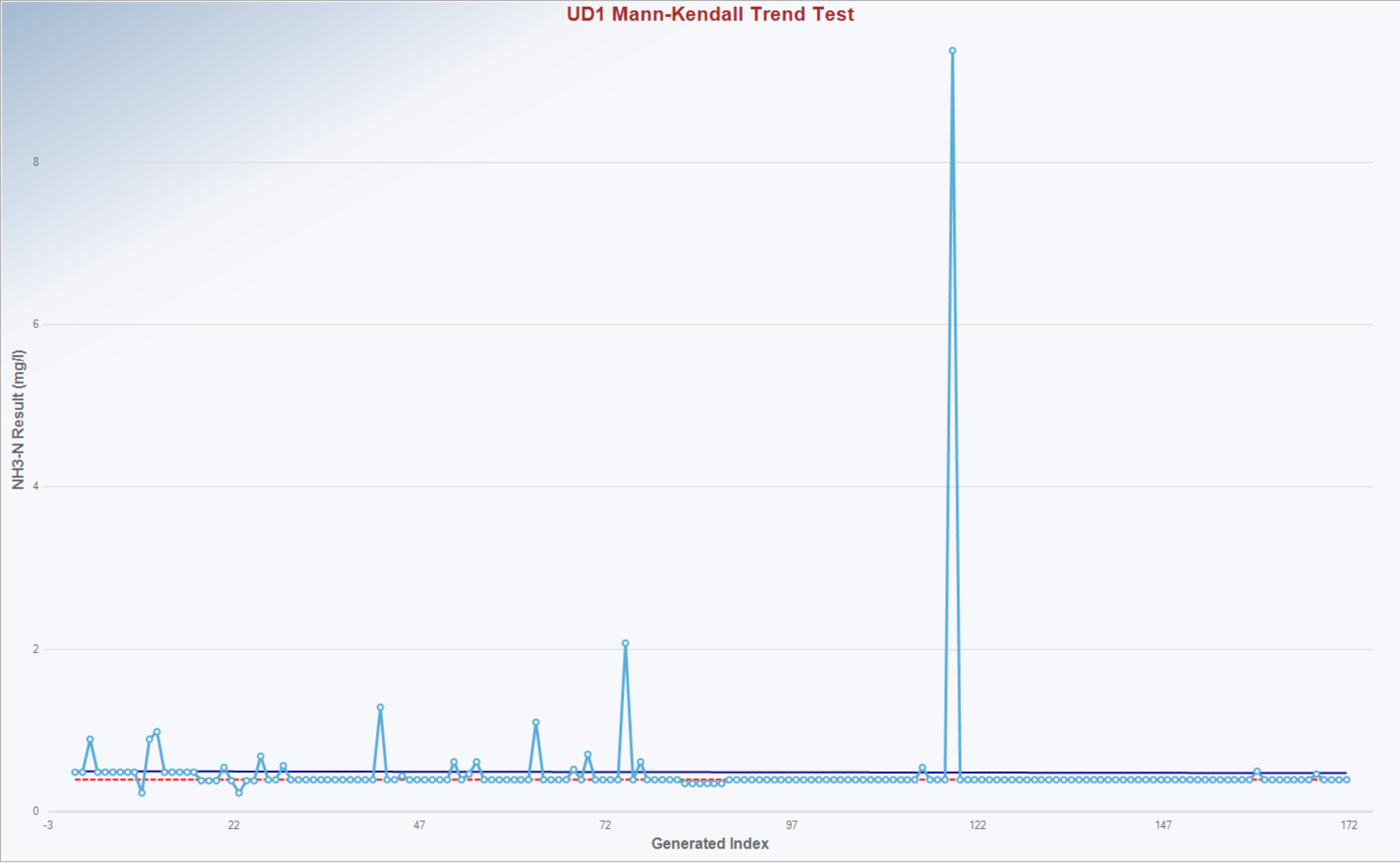
Number or Reported Events Not Used	0
Number of Generated Events	172
Number Values Reported (n)	172
Minimum	0.0400000
Maximum	9.1900000
Mean	0.2979832
Geometric Mean	0.2267112
Median	0.2000000
Standard Deviation	0.7045050
Coefficient of Variation	2.3642437

Mann-Kendall Test

M-K Test Value (S)	-1648.000
Critical Value (0.05)	-1.644854
Standard Deviation of S	591.92511
Standardized Value of S	-2.782447
Approximate p-value	0.0026975

Statistically significant evidence of a decreasing trend at the specified level of significance.

UD1 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	172
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	591.9251
Standardized Value of S	-2.7824
M-K Test Value (S)	-1,648
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0027

OLS Regression Line (Blue)

OLS Regression Slope	-0.0001
OLS Regression Intercept	0.3045

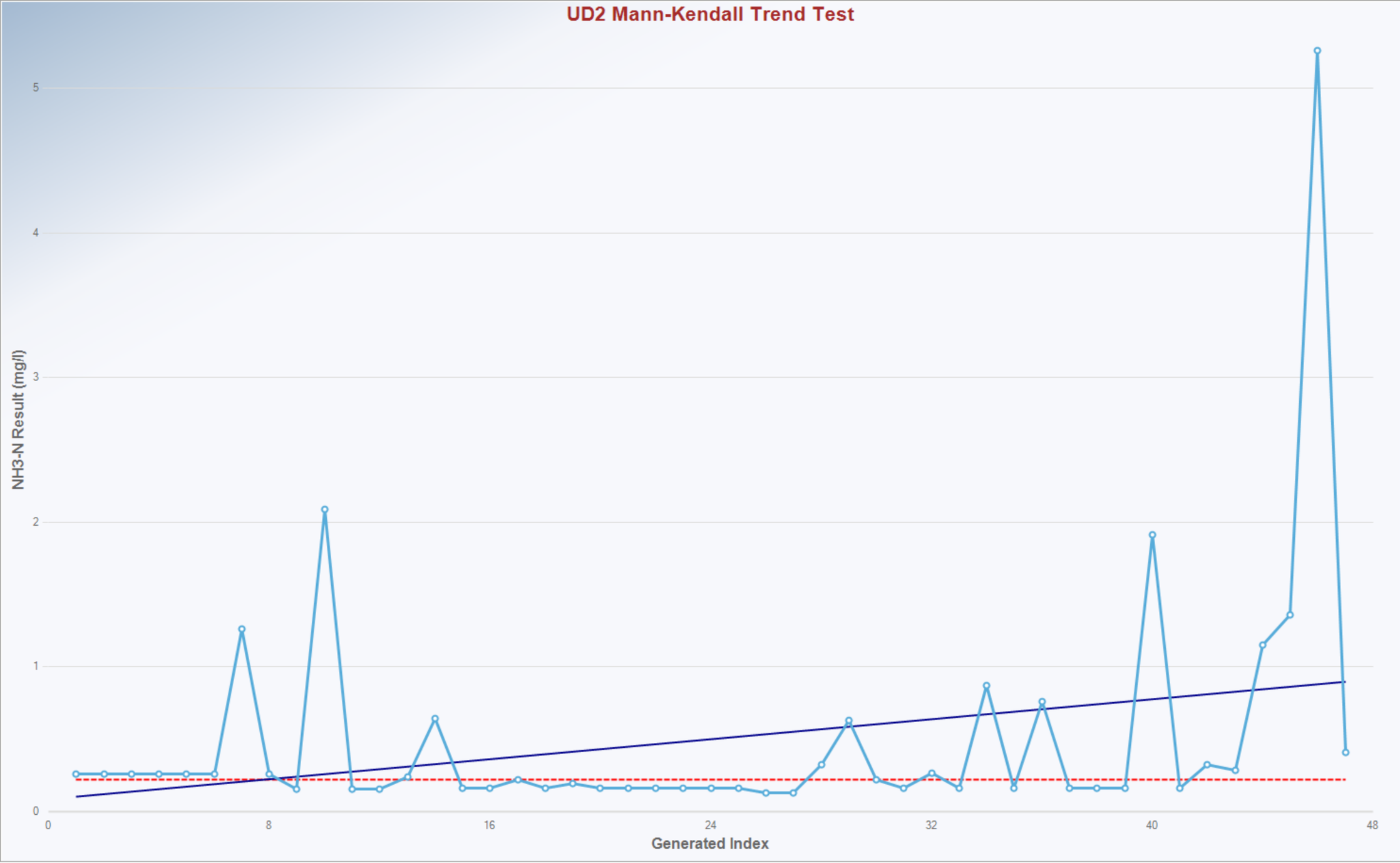
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 23/08/2023 17:47:58							
4			From File	UD2.xls							
5			Full Precision	ON							
6			Confidence Coefficient	0.9500000							
7			Level of Significance	0.0500000							
8											
9			**NH3-N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	47							
14			Number Values Reported (n)	47							
15			Minimum	0.1650000							
16			Maximum	5.3000000							
17			Mean	0.5394944							
18			Geometric Mean	0.3408083							
19			Median	0.2610588							
20			Standard Deviation	0.8411760							
21			Coefficient of Variation	1.5591934							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	112.00000							
25			Critical Value (0.05)	1.6448536							
26			Standard Deviation of S	106.53012							
27			Standardized Value of S	1.0419588							
28			Approximate p-value	0.1487154							
29											
30	**Insufficient evidence to identify a significant**										
31	**trend at the specified level of significance.**										

UD2 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	47
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	106.5301
Standardized Value of S	1.0420
M-K Test Value (S)	112
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.1487

OLS Regression Line (Blue)

