Safety Evaluation Report
License Renewal of the Kennecott Uranium Company Sweetwater Uranium Project, Sweetwater County, Wyoming

Materials License No. SUA-1350

Docket No. 040-08584

KENNECOTT URANIUM COMPANY

February 2018

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ACRONYMS AND ABBREVIATIONS

ac	acre(s)
ADAMS PLL	ADAMS Public Legacy Library
ALARA	as low as reasonably achievable
ALI	annual limit on intake
CAP	corrective action program
CEDE	committed effective dose equivalent
CFR	Code of Federal Regulations
cm	centimeter(s)
DAC	derived air concentration
EA	environmental assessment
EDE	effective dose equivalent
EIS	environmental impact statement
ER	environmental report
FR	Federal Register
ft	foot/feet
GPS	ground water protection standard
ha	hectare(s)
hr	hour(s)
in.	inch(es)
ISR	in situ recovery
IX	ion exchange
kg	kilogram(s)
km	kilometer(s)
L	liter(s)
lb	pound(s)
LLD	lower limit of detection
LRA	license renewal application
m	meter(s)
m^2	square meter(s)
MCE	maximum credible earthquake
mg	milligram(s)
mg/L	milligram(s) per liter
mi	mile(s)
MILDOS	Uranium Mill Radiation Dose (computer program)
mR/hr	milliroentgen(s) per hour
mrem	millirem
mrem/yr	millirem per year
NA	not applicable
NH_3	ammonia
NRC	U.S. Nuclear Regulatory Commission
OSL	optically stimulated luminescent
pCi/g	picocurie(s) per gram
pCi/L	picocurie(s) per liter
PGA	peak ground acceleration
POC	point of compliance

ppm	parts per million
QA	quality assurance
QC	quality control
Ra-226	radium-226
Ra-228	radium-228
RAI	request for additional information
rem	roentgen equivalent man
RESRAD	Residual Radiation Dose (computer program)
RG	regulatory guide
Rn-222	radon-222
RSO	Radiation Safety Officer
SER	safety evaluation report
SERP	Safety and Environmental Review Panel
SOP	standard operating procedure
SX	solvent extraction
TDS	total dissolved solids
TEDE	total effective dose equivalent
TER	technical evaluation report
Th-230	thorium-230
TLD	thermoluminescent dosimeter
µg	microgram(s)
µR	microroentgen(s)
U-nat	natural uranium
U_3O_8	uranium oxide
U.S.	United States
USGS	U.S. Geological Survey
WL	working level(s)

INTRODUCTION

By letter dated July 24, 2014, Kennecott Uranium Company (KUC) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for renewal of Source Material License SUA-1350 for the Kennecott facility located in Sweetwater County, Wyoming. The Kennecott facility is a conventional uranium mill facility subject to safety requirements found in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 40, "Domestic Licensing of Source Material" and 10 CFR Part 20, "Standards for Protection Against Radiation."

The Kennecott license renewal application (LRA) for the Kennecott facility consisted of a combined technical and environmental report (KUC, 2014). Subsequent submittals (KUC 2015; 2016a-c, 2017, 2018) were submitted by the licensee in response to requests for additional information (RAI) from the NRC staff. The LRA and supplemental information formed the basis of the NRC staff's review.

This safety evaluation report (SER) documents the staff's review of the safety aspects of the renewal application under 10 CFR Parts 20 and 40. The Atomic Energy Act of 1954 as amended by the Uranium Mill Tailings Radiation Control Act of 1978, authorizes the NRC to issue licenses for the possession and use of source material and byproduct material. The NRC must license facilities, including conventional uranium mills, in accordance with NRC regulatory requirements to protect public health and safety from radiological hazards. In accordance with 10 CFR § 40.43, an application for renewal of a specific license must be filed on NRC Form 313 and in accordance with § 40.31, "Application for specific licenses." In accordance with 10 CFR § 40.32, "General Requirements for Issuance of Specific Licenses," the NRC staff is required to make the following safety findings when issuing a conventional uranium mill license:

> The application is for a purpose authorized by the Atomic Energy Act.
>
> The licensee is qualified by reason of training and experience to use the source material for the purpose requested in such a manner as to protect health and minimize danger to life or property.
>
> The licensee's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life or property.
>
> The issuance of the license will not be inimical to the common defense and security or to the health and safety of the public.

This SER documents the safety portion of the staff's review of the LRA, as amended, and includes an analysis to determine KUC's compliance with these and other applicable 10 CFR Part 20 and Part 40 requirements, including applicable requirements set forth in 10 CFR Part 40, Appendix A, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content."

An Environmental Assessment (EA) is being prepared in parallel with this SER to address environmental impacts of the proposed action in accordance with 10 CFR Part 51, the NRC's National Environmental Policy Act (NEPA) implementing regulations.

The NRC issued Source Materials License No. SUA-1350 to Mineral Exploration Company on February 16, 1979. This license authorized the licensee to produce, possess, and transfer

uranium at its Sweetwater mill located in Sweetwater County, WY. Minerals Exploration Company constructed the mill in 1979 and 1980 and operated it for 2 years from February 1981 until April 1983 before operations were suspended because of decline in the market price for yellowcake (uranium oxide (U_3O_8)). During this initial operation, the mill processed a total of 2.3 million metric tons (2.5 million tons) of uranium ore with an average ore grade of 0.029 percent U_3O_8. The NRC renewed Source Materials License No. SUA-1350 on May 29, 1985, and again on June 23, 1992, when the license was transferred to KUC. The renewals were for "possession only" status and not for operation. In 1997, KUC requested a performance-based license, which included a request to resume operation of the mill. The NRC approved the request for a performance-based operating license in 1999 (NRC, 1999). As described in the 1999 SER, (NRC, 1999), under a performance based license, the licensee may:

- Make changes in the facility or process as presented in the application;
- Make changes in the procedures presented in the application; or
- Conduct tests or experiments not presented in the application, without prior NRC approval if the licensee ensures that the following conditions are met:
    - The change, test, or experiment does not conflict with any requirement specifically stated in the license (excluding material referenced in the performance based license condition) or impair the licensee's ability to meet all applicable NRC regulations.
    - There is no degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan.
    - The change, test or experiment is consistent with NRC's conclusions regarding actions analyzed and selected in the environmental assessment (EA).