OLS Regression Slope	0.0172
OLS Regression Intercept	0.1261

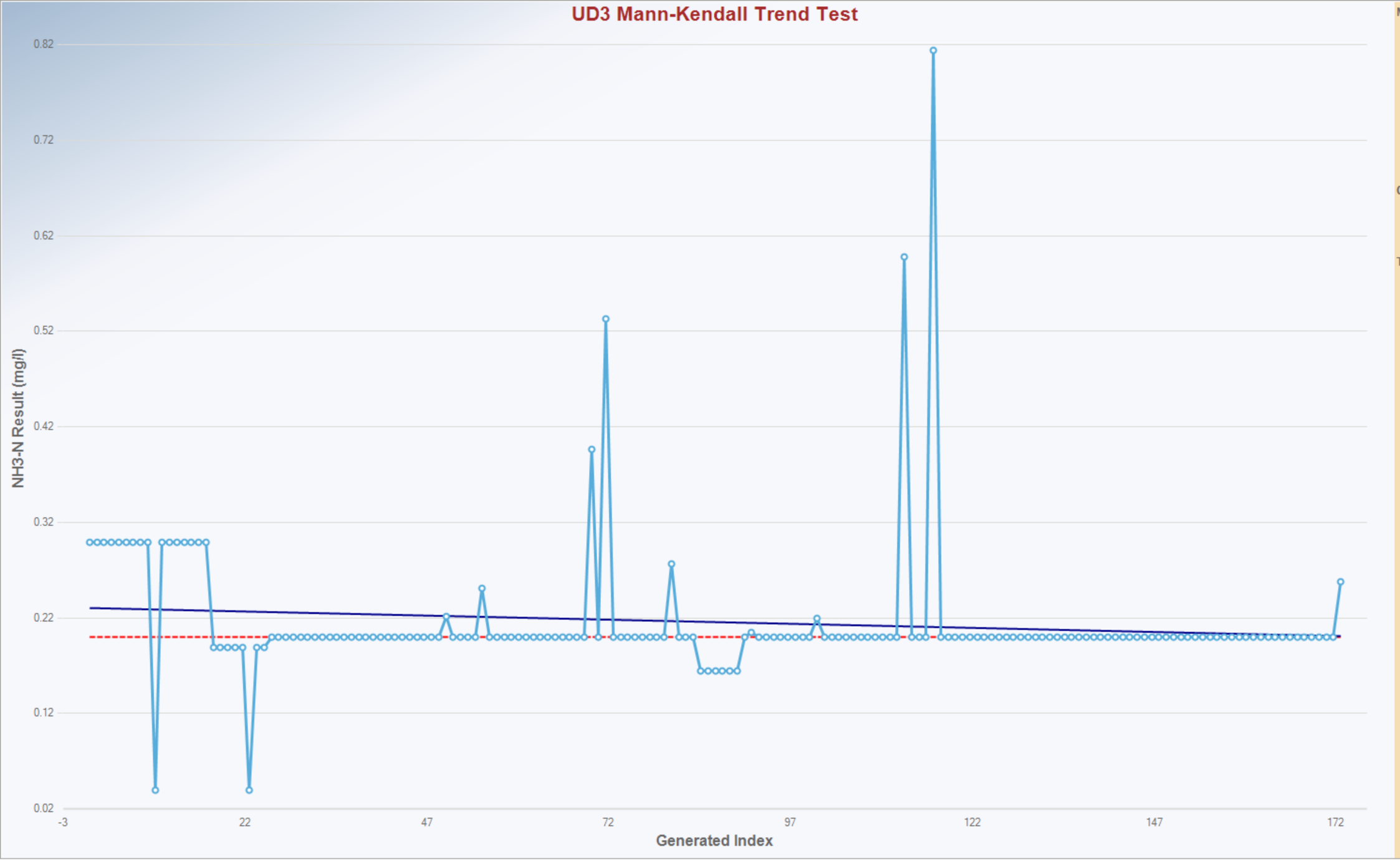
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2611

Insufficient statistical evidence of a significant trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 23/08/2023 16:15:40							
4			From File	UD3.xls							
5			Full Precision	ON							
6			Confidence Coefficient	0.9500000							
7			Level of Significance	0.0500000							
8											
9			**NH3-N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	173							
14			Number Values Reported (n)	173							
15			Minimum	0.0400000							
16			Maximum	0.8150000							
17			Mean	0.2160588							
18			Geometric Mean	0.2082049							
19			Median	0.2000000							
20			Standard Deviation	0.0713408							
21			Coefficient of Variation	0.3301915							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-1114.000							
25			Critical Value (0.05)	-1.644854							
26			Standard Deviation of S	566.81273							
27			Standardized Value of S	-1.963612							
28			Approximate p-value	0.0247876							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

UD3 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	173
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	566.8127
Standardized Value of S	-1.9636
M-K Test Value (S)	-1,114
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0248

OLS Regression Line (Blue)

OLS Regression Slope	-0.0002
OLS Regression Intercept	0.2312

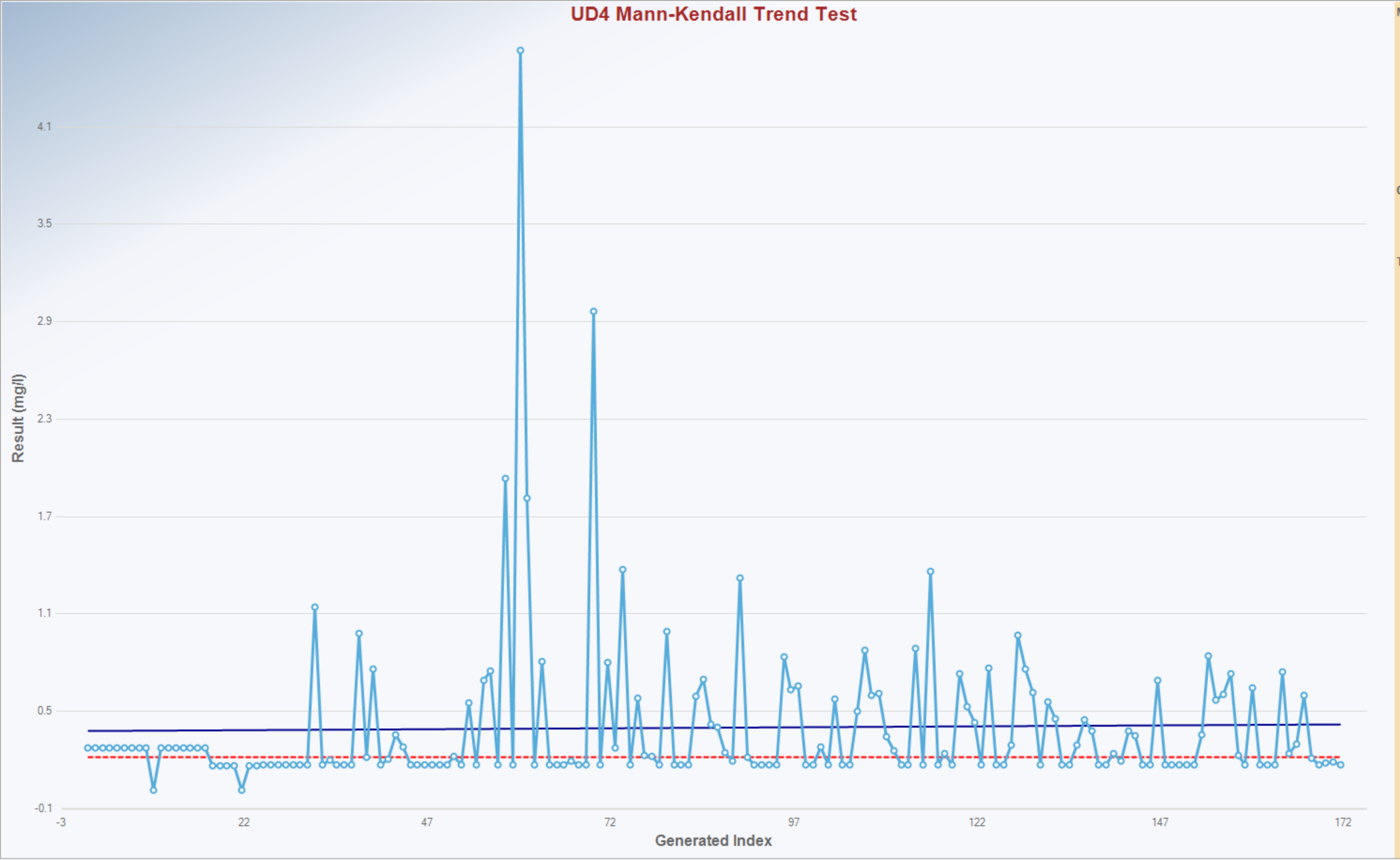
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 23/08/2023 16:09:30							
4			From File	UD4.xls							
5			Full Precision	ON							
6			Confidence Coefficient	0.9500000							
7			Level of Significance	0.0500000							
8											
9			**Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	172							
14			Number Values Reported (n)	172							
15			Minimum	0.0400000							
16			Maximum	4.6000000							
17			Mean	0.4263116							
18			Geometric Mean	0.3189371							
19			Median	0.2442059							
20			Standard Deviation	0.4879003							
21			Coefficient of Variation	1.1444688							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	1229.0000							
25			Critical Value (0.05)	1.6448536							
26			Standard Deviation of S	729.70062							
27			Standardized Value of S	1.6828819							
28			Approximate p-value	0.0461990							
29											
30	**Statistically significant evidence of an increasing**										
31	**trend at the specified level of significance.**										

UD4 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	172
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	729.7006
Standardized Value of S	1.6829
M-K Test Value (S)	1,229
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.0462

OLS Regression Line (Blue)

OLS Regression Slope	0.0002
OLS Regression Intercept	0.4067

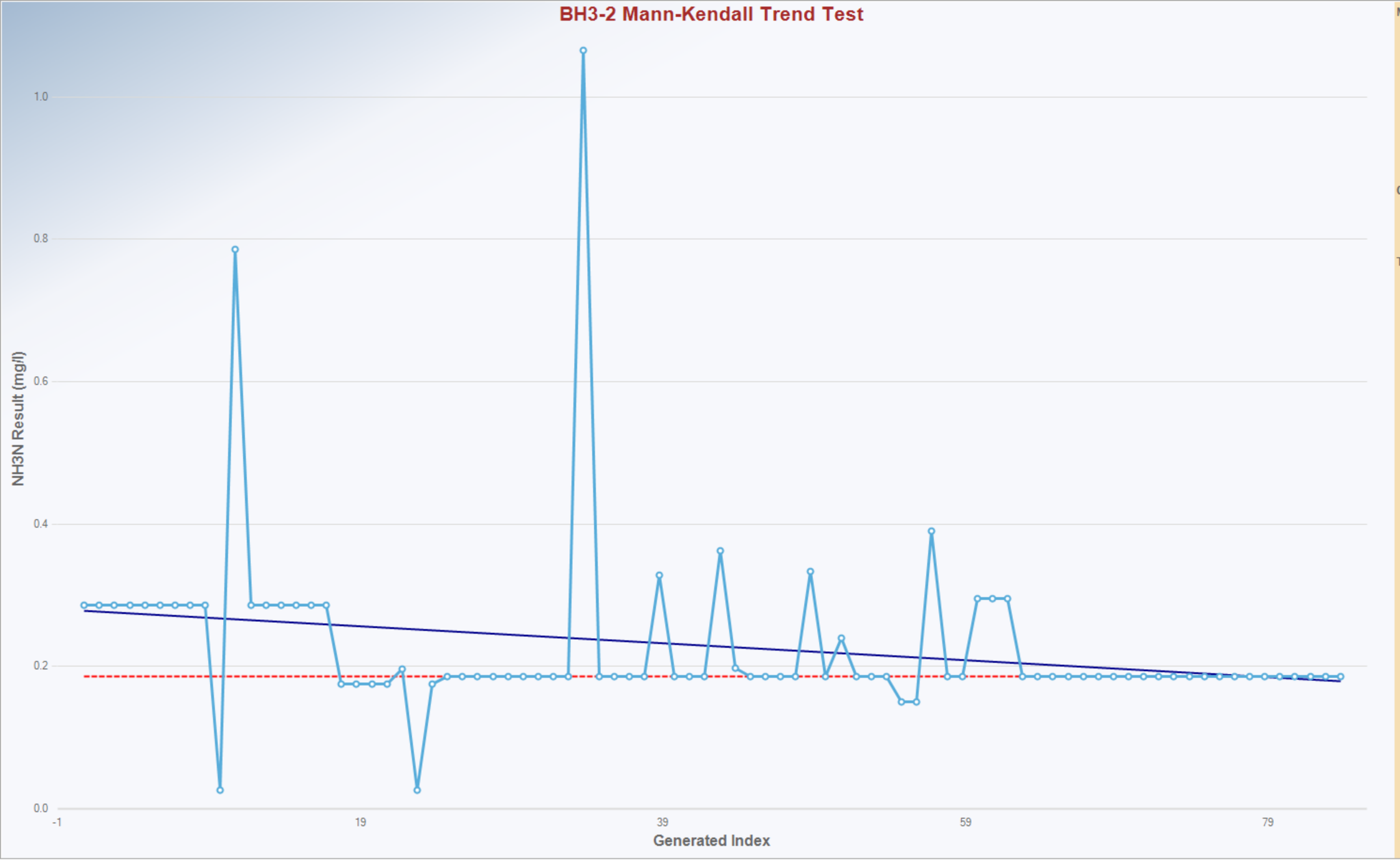
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2442