In this license renewal application, KUC is requesting a modification to the current license. This is discussed in Section 1 of the SER. The staff's review of KUC's license renewal application for the Kennecott facility identified several issues. The NRC staff identified these issues in RAIs and evaluates the licensee's responses in this SER. Table 1 includes license condition language as well as the section of this SER where the the license condition is discussed. The staff concludes that the findings described in succeeding sections of this SER, subject to imposition of the license conditions, support the renewal of this license.

Table 1. New or Modified License Conditions, Source Material License SUA-1350
(New text in underlined italics; removed text struck out)

License Condition Number	SER Section	License Condition
9.5	1.4	The licensee shall conduct operations in accordance with statements, representations, and conditions contained in Section 5.2, 5.3, 5.4, and 6.0 of the original license application as revised, dated August 1978, in Sections 2.0, 3.0 and 4.0 of the renewal application dated March 1984, as supplemented by submittals dated April 3, 1983, and January 17, 1985, and the Final Design Volume VII of the license renewal application submitted September 18, 1997, with page changes submitted April 13, June 10, July 1, and July 20, 1998, and March 25, 1999, the renewal application dated May 25, 2004 *(ML041530047),* except where superseded by license conditions below*, and the renewal application dated July 24, 2014 (ML14251A113), as supplemented by submittals dated, October 31, 2015 (ML15300A296 and ML15300A295), June 2, 2016 (ML16160A410), October 18, 2016 (ML16298A147), November 14, 2016 (ML16635A183), September 28, 2017 (ML17277A074), and January 12, 2018 (ML18043A034).* Whenever the word "will" is used in the above referenced submittals, it shall denote a requirement. *In addition, the licensee must use the approach, methods, and criteria described in the guidance and other documents it has committed to follow in its applications and other submittals referenced above. Although guidance or other references describe recommended or approved approaches, using permissive or normative language such as "may" or "should," where the licensee has committed to such language, it shall denote a requirement.*

License Condition Number	SER Section	License Condition
9.7	7.4	The licensee shall maintain an NRC-approved financial surety arrangement, consistent with 10 CFR 40, Appendix A, Criteria 9 and 10, adequate to cover the estimated costs, if accomplished by a third party for decommissioning and decontamination of the mill and mill site, reclamation of any existing or approved tailings or waste disposal areas, reclamation of approved evaporation ponds, groundwater restoration, and the long-term surveillance fee. With submittal of a revised reclamation/decommissioning plan, the licensee shall submit, for NRC review and approval, a proposed revision to the financial surety arrangement, if estimated costs in the proposed plan exceed the amount covered in the existing financial surety. The NRC-approved revision to the cost estimate shall be incorporated into the next annual surety amount. For approved reclamation plan referenced in License Contion 10.5, the license shall provide the NRC-approved surety amount (adjusted for inflation) for reclamation of the proposed structures associated with resumption of mill operation (e.g., tailings impoundment, evaporation ponds, and diversion channels) before commencement of construction of any of these structures. Annual updates to the surety amount required by 10 CFR 40, Appendix A, Criteria 9 and 10, shall be submitted to the NRC at least three (3) months prior to the anniversary date (October 30) of the approved surety arrangement. If the NRC has not approved a proposed revision to the surety coverage thirty (30) days prior to the expiration date of the existing surety arrangement, the licensee shall extend the existing surety arrangement. The revised surety amount will be in effect within three (3) months of written NRC approval. The licensee's currently NRC-approved surety (performance bond) shall be continuously maintained in an amount no less than *$12,033,000* for the purpose of complying with 10 CFR 40, Appendix A Criteria 9 and 10, for decommissioning costs related to the existing facility, until a replacement amount is authorized by the NRC.
9.10	7.4	Decommissioning of the facility shall be performed as presented in the Final Design, Volume VI, Part 2-Mill Decommissioning Addendum to the Existing Impoundment Reclamation Plan, submitted May 28, 1998, as supplemented by the response to comments submitted February 3, 1999, and the catchment basis remediation plan dated May 12, 2004 *(ML041480493)*, as revised July 22, 2004 *(ML042110348)*, December 15, 2004 *(ML043520255)*, January 18, 2005 *(ML050350266)*, and October 3, 2006 *(ML062930067 and ML062860031)*. ~~The verification results of this remediation are to be submitted to NRC for approval, as soon as reasonably possible.~~ The catchment basin verification report and NRC's approval letter shall be referenced in the Final Status Survey Report. Residual contamination remaining under structural foundations after the catchment basis remediation shall be removed at the time the structures are decommissioned. The NRC shall be notified and detailed SOPs for decommissioning (land and buildings) shall be available for review at least three (3) months before decommissioning begins.

License Condition Number	SER Section	License Condition
11.3	7.4	The licensee shall *fully characterize the areal extent of ground water contamination associated with the site and prepare and submit a revised corrective action program (CAP) to the NRC for review and approval that will achieve compliance with the approved ground water protection standards for the site. The revised CAP shall propose acceptable methods to achieve and demonstrate compliance for those parameters in exceedance of the corresponding ground water protection standard and also include a time limit to reach compliance. The licensee shall submit a report on the full areal extent of ground water contamination to NRC for review and approval within 6 months of receipt of the approved license. The licensee shall submit a revised CAP to the NRC for review and approval within 6 months of NRC's approval of the aforementioned ground water contamination report. The effectiveness of the licensee's CAP will inform the pre-operational inspection that is required before the licensee can resume milling activities.* *Until a revised CAP is approved by NRC, point of compliance (POC), monitoring, and pumpback wells for the existing tailings impoundment shall continue to be sampled at the locations, at the frequency, and for the parameters provided in Table 5-1 (for the existing impoundment) of the Final Design Volume VII, submitted (page change) June 21, 1999, as revised January 18, 2005 (ML050350266).* The ground-water protection standards at point of compliance (POC) Wells TMW-15, 16, 17, and 18 are: arsenic = 0.05 mg/L, beryllium = 0.01 mg/L, cadmium = 0.01 mg/L, chromium = 0.05 mg/L, lead-210 = 8.9 pCi/L, nickel = 0.01 mg/L, combined radium-226/228 = 5.8 pCi/L, selenium = 0.01 mg/L, thorium-230 = 7.0 pCi/L, natural uranium = 36.0 pCi/L, and gross alpha = 15.0 pCi/L, manganese = 0.2 mg/L, and iron = 0.6 mg/L. Reporting limits for sampled constituents shall be as provided in Table 5-11 of the Final Design Volume VII, submitted April 13, 1998. *Also, until the NRC approves a revised CAP,* ~~The~~ *the* catchment basin pumpback wells and monitoring Wells TMW-92, 93, 94, 95, 97, 98, 99, 100, 101, 104, 111, 112, 113, and 115 will be sampled quarterly for diesel range and gasoline range organics and volatile organic compounds, in addition to the ~~above~~ constituents *specified above for the existing tailings impoundment*. The *additional* ground water protection standards to be used to assess data from these wells are as follows: 1,1-dichloroethane = 3.0 mg/L, 1,1-dichloroethene = 0.007 mg/L, DRO = 10 mg/L, GRO = 10 mg/L, naphthalene = 1.5 mg/L, toluene = 1 mg/L, 1,1,1-trichloroethane = 0.20 mg/L, 1,2,4-trimethylbenzene = 0.012 mg/L, 1,3,5-trimethylbenzene = 0.012 mg/L, m+p xylenes = 10 mg/L, manganese = 0.2 mg/L, aluminum =1.8 mg/L, and iron = 0.6 mg/L.

11.4	5.4	[*This license condition has been substantially modified in comparison to the version in License Amendment No. 34*] Upon resumption of milling operations, the licensee shall implement a ground-water detection and compliance monitoring program for the tailings impoundment and evaporation ponds in accordance with the standards stipulated in the Addendum to the Revised Environmental Report--Background Ground Water Quality and Detection Standards, dated January 1996, as revised by the submittals of January 8, 1998, and March 25, 1999, and the following table:

Category	**Locations**	**Frequency**	**Analytical Parameters**
Tailings Liquid	Tailings Impoundment	Weekly	Bromide tracer† (required concentration ≥ 10 mg/L)
Evaporation Ponds Liquid	Evaporation Ponds (one cell)	Weekly	Bromide tracer† (required concentration ≥ 10 mg/L)
Monitoring Wells, Tailings Impoundment	TMW-31, TMW-64, TMW-65*, TMW-75, TMW-78, TMW-85	Monthly for first year, quarterly thereafter	Bromide tracer† Chloride pH
Monitoring Wells, Evaporation Ponds	TMW-3, TMW-49, plus three new wells (per Figure 6 in ML ML17277A074)	Monthly for first year, quarterly thereafter	Bromide tracer† Chloride pH
Point of Compliance Well, Tailings Impoundment	TMW-64	Semiannually	Arsenic, beryllium, bromide, cadmium, chromium, Pb-210, nickel, combined Ra-226 and -228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, TDS
Point of Compliance Well, Evaporation Ponds	TMW-3, TMW-49, plus three new wells (per Figure 6 in ML ML17277A074)	Semiannually	Arsenic, beryllium, bromide, cadmium, chromium, Pb-210, nickel, combined Ra-226 and -228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, TDS
*Perched well; fluids to be analyzed if present; †The reporting limit for bromide is 0.05 mg/L			

Within 1 year of resumption of milling operations, and annually thereafter, the licensee shall perform an evaluation to determine whether each detection monitoring and point of compliance well is downgradient of its associated impoundment. For each detection or point of compliance well found not downgradient, the licensee shall, within 6 months, install or place in service, a downgradient well.

License Condition Number	SER Section	License Condition
		For non-ground water environmental monitoring, upon resumption of milling operations the licensee shall conduct a monitoring program in accordance with the pertinent on-file SOPs for environmental monitoring and the relevant requirements in Table 5-2 of the Final Design Volume VII, submitted (page change) June 21, 1999.
11.5	5.4	During ~~any~~*the current period* of mill standby, the licensee shall conduct an environmental monitoring program in accordance with on-file SOPs for environmental monitoring, and in accordance with Table 5-1 of the Final Design Volume VII, submitted (page change) June 21, 1999, as revised January 18, 2005*, except for the requirements in Table 5-1 pertaining to wells associated with "Tailings Impoundment Point of Compliance," "Catchment Basin Compliance Monitoring," "Tailings Monitor," "Tailings Impoundment Pumpback" and "Catchment Basin Pumpback" which are superseded by the requirements in license condition 11.3.* *For environmental monitoring during any future, post-operations mill standby period, the licensee must submit a license amendment application to NRC for review and approval.*

References

10 CFR Part 20, “Standards for Protection Against Radiation.”

10 CFR Part 40, Appendix A, “Criteria Relating to the Operation of Uranium Mills and to the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily from their Source Material Content.”

Atomic Energy Act of 1954, as amended, 42 U.S.C. § 2011 et seq.

KUC, 2018, Sweetwater Uranium Project-Docket Number 40-8584, Source Material License SUA-1350, License Renewal, Responses to October 31, 2017 Requests for Additional Information (RAIs), dated January 12, 2018 (ADAMS Accession No. ML18043A034)

KUC, 2017, Sweetwater Uranium Project-Docket No. 40-8584, Source Material License SUA-1350-Sweetwater County, WY, License Renewal, Response to the June 26, 2017 Request for Additional Information (RAIs), September, 2017, (ADAMS Accession No. ML17277A074)

KUC, 2016a, Sweetwater Uranium Project-Docket No. 40-8584, Source Material License SUA-1350-Sweetwater County, WY, Supplement to Licensee’s Environmental Report, June 2, 2016 (ADAMS Accession No. ML16160A410)

KUC, 2016b, Sweetwater Uranium Project-Docket No. 40-8584, Source Material License SUA-1350-Sweetwater County, WY, Completion of the Response to the August 25, 2016 Letter, Attachment 2-Groundwater Monitoring Plan and Attachment 3-Air Effluent Monitoring Program, October 18, 2016, (ADAMS Accession No. ML16298A147)

KUC, 2016c, Sweetwater Uranium Project-Docket No. 40-8584, Source Material License SUA-1350-Sweetwater County, WY, Revised Supplemental Environmental Report (ER), November 14, 2016, (ADAMS Accession No. ML16635A183)

KUC, 2015, Responses to NRC Requests for Additional Information, October 31, 2015, (ADAMS Accession No. ML15300A296 and ML15300A295)

KUC, 2014, “Sweetwater Uranium Project—Docket Number 40-8584, Source Material License No. SUA-1350—Request for a Renewal Source Material License SUA-1350 for a Ten (10) Year Term,” Kennecott Uranium Company, July 24, 2014. (ADAMS Accession No. ML14251A113 (package)

NRC, 2014, NUREG-2126, “Standard Review Plan for Conventional Uranium Mill and Heap Leach Facilities, Draft Report for Comment,” November 2014.