Statistically significant evidence of an increasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 11:40:44							
4			From File	BH3-2.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	84							
14			Number Values Reported (n)	84							
15			Minimum	0.04							
16			Maximum	1.08							
17			Mean	0.243							
18			Geometric Mean	0.224							
19			Median	0.2							
20			Standard Deviation	0.127							
21			Coefficient of Variation	0.522							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-567							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	232.2							
27			Standardized Value of S	-2.437							
28			Approximate p-value	0.0074							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

BH3-2 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	84
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	232.2075
Standardized Value of S	-2.4375
M-K Test Value (S)	-567
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0074

OLS Regression Line (Blue)

OLS Regression Slope	-0.0012
OLS Regression Intercept	0.2934

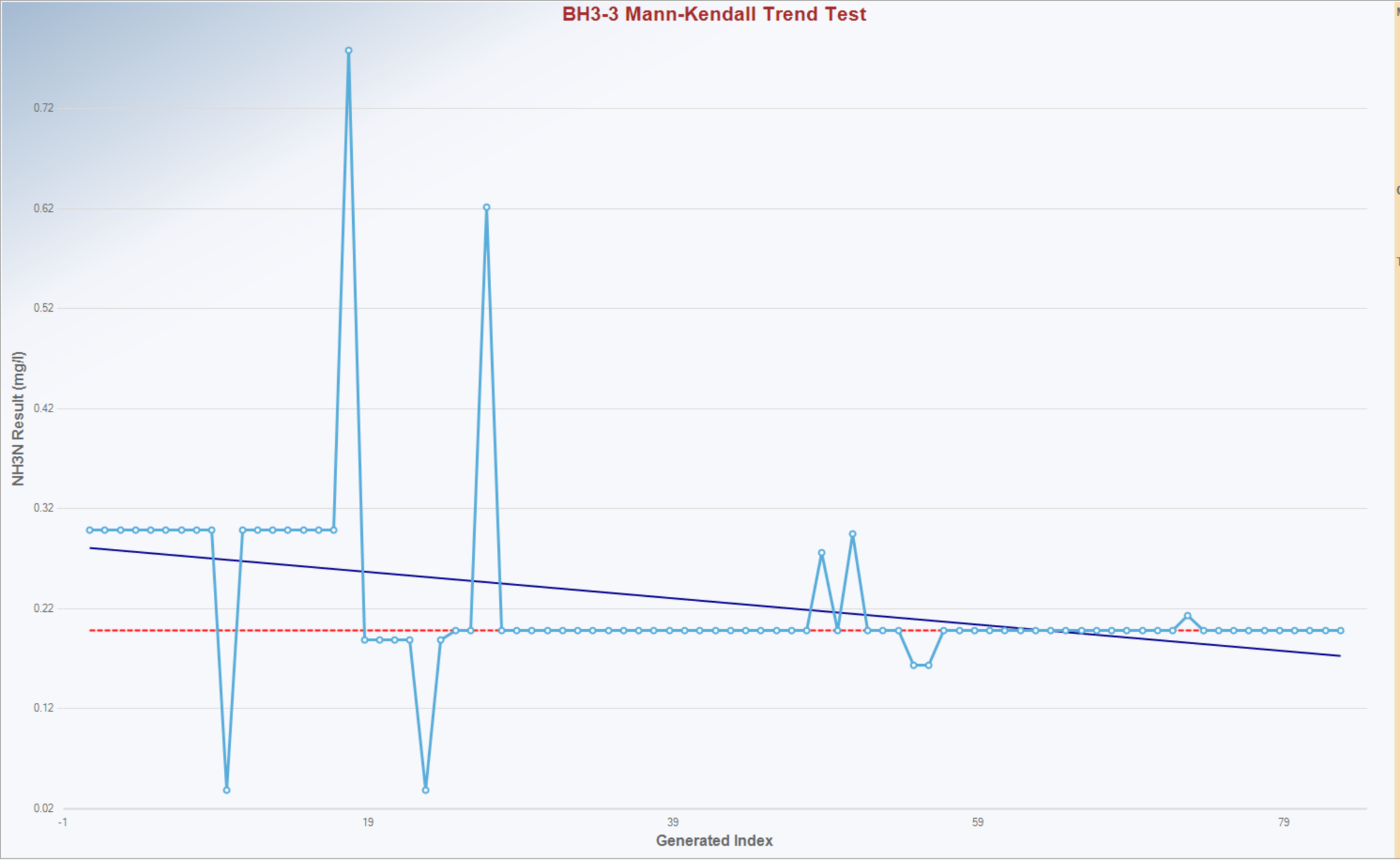
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 11:43:37							
4			From File	BH3-3.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	83							
14			Number Values Reported (n)	83							
15			Minimum	0.04							
16			Maximum	0.78							
17			Mean	0.228							
18			Geometric Mean	0.215							
19			Median	0.2							
20			Standard Deviation	0.091							
21			Coefficient of Variation	0.398							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-702							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	217.1							
27			Standardized Value of S	-3.228							
28			Approximate p-value	6.2264E-4							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

BH3-3 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	83
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	217.1420
Standardized Value of S	-3.2283
M-K Test Value (S)	-702
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0006

OLS Regression Line (Blue)

OLS Regression Slope	-0.0013
OLS Regression Intercept	0.2839

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 11:46:39	
From File	BH3-4.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

NH3N Result (mg/l)

General Statistics

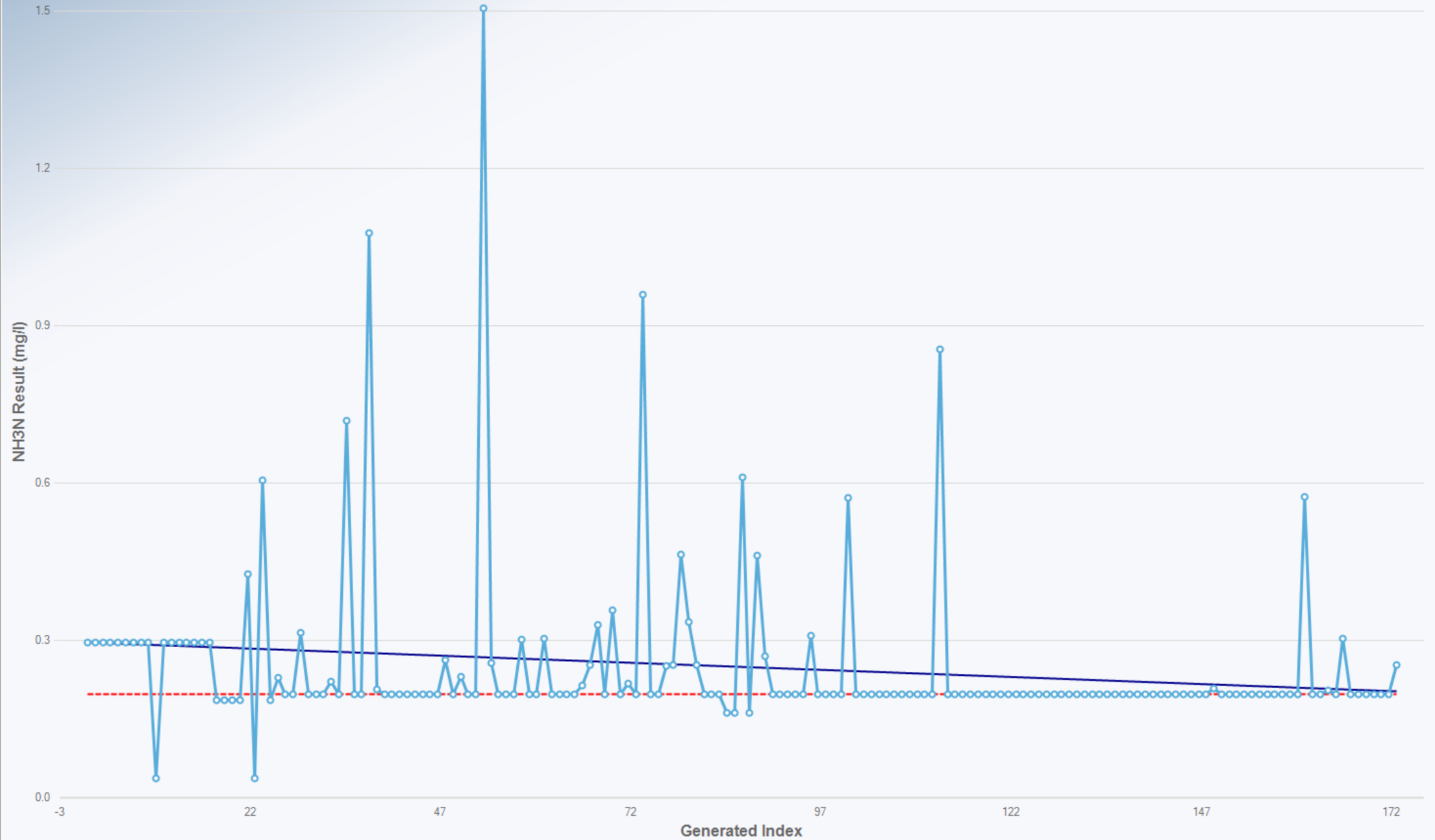
Number or Reported Events Not Used	0
Number of Generated Events	173
Number Values Reported (n)	173
Minimum	0.04
Maximum	1.51
Mean	0.253
Geometric Mean	0.23
Median	0.2
Standard Deviation	0.161
Coefficient of Variation	0.637

Mann-Kendall Test

M-K Test Value (S)	-2230
Critical Value (0.05)	-1.645
Standard Deviation of S	655.6
Standardized Value of S	-3.4
Approximate p-value	3.3720E-4

Statistically significant evidence of a decreasing trend at the specified level of significance.