NRC, 1999, Letter from NRC to Kennecott, “Renewal of Source Material License SUA-1350 for Operation and Approval of the Reclamation Plan and Surety Amount for the Kennecott Uranium Company, Sweetwater Uranium Project, Sweetwater County, Wyoming,” August 18, 1999 (ADAMS Accession No. ML080590244).

1.0 Proposed Activities

1.1 Regulatory Requirements

The purpose of this section of the safety evaluation report (SER) is to determine whether the licensee's description of the proposed activities at the Kennecott Uranium Company (KUC) facility in the license renewal application (LRA) is in compliance with the applicable requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 40.31, "Application for Specific Licenses," and 10 CFR 40.43, "Renewal of licenses."

1.2 Regulatory Acceptance Criteria

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the application in accordance with the regulatory requirements in 10 CFR Part 40 and associated guidance presented in NUREG-2126, "Standard Review Plan for Conventional Uranium Mill and Heap Leach Facilities, Draft Report for Comment," issued November 2014 (NRC, 2014).

1.3 Staff Review and Analysis

The licensee is requesting renewal of Source Materials License No. SUA-1350 for the KUC facility located in Sweetwater, WY, for an additional 10-year period. The proposal is for "the license [to] be renewed in its existing form" with only an update change to License Condition 9.10 related to decommissioning activities. Unless otherwise stated, information presented in this section comes from Section 1 of the LRA (KUC, 2014), as updated. The NRC staff review and analysis includes an overview of the facility's current status, ownership, license, and facility inspection reports since the last license renewal in 2004.

Per License Condition 9.4 in license amendment no. 33 (NRC, 2015), KUC is licensed as follows:

> The licensee may possess byproduct material in the form of uranium waste tailings and other uranium byproduct waste generated by its milling operations.
>
> The licensee may operate an ion exchange (IX) uranium recovery facility in accordance with submittals dated September 27, 1989, and October 18, 1991. Contaminated liquid and solid wastes from the IX plant shall be placed in the tailings impoundment.
>
> KUC is not authorized to produce any other uranium concentrates until a pre-operational inspection has been completed and any safety issues resolved. The inspection should confirm, in part, that operating procedures and approved radiation safety and environmental monitoring programs are in place, and that pre-operational testing is complete.
>
> For monitoring purposes, the standby mode of operation is applicable for any continuous 90-day or longer period when no yellowcake is produced by the mill. The NRC shall be notified at least 90 days before any planned resumption of uranium milling operations.

The facility has continued to operate in standby mode since the NRC revised the license from possession only to a performance-based operating license, and no major activities, such as the production of yellowcake, have occurred at the facility other than reclamation of several areas within the licensed area. This reclamation is the cleanup process and not related to yellowcake production. However, under the current license, the licensee has the option to resume operations upon notification to the NRC, the completion of a pre-operational inspection, and the resolution of safety issues.

The facility's licensee and manager is KUC. The facility is owned by the Green Mountain Mining Venture, which is wholly owned by Rio Tinto. The footprint of the facility remains the same as compared to the license renewal in 2004.

The NRC has approved the following license amendments since the last license renewal:

Amendment No. 21—Catchment Basin Remediation Amendment and Revision to License Condition 9.10, May 26, 2005 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML051510395)

Amendment No. 22—Amendment of Source Materials License No. SUA-1350 to Delete Obsolete Language, June 17, 2005 (ADAMS Accession No. ML051710500)

Amendment No. 23—Annual Surety Update, July 29, 2005 (ADAMS Accession No. ML05260237)

Amendment No. 24—Annual Surety Update, September 16, 2006 (ADAMS Accession No. ML062650081)

Amendment No. 25—Modification to the Mill Decommissioning Plan, Catchment Basin Reclamation, November 24, 2006 (ADAMS Accession No. ML063050175)

Amendment No. 26—Annual Surety Update, October 3, 2007 (ADAMS Accession No. ML072410229)

Amendment No. 27—Annual Surety Update, October 2, 2008 (ADAMS Accession No. ML082620508)

Amendment No. 28—5-Year Rebaseline Report and Surety Update, December 23, 2009 (ADAMS Accession No. ML093230536)

Amendment No. 29—Annual Surety Update, October 7, 2010 (ADAMS Accession No. ML102440120)

Amendment No. 30–Annual Surety Update, December 15, 2011 (ADAMS Accession No. ML11333A016)

Amendment No. 31—Annual Surety Update, September 27, 2012 (ADAMS Accession No. 12262A506)

Amendment No. 32—Annual Surety Update, August 8, 2013 (ADAMS Accession No. ML13217A065)

Since the last license renewal, the licensee conducted a number of safety and environmental reviews through the Safety and Environmental Review Panel (SERP), described in License Condition 9.3 (KUC, 2014). The SERP consists of licensee personnel authorized to make changes not requiring a license amendment. The specific SERP reviews conducted since the last license renewal consist of the following:

Safety and Environmental Evaluation #9—Change in Reporting Titles/Updated Organization Chart, January 10, 2005

Safety and Environmental Evaluation #10—Change in Reporting Titles/Updated Organization Chart, August, 8, 2005

Safety and Environmental Evaluation #11—Change in Reporting Titles/Updated Organization Chart, November 28, 2005

Safety and Environmental Evaluation #12—Use of Any Type National Voluntary Laboratory Accreditation Program (NVLAP) Dosimetry for Personnel Dosimetry, November 28, 2005

Safety and Environmental Evaluation #13—Change in Reporting Titles/Updated Organization Chart, March 21, 2006.