BH3-4 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	173
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	655.6310
Standardized Value of S	-3.3998
M-K Test Value (S)	-2,230
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0003

OLS Regression Line (Blue)

OLS Regression Slope	-0.0005
OLS Regression Intercept	0.3001

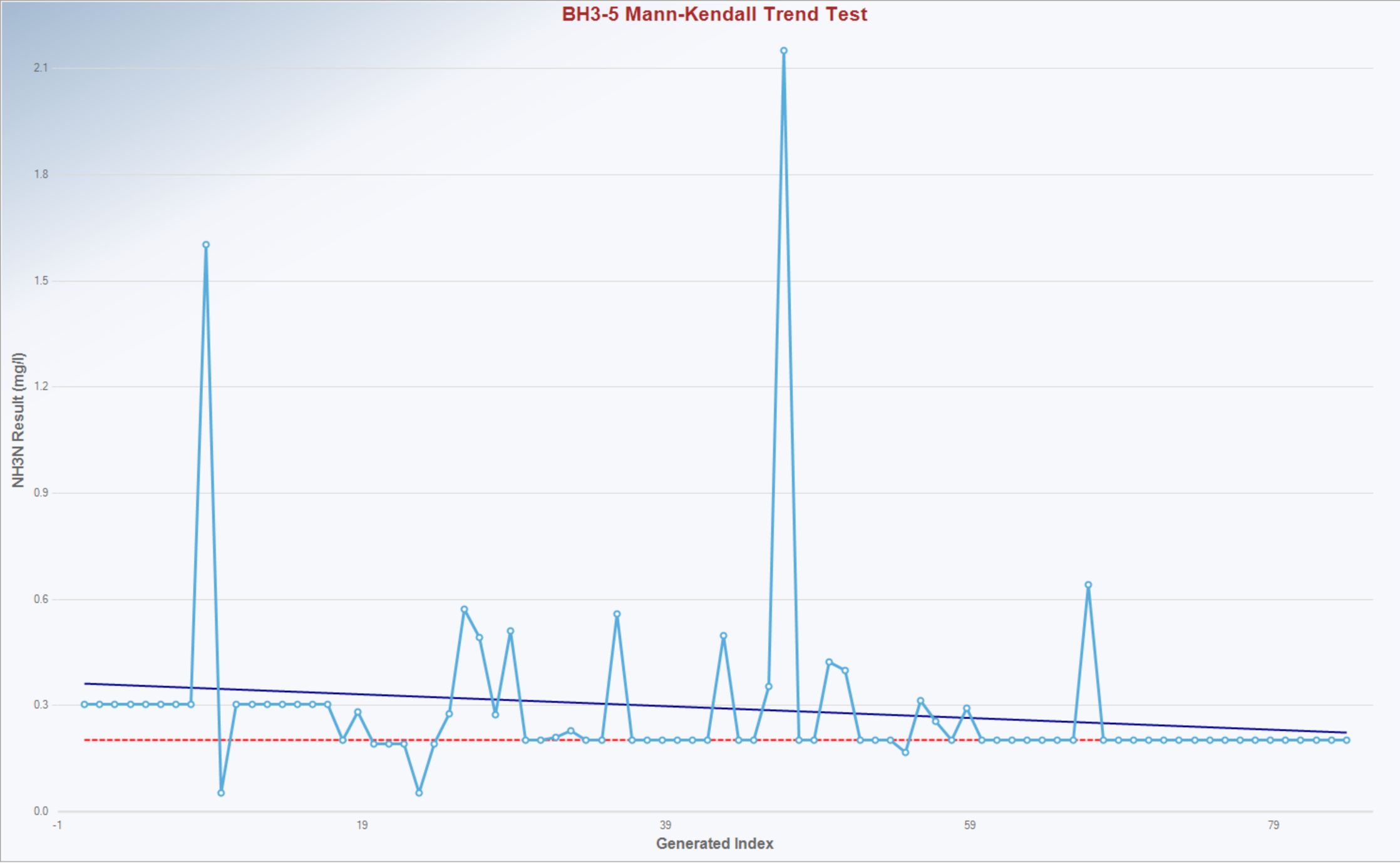
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	A	B	C	D	E	F	G	H	I	J	K
1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 11:49:47							
4			From File	BH3-5.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9	**NH3N Result (mg/l)**										
10											
11	**General Statistics**										
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	84							
14			Number Values Reported (n)	84							
15			Minimum	0.05							
16			Maximum	2.15							
17			Mean	0.291							
18			Geometric Mean	0.246							
19			Median	0.2							
20			Standard Deviation	0.272							
21			Coefficient of Variation	0.936							
22											
23	**Mann-Kendall Test**										
24			M-K Test Value (S)	-869							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	241							
27			Standardized Value of S	-3.602							
28			Approximate p-value	1.5801E-4							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

BH3-5 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	84
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	240.9903
Standardized Value of S	-3.6018
M-K Test Value (S)	-869
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0002

OLS Regression Line (Blue)

OLS Regression Slope	-0.0017
OLS Regression Intercept	0.3625

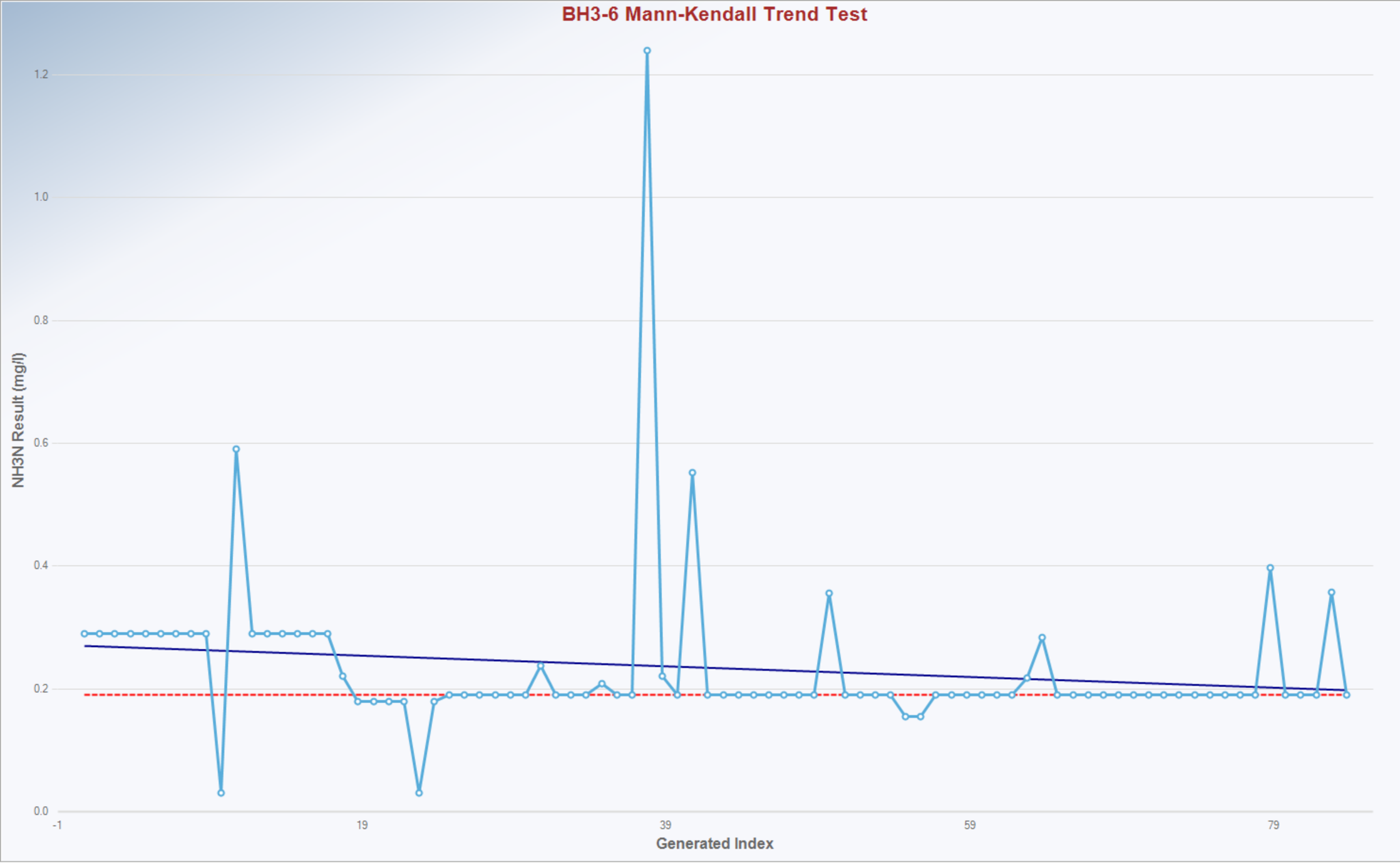
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 11:52:35							
4			From File	BH3-6.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	84							
14			Number Values Reported (n)	84							
15			Minimum	0.04							
16			Maximum	1.25							
17			Mean	0.244							
18			Geometric Mean	0.223							
19			Median	0.2							
20			Standard Deviation	0.137							
21			Coefficient of Variation	0.561							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-605							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	232.2							
27			Standardized Value of S	-2.601							
28			Approximate p-value	0.00465							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

BH3-6 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	84
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	232.2133
Standardized Value of S	-2.6011
M-K Test Value (S)	-605
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0046

OLS Regression Line (Blue)