Safety and Environmental Evaluation #14—Amendment to Procedure for the Repair of the Tailings Impoundment's Interior Side Slopes and Repair of Damaged Sections of the Hypalon Liner on Repaired Side Slopes, July 21, 2006

Safety and Environmental Evaluation #15—Change in Reporting Titles/Updated Organization Chart, July 21, 2006

Safety and Environmental Evaluation #16—Change in Reporting Titles/Updated Organization Chart, November 13, 2006

Safety and Environmental Evaluation #17—Change in Reporting Titles/Updated Organization Chart, May 23, 2008

Safety and Environmental Evaluation #18—Optimization of Evaporation and Control of Windblown Tailings in the Sweetwater Uranium Project Tailings Impoundment, July 10, 2009

Safety and Environmental Evaluation #19—Change in Reporting Titles/Updated Organization Chart, Change in SERP Membership, November 11, 2009

Safety and Environmental Evaluation #20—Change in Composition of SERP, July 16, 2011

Safety and Environmental Evaluation #21—Change in Reporting Titles/Updated Organization Chart, Change in SERP Membership, March 7, 2012

Safety and Environmental Evaluation #22—Change in Reporting Titles/Updated Organization Chart, December 17, 2012

Safety and Environmental Evaluation #23—Establishment of Annual Pumpback Volume Based upon Tailings Impoundment Evaporative Capacity, May 31, 2013

NRC staff reviewed the licensee's safety and environmental evaluation reports during inspections performed in 2007, 2009, 2011, 2013, and 2016, as identified below. As documented in the associated facility inspection reports, the NRC staff found that the SERP functioned consistent with the license.

The NRC inspections related to Source Materials License No. SUA-1350 occurred on the following dates:

July 10 and July 11, 2007—no violations were identified (ADAMS Accession No. ML072220332)

August 4 and August 5, 2009—one non-cited violation was identified; the licensee missed two monitoring well samples (ADAMS Accession No. ML092470618)

September 13 and September 14, 2011—no violations were identified (ADAMS Accession No. ML11285A443)

August 28, 2013—no violations were identified (ADAMS Accession No. ML13266A426)

As part of this LRA (KUC, 2014), the licensee is requesting a change to License Condition 9.10. The change reflects the completion of the remediation of the catchment basin and the removal of current language in the license condition. The change is discussed in more detail Section 7 of this SER.

1.4 Evaluation Findings

The NRC staff has reviewed the licensee's summary of proposed and past activities at the site using the review procedures in Section 1.2 of NUREG-2126 and finds it acceptable in accordance to the acceptance criteria in Section 1.3 of NUREG-2126. The NRC staff has determined that facility, consistent with NRC inspection reports, has been operated so as to protect health and that no safety-related concerns have been identified since the last license renewal.

The NRC staff will revise license condition 9.5 of Source Material License SUA-1350 to include the licensee's most recent submittals, specifically the license renewal request and its supplements, as follows:

9.5 The licensee shall conduct operations in accordance with statements, representations, and conditions contained in Section 5.2, 5.3, 5.4, and 6.0 of the original license application as revised, dated August 1978, in Sections 2.0, 3.0 and 4.0 of the renewal application dated March 1984, as supplemented by submittals dated April 3, 1983, and January 17, 1985, and the Final Design Volume VII of the license renewal application submitted September 18, 1997, with page changes submitted April 13, June 10, July 1, and July 20, 1998, and March 25, 1999, the renewal application dated May 25, 2004 *(ML041530047),* except where superseded by license conditions below*, and the renewal application dated July 24, 2014 (ML14251A113), as supplemented by submittals dated, October 31, 2015 (ML15300A296 and ML15300A295), June 2, 2016 (ML16160A410), October 18, 2016 (ML16298A147), November 14, 2016 (ML16635A183), September 28, 2017 (ML17277A074), and January 12, 2018 (ML18043A034).*

Whenever the word “will” is used in the above referenced submittals, it shall denote a requirement. *In addition, the licensee must use the approach, methods, and criteria described in the guidance and other documents it has committed to follow in its applications and other submittals referenced above. Although guidance or other references describe recommended or approved approaches, using permissive or normative language such as “may” or “should,” where the licensee has committed to such language, it shall denote a requirement.*

1.5 References

KUC, 2014, “Sweetwater Uranium Project—Docket Number 40-8584, Source Material License No. SUA-1350—Request for a Renewal Source Material License SUA-1350 for a Ten (10) Year Term,” Kennecott Uranium Company, July 24, 2014. (ADAMS Accession No. ML14251A113 (package)

KUC, 2004, Sweetwater Uranium Project-Docket Number 40-8584-Source Material License No. SUA-1350, Request for a Ten (10) Year License Renewal, May 25, 2004 (ADAMS Accession No. ML041530047)

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2.0 Site Characterization

2.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has provided sufficient characterization of the environment and site to demonstrate that there is no adverse impact from the facility or programs as required by 10 CFR Part 20, "Standards for Protection Against Radiation," and 10 CFR Part 40, "Domestic Licensing of Source Material."

2.2 Regulatory Acceptance Criteria

The NRC staff review of this section was performed in accordance with the regulatory guidance presented in Section 2 of NUREG-2126 (NRC, 2014).

2.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps that the licensee submitted in the LRA (KUC, 2014), as updated in response to RAIs. This review specifically focused on the changes from the previously-issued license renewal (NRC, 2004), and takes into consideration information from the 1999 NRC SER (NRC, 1999a) and 1999 NRC EA (1999b).

2.3.1 Site Location and Layout

The licensee discussed the site location and layout in Section 2.0 of the LRA (KUC, 2014). The LRA also includeds a 2013 site contour and NRC Bonded Area Boundary map (Appendix 5 to the LRA) for comparison with the 2004 site contour and NRC Bonded Area Boundary map (Appendix 13 to the LRA) submitted for the previous license renewal. The licensee stated the facility's catchment basin has been backfilled with clean fill from the ore pad, resulting in a reduction in size of the catchment basin. In addition, the licensee stated that tailings in the tailings impoundment have been regraded (leveled) and internal evaporation ponds were constructed on top of the reclaimed tailings. The NRC staff does not consider that any of the site layout changes has negative safety implications as they do not involve any alteration of systems, structures, and components necessary to ensure public health and safety. The NRC Bonded Area Boundary has not increased or decreased since the last license renewal in 2004.