OLS Regression Slope	-0.0009
OLS Regression Intercept	0.2809

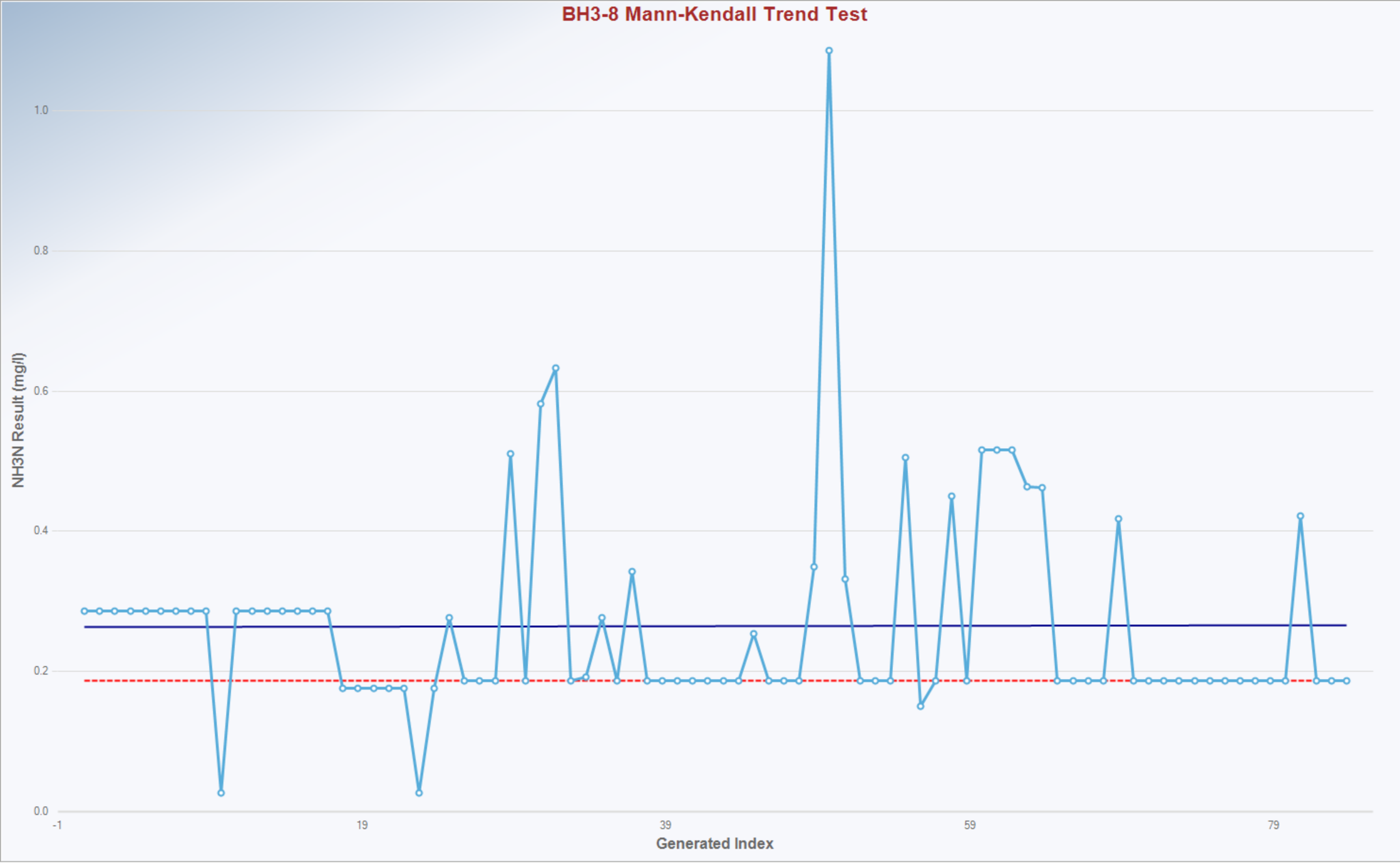
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	A	B	C	D	E	F	G	H	I	J	K
1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 11:55:22							
4			From File	BH3-8.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9	**NH3N Result (mg/l)**										
10											
11	**General Statistics**										
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	84							
14			Number Values Reported (n)	84							
15			Minimum	0.04							
16			Maximum	1.1							
17			Mean	0.278							
18			Geometric Mean	0.249							
19			Median	0.2							
20			Standard Deviation	0.148							
21			Coefficient of Variation	0.533							
22											
23	**Mann-Kendall Test**										
24			M-K Test Value (S)	-318							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	246.2							
27			Standardized Value of S	-1.287							
28			Approximate p-value	0.099							
29											
30	**Insufficient evidence to identify a significant**										
31	**trend at the specified level of significance.**										

BH3-8 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	84
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	246.2424
Standardized Value of S	-1.2873
M-K Test Value (S)	-318
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0990

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.2772

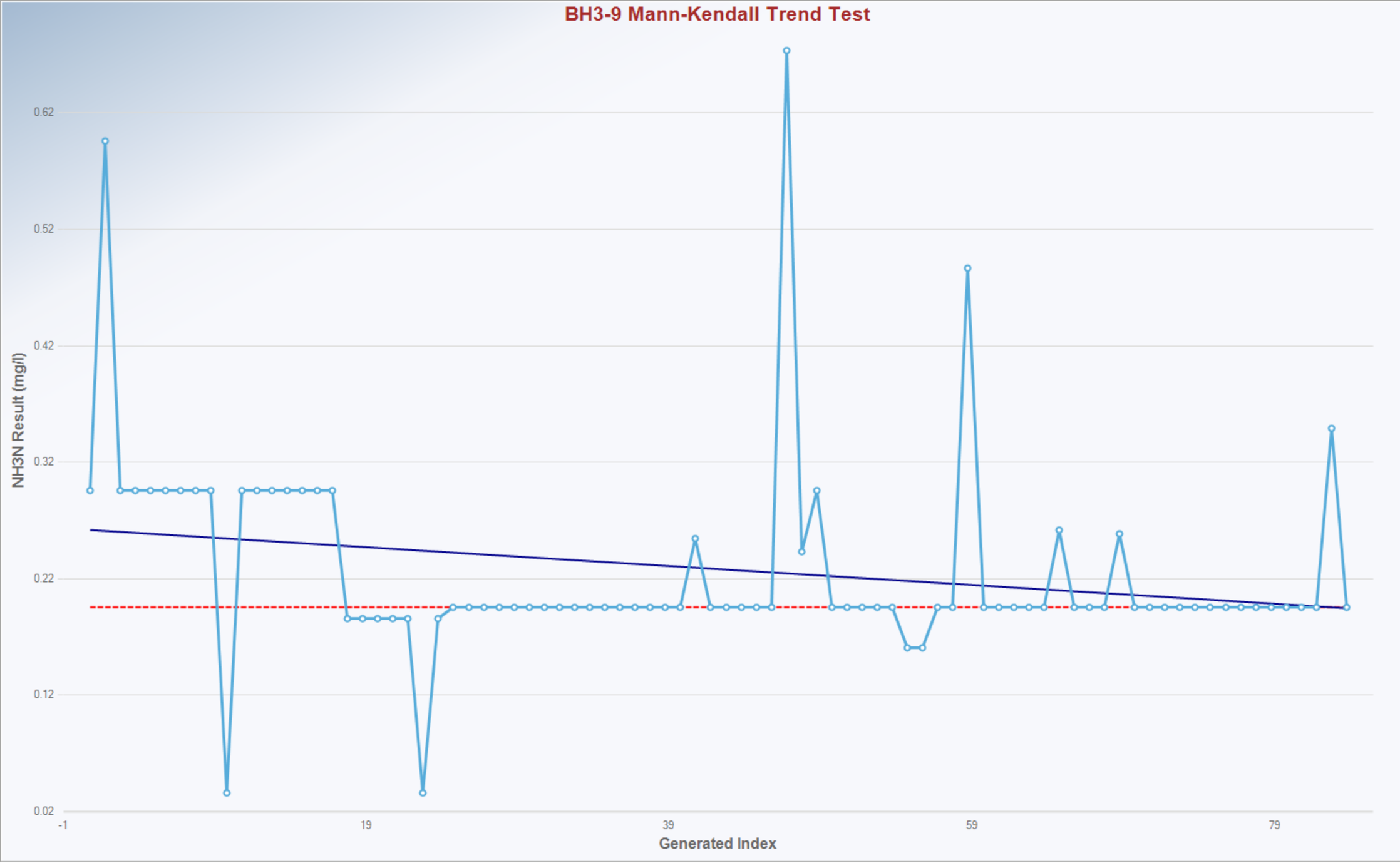
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Insufficient statistical evidence of a significant trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 11:58:25							
4			From File	BH3-9.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	84							
14			Number Values Reported (n)	84							
15			Minimum	0.04							
16			Maximum	0.678							
17			Mean	0.232							
18			Geometric Mean	0.218							
19			Median	0.2							
20			Standard Deviation	0.0876							
21			Coefficient of Variation	0.377							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-475							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	228.5							
27			Standardized Value of S	-2.075							
28			Approximate p-value	0.019							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

BH3-9 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	84
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	228.4608
Standardized Value of S	-2.0748
M-K Test Value (S)	-475
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0190

OLS Regression Line (Blue)

OLS Regression Slope	-0.0008
OLS Regression Intercept	0.2667

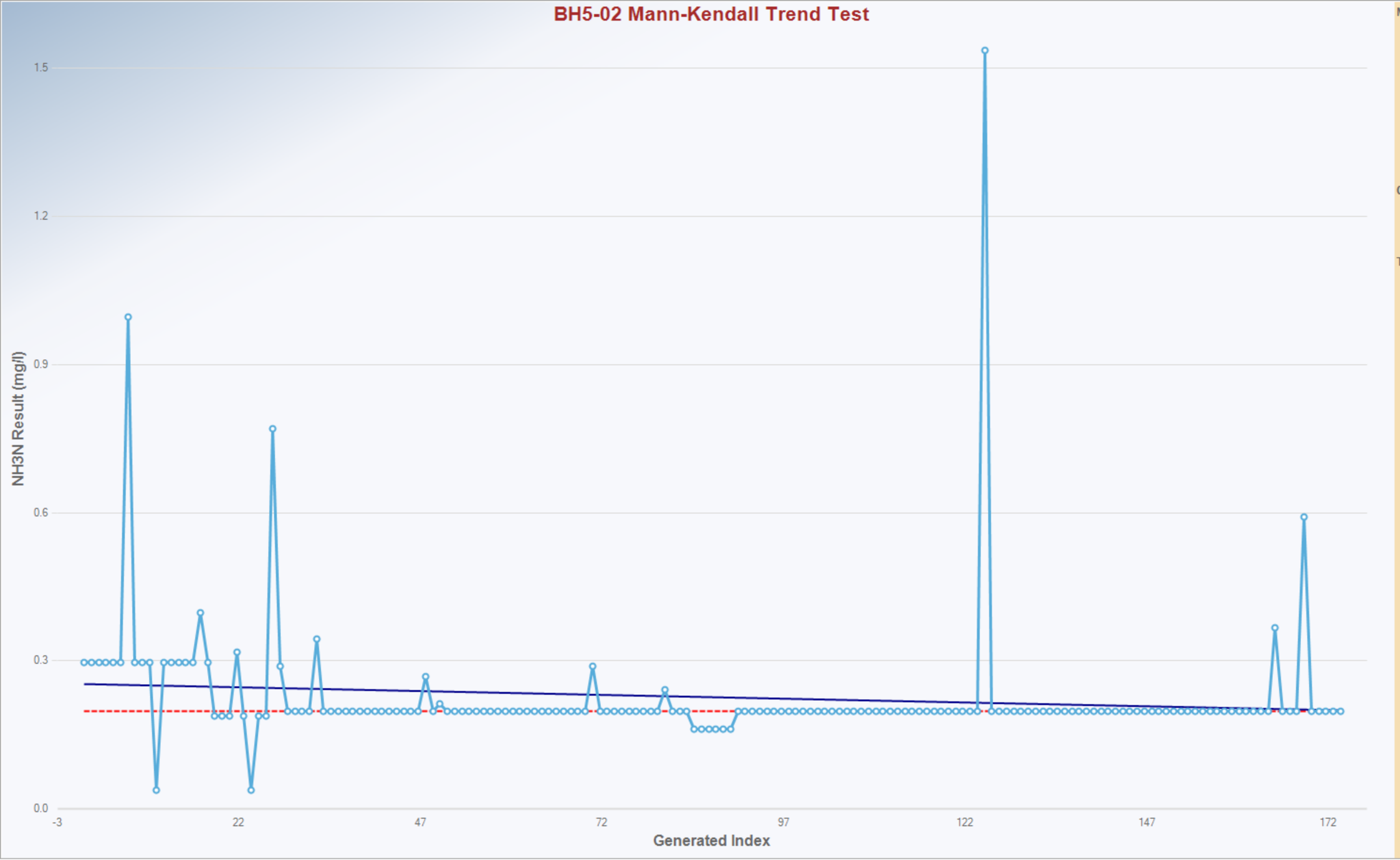
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 12:01:28							
4			From File	BH5-02.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	174							
14			Number Values Reported (n)	174							
15			Minimum	0.04							
16			Maximum	1.54							
17			Mean	0.229							
18			Geometric Mean	0.213							
19			Median	0.2							
20			Standard Deviation	0.134							
21			Coefficient of Variation	0.587							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-1721							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	575.7							
27			Standardized Value of S	-2.987							
28			Approximate p-value	0.00141							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										

BH5-02 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	174
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	575.7329
Standardized Value of S	-2.9875
M-K Test Value (S)	-1,721
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0014

OLS Regression Line (Blue)

OLS Regression Slope	-0.0003
OLS Regression Intercept	0.2555

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 11:20:27	
From File	BH208.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

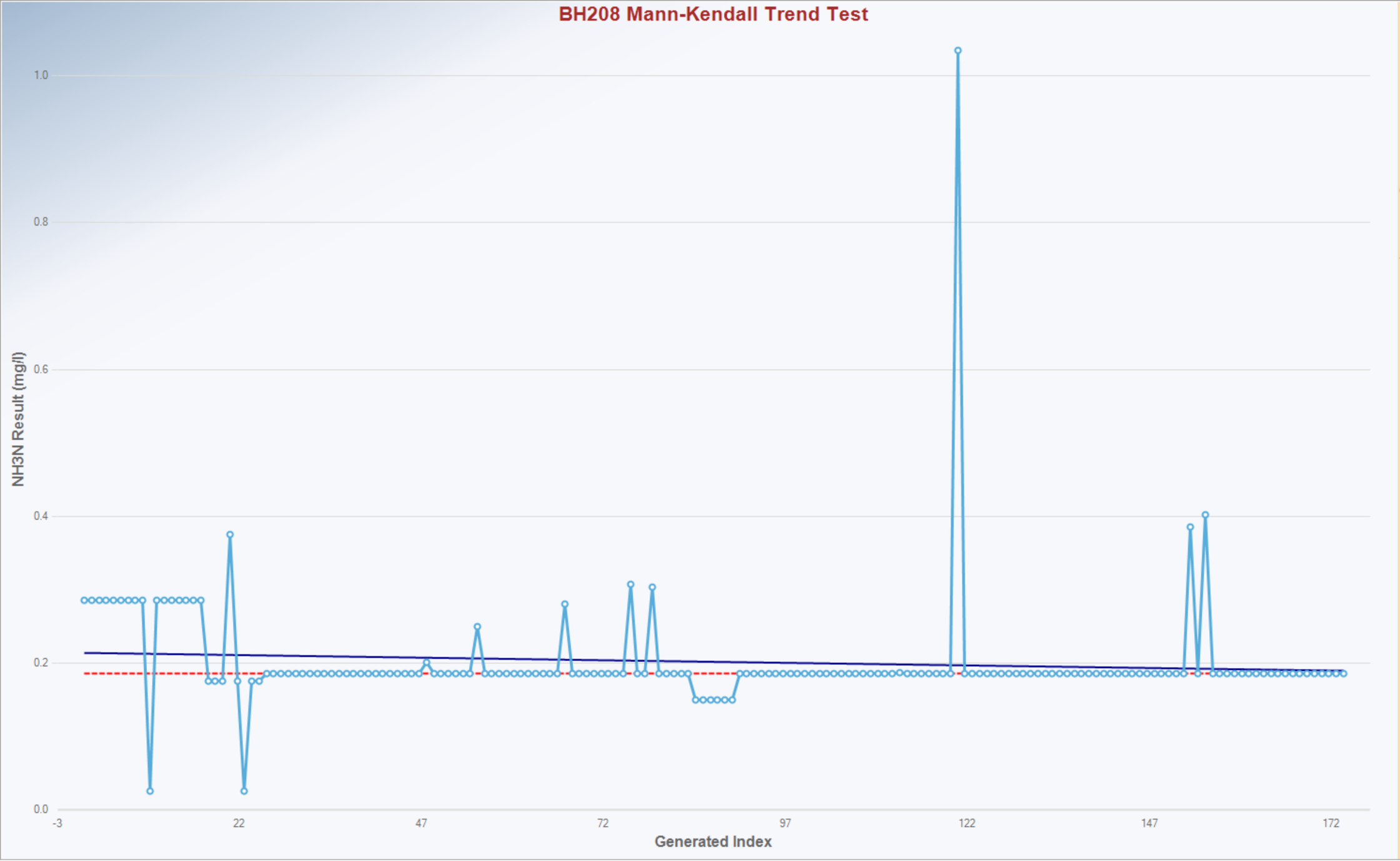
NH3N Result (mg/l)

General Statistics	
Number or Reported Events Not Used	0
Number of Generated Events	174
Number Values Reported (n)	174
Minimum	0.04
Maximum	1.05
Mean	0.217
Geometric Mean	0.209
Median	0.2
Standard Deviation	0.0783
Coefficient of Variation	0.361

Mann-Kendall Test	
M-K Test Value (S)	-1240
Critical Value (0.05)	-1.645
Standard Deviation of S	565.2
Standardized Value of S	-2.192
Approximate p-value	0.0142

Statistically significant evidence of a decreasing trend at the specified level of significance.

BH208 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	174
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	565.2463
Standardized Value of S	-2.1920
M-K Test Value (S)	-1,240
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0142

OLS Regression Line (Blue)

OLS Regression Slope	-0.0001
OLS Regression Intercept	0.2290

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2000

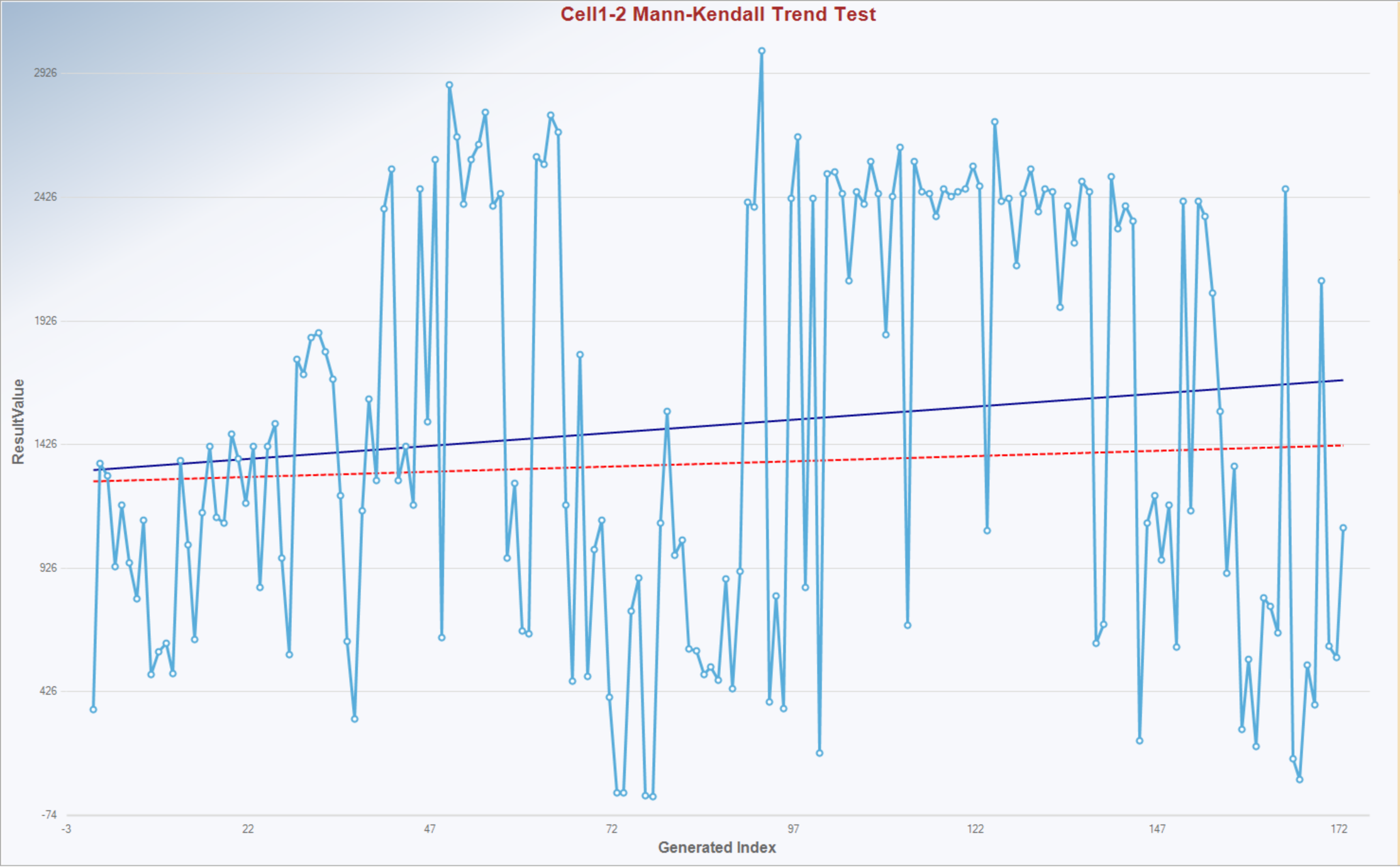
Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 12:04:58	
From File	Cell1-2.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

ResultValue	
General Statistics	
Number or Reported Events Not Used	0
Number of Generated Events	173
Number Values Reported (n)	173
Minimum	1.45
Maximum	3020
Mean	1504
Geometric Mean	1119
Median	1350
Standard Deviation	848.4
Coefficient of Variation	0.564
Mann-Kendall Test	
M-K Test Value (S)	626
Critical Value (0.05)	1.645
Standard Deviation of S	761.7
Standardized Value of S	0.821
Approximate p-value	0.206

Insufficient evidence to identify a significant trend at the specified level of significance.