2.3.2 Uses of Lands and Waters Adjacent to the Facility

The licensee included a 2013 Land Use Report Map as Appendix 9 to the LRA (KUC, 2014). Post-2004 land use changes around the facility include:

- The UR Energy, Inc. Lost Creek Project commenced production in August 2013. The facility is approximately 9.7 km (6 miles) northeast and downwind of the facility.
- Additional uranium-related claim staking has occurred in the area, as has some additional oil- and gas-related activity.

The licensee stated that with the exception of the removal of the Catchment Basin, which was removed via excavation in a period extending from December 2005 to November 2007, there have been no changes to the facility or to its programs since the last license renewal (KUC, 2017).

2.3.3 Population

The licensee provided an updated population distribution within an 80-kilometer (km) (50-mile (mi)) radius around the facility in the Supplement to the Environmental Report (KUC, 2016, Table 3-15). The table shows each community and its county, distance from the site, direction from the site, and total population (from the 2010 Census). Table 2 of this SER shows a comparison of the licensee's data to the data NRC published in its 1999 Environmental Assessment (NRC, 1999b):

Table 2. Population Distribution within 80 kilometers (50 miles) of the Facility

Community	County	Distance from Site km (miles)	Direction from Site	ER Population (2010)	EA Population (1999)	Change
Bairoil	Sweetwater	35 (22)	NE	106	228	(122)
Wamsutter	Sweetwater	43 (27)	S	451	240	211
Jeffrey City	Fremont	50 (31)	N	58	NA	NA
Rawlins	Carbon	64 (40)	ESE	9,259	9,380	(121)
Sinclair	Carbon	71 (44)	ESE	433	500	(67)
			Total	10,307	10,348	(41)

ESE = east-southeast, N = north, NE = northeast, S = south

The NRC staff reviewed publicly-available resources and did not observe any other towns or communities within an 80 km (50-mile) radius of the site. The 80-km (50-mile) radius is considered a conservative distance because it is the ingestion pathway emergency protection zone defined in 10 CFR 50, Appendix E, for nuclear power plants. The associated relative risks for a uranium recovery facility are much lower. The NRC staff also verified the distances from the site to the communities identified in the table above. The staff reviewed 2010 Census data (U.S. Census, 2012) for Bairoil, Sinclair, Wamsutter, Jeffrey City, and Rawlins, and found them to be identical to the populations reported in the Environmental Report (KUC, 2016). The NRC staff also examined the American Community Survey 2012-2016 5-year estimates and determined the 2016 population in these 5 communities was 10,032, or about 3 percent lower than the 1999 population (U.S. Census, 2018). Thus, the NRC staff finds that the overall change in population between 1999 and 2016 is not significant.

The NRC staff evaluated the updated information provided by the licensee concerning site location, layout, land use, water use, and population using the review procedures in Section 2.1.2 of NUREG-2126. The information is current and confirmed by independent sources. The community and overall population surrounding the site are little changed as the overall population change is about 3 percent over 17 years. The NRC staff therefore finds the licensee's description acceptable in accordance to the acceptance criteria in section 2.1.3 of NUREG- 2126.

2.3.4 Meteorology

Meteorological data is used to determine the location of air sampling stations to collect air sampling data for determining radiation dose to members of the public and for determining compliance with the limits in 10 CFR 20.1301, "Dose Limits for Individual Members of the Public," and 10 CFR 20.1302, "Compliance with Dose Limits for Individual Members of the Public." Regulatory Guide 4.14 recommends that three air particulate (and radon) sampling locations be at or near site boundaries in different sectors that have the highest predicted

concentrations of airborne particulate (NRC, 1980). Particulate air concentrations are a function of distance and wind direction. Thus, wind speed and wind direction are two important parameters measured by meteorological stations to identify and locate air sampling stations to collect air particulate and radon concentrations for determining radiation doses. As discussed below, the licensee's collection of wind speed and wind direction data is consistent with NRC Regulatory Guide 3.63 (NRC, 1988).

The licensee provided wind roses from the site for the periods 1983–1987, and 1991–1993 (see Tables 2.8-8 and 2.8-9 in the LRA (KUC, 2014)) and provided additional wind rose data from the site for the period 2004–2014 in the Supplement to the Environmental Report (KUC, 2016). The licensee stated that the predominant wind direction at the site based upon average annual data is from the southwest, with winds from the west-southwest and south-southwest as the next two most frequent wind directions (KUC, 2014). The average wind speed was 16 km (9.9 miles) per hour during the periods 1983-1987 and 1991-1993 (KUC, 2014). The average wind speed was 12.8 km (7.98 miles) per hour during the period 2004-2014 (KUC, 2016).

The NRC staff reviewed the most current wind roses (2004-2014) and determined that the top three predominant wind directions were from the west approximately 16 percent, from the west-southwest approximately 14 percent, and from the southwest/west-northwest approximately 9 percent. The NRC staff determined that this represents the three highest wind directions for the site. The impact on operational environmental monitoring of the observed change in wind directions is discussed in Section 5 of this SER.

The NRC staff has reviewed the updated meteorological information provided by the licensee using the review procedures in Section 2.3.2 of NUREG-2126 and finds it acceptable in accordance to the applicable acceptance criteria in Section 2.3.3 of NUREG-2126. Based on its review, the NRC staff concludes that the meteorology program for the facility meets the guidance in NRC Regulatory Guide 3.63 (NRC, 1988) because the licensee has characterized and updated the existing wind speed and wind direction at the site.

2.3.5 Regional Geology

As described in the LRA (KUC, 2014), the site is located in south-central Wyoming in the Red Desert area of the Great Divide Basin within the Wyoming Basin physiographic province. The altitude of the Wyoming Basin ranges from 1,980–2,290 meters (m) (6,500–7,500 ft) above sea level. As described in the LRA (KUC, 2014) and referenced documents (e.g., KUC, 1994), the Great Divide Basin is an internally-drained basin bounded by the Sweetwater Uplift to the north and northeast, the Rawlins Uplift to the east and southeast, the Rock Springs Uplift to the west, and the Wind River Uplift to the northwest. To the south, the Great Divide Basin is separated from the Washakie Basin by Laney Rim and Cathedral Bluffs.

The licensee indicated that approximately 7,010 m (23,000 ft) of Paleozoic, Mesozoic, and Cenozoic sediments underlie the site (KUC, 2014). Figures 2.5-2 and 2.5-3 in the LRA, respectively, provide stratigraphic columns for Sweetwater County and the Cenozoic units in the Red Desert area where the site is located (KUC, 2014).

Broad subsidiary folds associated with faulting are superimposed on the axis of the Great Divide Basin, including the Red Desert Syncline 16 to 19 km (10 to 12 miles) southwest of the site and the Cyclone Rim Syncline 15 to 20 miles northwest of the site (KUC, 1994). The Sweetwater Uplift is also reported to be associated with faults located 40 to 48 km (25 to 30 miles) north of

the site and the Chicken Springs fault zone situated 19 km (12 mi) northeast of the site (KUC, 1994; 1996).

The licensee states in Section 2.6 of the LRA (KUC, 2014) that the regional geologic data presented in KUC (1994) and summarized in this section of the LRA is unchanged. The NRC staff confirmed that the licensee's regional geologic descriptions are consistent with more recent information in the U.S. Geological Survey (USGS) (2015) on the geologic units recognized in Sweetwater County, Wyoming, Abzalov and Paulson's (2012) description of the regional geology and stratigraphy of the Great Divide basin, and Mason and Miller's (2005) characterization of the hydrogeology of Sweetwater County. Based on this review using the review procedures in Section 2.4.2 of NUREG-2126, the NRC staff finds that regional geologic information summarized in the LRA (2014) and in KUC (1994) is acceptable and consistent with current geologic data for the region in accordance with the acceptance criteria in Section 2.4.3 of NUREG-2126.

2.3.6 Site Geology

The licensee provided detailed information in the LRA (KUC, 2014) about the geology of the license area by referencing to the Revised Environmental Report (KUC, 1994) and the Addendum to the Revised Environmental Report—Geologic Cross Sections and Aquifer Information (KUC, 1995). Table 2.7-1 of the Revised Environmental Report (KUC, 1994) presents a stratigraphic column of the Mesozoic/Cenozoic geologic units present in the site area. Thicknesses of these various units are reported as follows ("?" indicates the value is uncertain):

Alluvium	0 to 15(?) m (0 to 50(?) ft)
Windblown sand	0 to 21 m (0 to 70) ft
Lake Deposits	0 to 8 m (0 to 25) ft
Battle Spring Formation	305(?) to 1,829± m (1,000(?) to 6,000± ft)
Fort Union Formation	213 to 823± m (700 to 2,700± ft)
Lance Formation	0 to 1372± m (0 to 4,500± ft)

The local stratigraphic information provided by the licensee indicates that the Battle Spring Formation, which are host rocks for uranium mineralization in the area, is exposed at the surface or immediately underlies surficial deposits in the project area. This formation consists of interbedded and inter-fingered beds of siltstone, mudstone, and fine- to coarse-grained sandstone. The licensee also provided several geological cross sections of the site that do not indicate the presence of faults (KUC, 1994).

The staff previously considered site geologic information in granting the prior license renewals (NRC, 2004; 1999). The licensee states in Section 2.6 of the LRA (KUC, 2014) that the original site geologic data presented in previous submittals (KUC 1994, 1995, and 1997a) is unchanged and no updated site-specific geologic characterization data is available. In its literature review, the NRC staff found no additional geologic studies. The NRC staff finds that the previous site-specific geological studies remain consistent with current literature, experience, and inspections and are acceptable.

2.3.7 Soils

In the 1994 Revised Environmental Report, the licensee provided a soils map for the site area, along with descriptions of soil types, based on information from a 1976 U.S. Soil Conservation

Service Survey that included the project location (KUC, 1994, Figure 2.5-6). The licensee stated in Section 2.6 of the LRA that the information regarding soils remains unchanged. To evaluate this information, the NRC staff consulted the Web Soil Survey of the Natural Resources Conservation Service (NRCS, 2016) online database for updated soil information for the site area and found that more recent soil surveys for the area have not been completed. The NRC staff therefore finds, consistent with its previous acceptance of the site soils characterization (NRC 2004; 1999), that KUC's characterization of soils is acceptable.

2.3.8 Seismology

The NRC staff conducted a review of previous and updated seismological information provided by the licensee to determine if the updated information changes the seismic design basis for the new tailings impoundment and evaporation ponds at the site.

In a 1996 Environmental Report Addendum (KUC, 1996), the licensee presented detailed deterministic and probabilistic site seismicity analyses for the site. The deterministic hazard analysis concluded that seismogenic potential is primarily associated with the Green Mountain Segment of the South Granite fault (40 km (25 mi) from the site) and the Chicken Springs fault system (19 km (11.8 mi) from the site). A maximum credible earthquake (MCE) of magnitude 6.75 from the Green Mountain Segment of the South Granite fault was calculated to result in a peak ground acceleration (PGA) at the site of 0.09 g (where 1.0 g is the acceleration of gravity) to 0.14 g. An MCE of magnitude 6.5 from the Chicken Springs fault system was calculated to result in a PGA of 0.22 g at the site. The probabilistic seismic analysis performed by the licensee concluded that a magnitude 6.5 "floating" (random) earthquake at a distance of 24 km from the site would result in a PGA of 0.18 g at the site. As documented in the 1999 SER (NRC, 1999) for the facility, the NRC accepted the use of 0.22 g as the design basis for the geotechnical engineering design of the new tailings impoundment evaporation ponds.