Cell1-2 Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	173
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	761.6732
Standardized Value of S	0.8206
M-K Test Value (S)	626
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.2059

OLS Regression Line (Blue)

OLS Regression Slope	2.1077
OLS Regression Intercept	1,320.6717

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.8459
Theil-Sen Intercept	1,276.4080

Insufficient statistical evidence of a significant trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 12:14:35	
From File	Cell3-4.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

NH3N Result (mg/l)

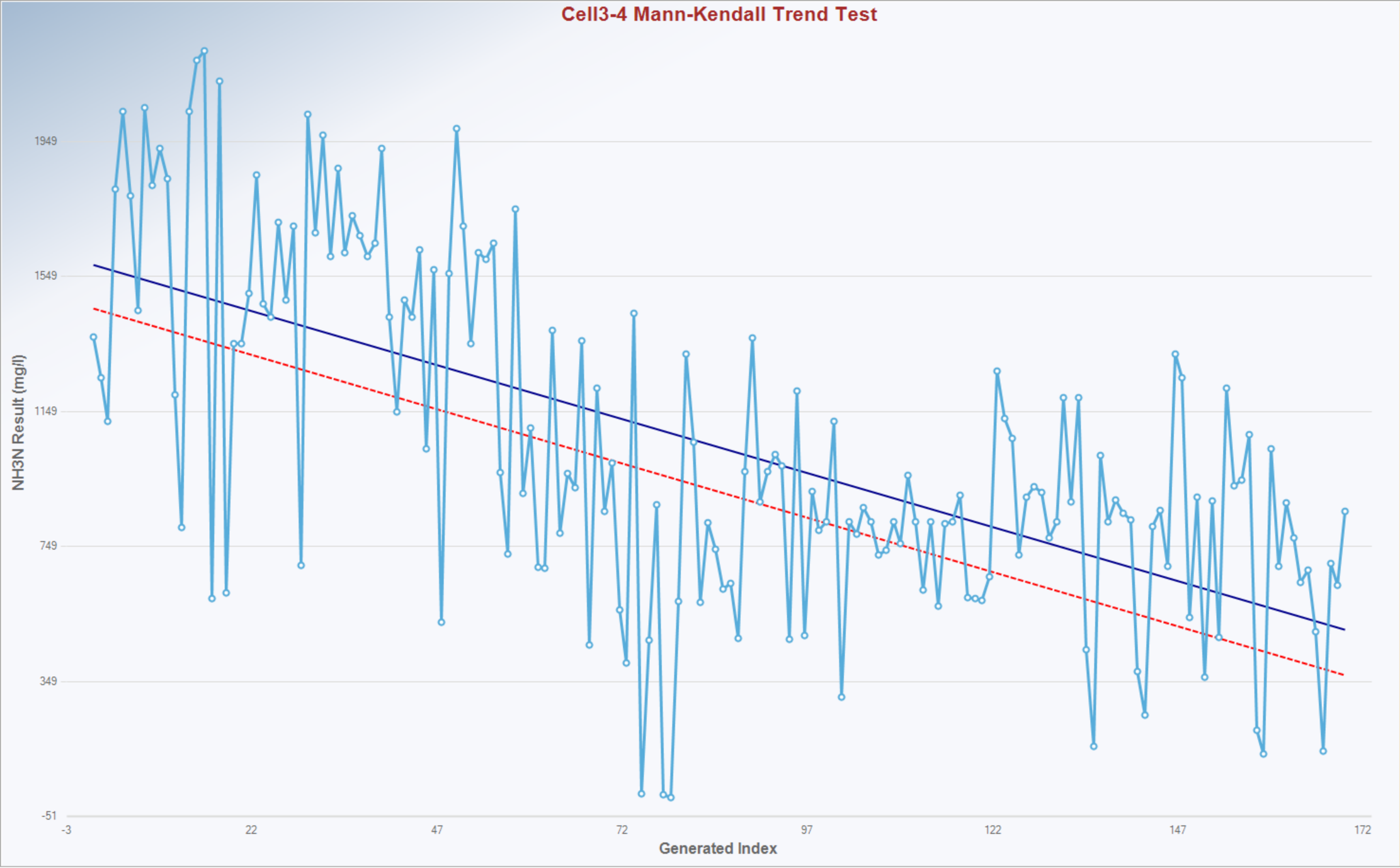
General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	170
Number Values Reported (n)	170
Minimum	4.59
Maximum	2220
Mean	1043
Geometric Mean	870.7
Median	912
Standard Deviation	497.1
Coefficient of Variation	0.477

Mann-Kendall Test

M-K Test Value (S)	-5909
Critical Value (0.05)	-1.645
Standard Deviation of S	742
Standardized Value of S	-7.962
Approximate p-value	8.460E-16

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	170
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	742.0186
Standardized Value of S	-7.9621
M-K Test Value (S)	-5,909
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0000

OLS Regression Line (Blue)

OLS Regression Slope	-6.4099
OLS Regression Intercept	1,591.2059

Theil-Sen Trend Line (Red)

Theil-Sen Slope	-6.4405
Theil-Sen Intercept	1,462.6593

Statistically significant evidence of a decreasing trend at the specified level of significance.

	Mann-Kendall Trend Test Analysis	
User Selected Options		
Date/Time of Computation	ProUCL 5.2 29/08/2023 12:18:32	
From File	Cell5.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

NH3N Result (mg/l)

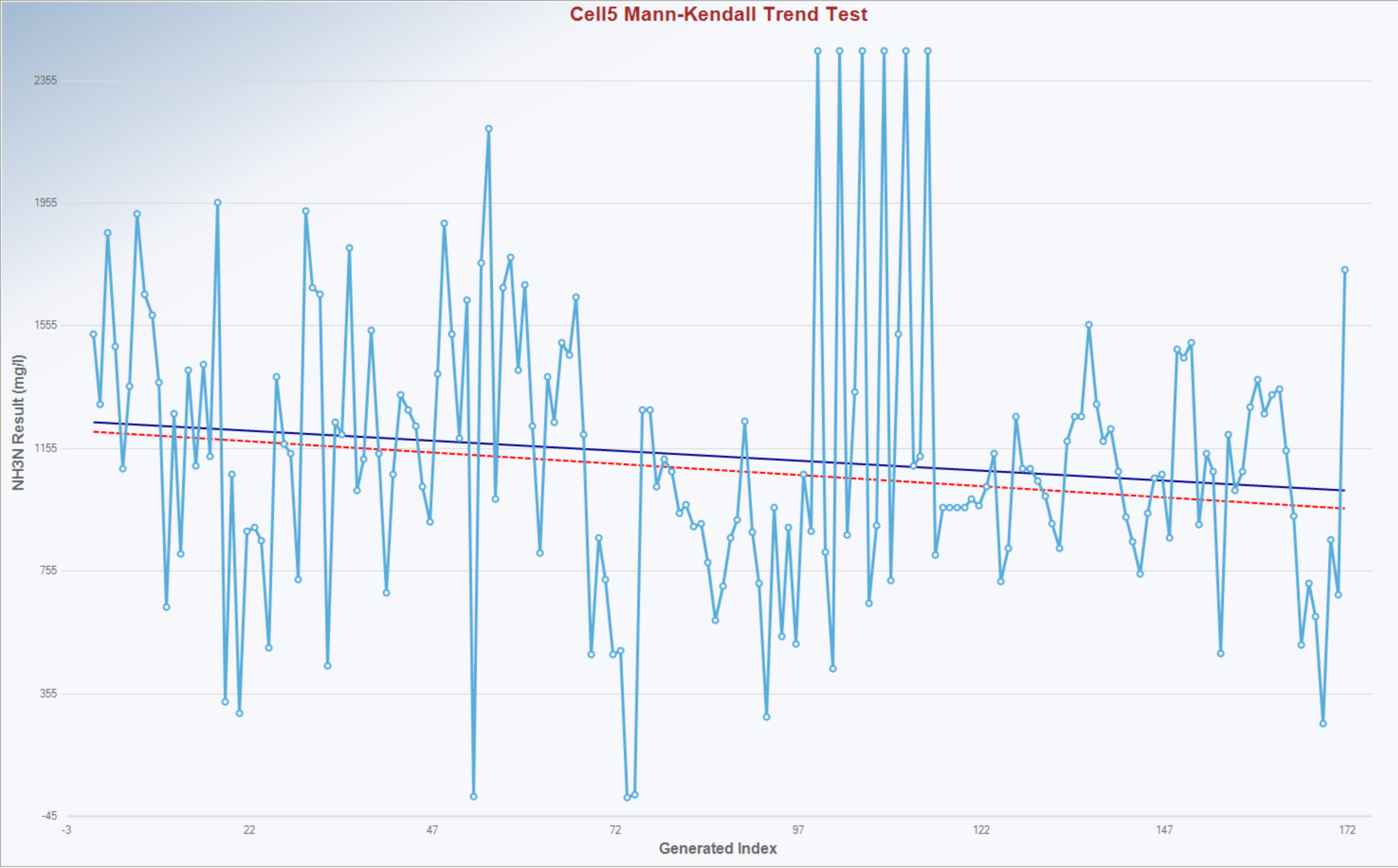
General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	172
Number Values Reported (n)	172
Minimum	16.1
Maximum	2454
Mean	1130
Geometric Mean	992.6
Median	1085
Standard Deviation	465.1
Coefficient of Variation	0.411

Mann-Kendall Test

M-K Test Value (S)	-1679
Critical Value (0.05)	-1.645
Standard Deviation of S	755.1
Standardized Value of S	-2.222
Approximate p-value	0.0131

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	172
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	755.0940
Standardized Value of S	-2.2222
M-K Test Value (S)	-1,679
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0131

OLS Regression Line (Blue)

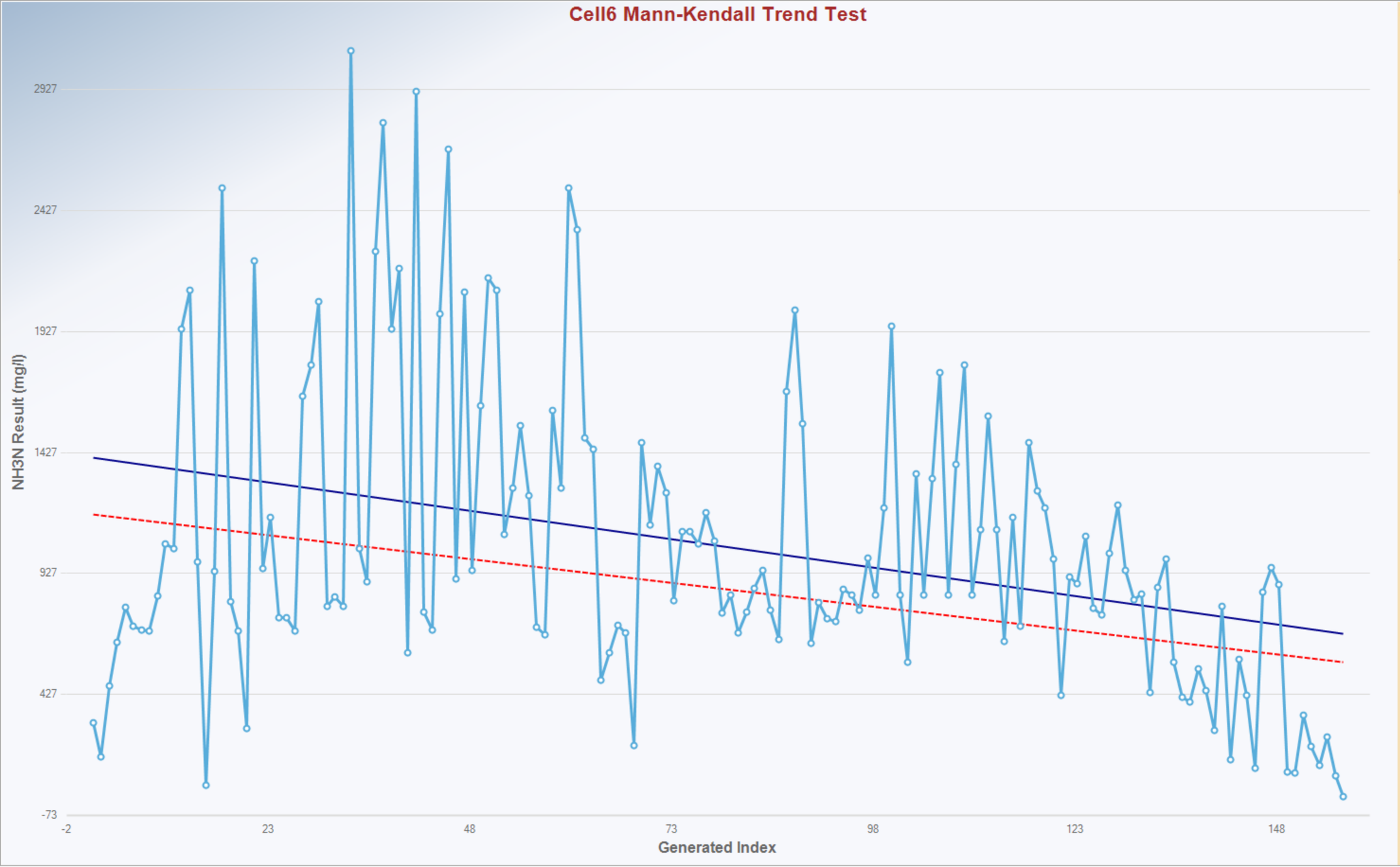
OLS Regression Slope	-1.2921
OLS Regression Intercept	1,242.0234

Theil-Sen Trend Line (Red)

Theil-Sen Slope	-1.4717
Theil-Sen Intercept	1,212.3045

Statistically significant evidence of a decreasing trend at the specified level of significance.

1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 12:21:41							
4			From File	Cell6.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9			**NH3N Result (mg/l)**								
10											
11			**General Statistics**								
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	156							
14			Number Values Reported (n)	156							
15			Minimum	3.84							
16			Maximum	3090							
17			Mean	1042							
18			Geometric Mean	828.7							
19			Median	866.4							
20			Standard Deviation	619.7							
21			Coefficient of Variation	0.595							
22											
23			**Mann-Kendall Test**								
24			M-K Test Value (S)	-2506							
25			Critical Value (0.05)	-1.645							
26			Standard Deviation of S	652.5							
27			Standardized Value of S	-3.839							
28			Approximate p-value	6.1774E-5							
29											
30	**Statistically significant evidence of a decreasing**										
31	**trend at the specified level of significance.**										



Mann-Kendall Trend Analysis

n	156
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	652.5177
Standardized Value of S	-3.8390
M-K Test Value (S)	-2,506
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0001

OLS Regression Line (Blue)

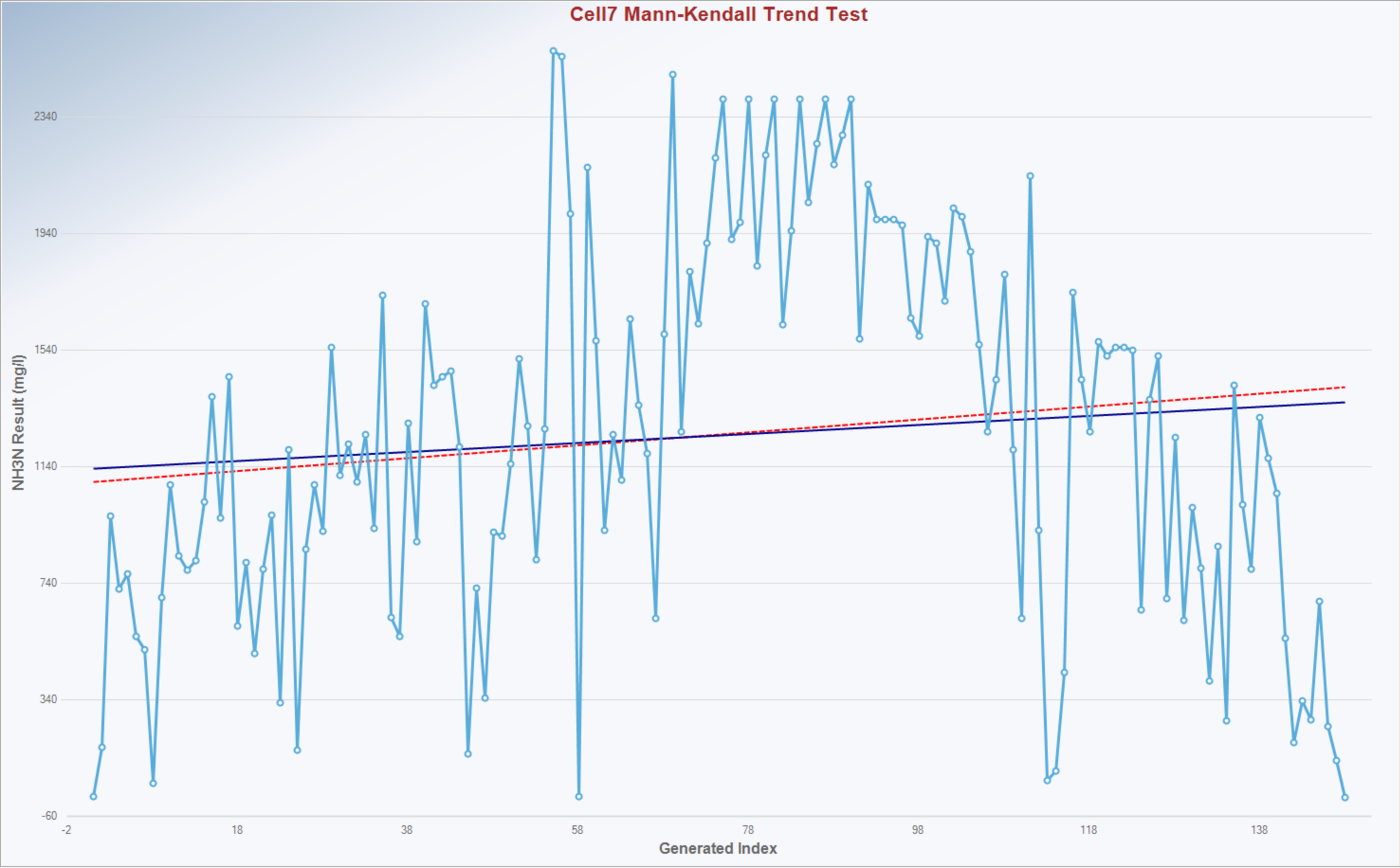
OLS Regression Slope	-4.6852
OLS Regression Intercept	1,409.3639

Theil-Sen Trend Line (Red)

Theil-Sen Slope	-3.9533
Theil-Sen Intercept	1,176.6875

Statistically significant evidence of a decreasing trend at the specified level of significance.

	A	B	C	D	E	F	G	H	I	J	K
1				**Mann-Kendall Trend Test Analysis**							
2			User Selected Options								
3			Date/Time of Computation	ProUCL 5.2 29/08/2023 12:26:47							
4			From File	Cell7.xls							
5			Full Precision	OFF							
6			Confidence Coefficient	0.95							
7			Level of Significance	0.05							
8											
9	**NH3N Result (mg/l)**										
10											
11	**General Statistics**										
12			Number or Reported Events Not Used	0							
13			Number of Generated Events	148							
14			Number Values Reported (n)	148							
15			Minimum	4.04							
16			Maximum	2570							
17			Mean	1248							
18			Geometric Mean	945							
19			Median	1251							
20			Standard Deviation	655.9							
21			Coefficient of Variation	0.525							
22											
23	**Mann-Kendall Test**										
24			M-K Test Value (S)	873							
25			Critical Value (0.05)	1.645							
26			Standard Deviation of S	603.1							
27			Standardized Value of S	1.446							
28			Approximate p-value	0.0741							
29											
30	**Insufficient evidence to identify a significant**										
31	**trend at the specified level of significance.**										



Mann-Kendall Trend Analysis

n	148
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	603.1360
Standardized Value of S	1.4458
M-K Test Value (S)	873
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.0741

OLS Regression Line (Blue)

OLS Regression Slope	1.5490
OLS Regression Intercept	1,133.0043

Theil-Sen Trend Line (Red)

Theil-Sen Slope	2.1992
Theil-Sen Intercept	1,087.0423

Insufficient statistical evidence of a significant trend at the specified level of significance.