The licensee submitted updated information pertaining to the seismicity of the site in June 2016 (KUC, 2016) in response to an RAI. The licensee reviewed information in the environmental report (ER) for the nearby Lost Creek ISR facility (Lost Creek ISR, LLC, 2007) regarding the Lost Creek fault located approximately 19 km (12 mi) northeast of the KUC facility. The licensee indicated that the Lost Creek fault is not characterized as an active fault in the Lost Creek ER nor is it included in active fault surveys by USGS (2001) or the Wyoming State Geological Survey (Casey et al., 2002). The Wyoming State Geological Survey documented a seismological characterization of Sweetwater County, WY. The NRC staff notes that the deterministic analysis of regional active faults in or near Sweetwater County presented in Casey et al. (2002) is consistent with previous findings regarding seismic hazards at the KUC Sweetwater facility. In addition, in regard to siting a uranium mill tailings site within Sweetwater County, Casey et al. (2002) concluded that: "A magnitude 6.25 'floating' earthquake, placed 15 kilometers [9.3 mi] from any structure in Sweetwater County, would generate horizontal accelerations of approximately 15 percent g at the site." The NRC staff notes that this result is lower than the 0.22 g design basis used for the geotechnical engineering design of the new tailings impoundment evaporation ponds at the KUC Sweetwater facility.

The licensee (KUC, 2016) updated the earthquake magnitude data for Sweetwater County (WY) presented in Casey et al. (2002) with data obtained from the USGS Earthquake Catalog for post-2002 events with epicenters located within 80 km (50 miles) of the KUC Sweetwater facility (KUC, 2016). This data indicates that the highest recorded earthquake in the area of review occurred in 1963 and was of magnitude 4.5. The NRC staff notes that this is significantly lower than the 6.5 magnitude MCE used to compute the design basis PGA for the site.

The licensee has provided a review of updated historical seismicity data citing documented sources and the updated information is consistent with the previous seismological characterization of the site. The NRC staff has reviewed the updated seismology information provided by the licensee using the review procedures in Section 2.4.2 of NUREG-2126 and finds it acceptable in accordance to the acceptance criteria in Section 2.4.3 of NUREG-2126. Therefore, the NRC staff concludes that the previously approved (NRC, 1999a) seismic design basis for the site remains valid.

2.3.9 Geotechnical Designs

The licensee identified in Section 6.2.2 of the LRA (KUC, 2014) the geotechnical determinations (materials properties, slope stability, settlement, liquefaction potential, and liner design) for the proposed new tailings impoundment that were previously documented in Final Design Volumes II (Data Report) (KUC, 1997a), III (Embankment Design Report) (KUC, 1997b) and IV (Liner Design Report) (KUC, 1997c). Geotechnical aspects of the reclamation plan for the new and existing tailings impoundments were addressed by the licensee in Final Design Volumes V (KUC, 1997d) and VI (KUC, 1997e), respectively. The geotechnical aspects of site design were previously accepted by the NRC staff (NRC, 2006; 1999a) and have not changed since the last license renewal, as stated by the licensee (KUC, 2017). The NRC staff finds that the previous acceptance of these aspects remains current and valid.

2.3.10 Surface Water Hydrology

In Section 6.2.3 of the LRA (KUC, 2014) the licensee described the hydrology of the site by reference to KUC (1994). The site area is drained by Battle Spring Draw, its tributaries, and other unnamed draws all of which are ephemeral and flow into closed depressions within Battle Spring Flat a few kilometers to the southwest. Precipitation is the primary source of water for these draws. Although a few intermittent springs (e.g., Battle Spring) discharge into the draws, the water seeps back into the ground a short distance downstream. Several closed lakes, including Circle Bar Lake, Hansen Lake, lie approximately 8 to 16 km (5 to 10 mi) to the south and southeast of the site.

The licensee also identified in Section 6.2.3 of the LRA that hydrologic determinations regarding flooding, water profiles, channel velocities, shear stresses, and erosion protection for the reclamation of the new tailings impoundment were previously documented in Final Design Volumes V (KUC, 1997d). Erosion protection for the reclamation of the existing impoundment were previously documented in Final Design Volume VI (KUC, 1999e).

The surface water hydrologic characterization of the site was previously accepted by NRC staff (NRC, 2006; 1999a). In a TER appended as Enclosure 2 to the 1999 SER (NRC, 1999), the NRC staff assessed and approved the characterization of the surface water hydrology of the site area and the erosion protection design for the reclamation of the existing and proposed tailings impoundments. The tw2o drainage areas relevant to the site were identified in the 1999 TER (NRC, 1999) as Battle Spring Draw, which drains toward the site from the northeast and Blue Gulch, located to the west of Battle Spring Draw. For the current license renewal evaluation, the NRC staff used historical aerial imagery, focusing on changes in channel patterns or locations within these drainage areas since 1994, which was the earliest image available for the area and the closest in time to the 1999 NRC staff evaluation. The available post-1994 images date from 2006, 2009, and 2014. No discernable changes in channel patterns or locations were identified across the images. Given that the surface water hydrology has shown no changes

over the 20 year period that encompasses the NRC's 1999 hydrologic analysis of the site area, the NRC staff finds that the previous staff approval of the hydrologic analysis remains valid.

2.3.11 Background Radiological Characteristics

The licensee conducted a pre-operational radiological environmental monitoring program before commencing operations in 1979, to obtain pre-operational radiological environmental data. A pre-operational radiological environmental monitoring program was performed by the Mineral Exploration Company (MEC) facility in 1975 and 1976 as documented in Figure 6.1 and Table 6.1 of the Final Environmental Statement (NUREG-0505), issued December 1978 (NRC, 1978). A pre-operational monitoring program is performed prior to operation and it is not repeated once the facility goes into operation. The NRC staff has determined that the information is consistent with 10 CFR Part 40, Appendix A, Criterion 7 for pre-operational monitoring program and no further pre-operational monitoring is necessary. The NRC staff finds that the previous acceptance of these aspects remains current and valid.

2.4 Evaluation Findings

The NRC staff has completed its review of the site characterization information in the LRA (KUC, 2014) in accordance with the review procedures and acceptance criteria in Section 2 of NUREG-2126. Updated site characterization is presented in the LRA for site layout, land use and population adjacent to the facility, meteorology, and seismology. No changes are identified by the licensee with regard to water use in the area, site geology, and geotechnical designs, or regional geology and soils. The NRC staff confirmed licensee site characterization information by consulting independent data sources, as appropriate.

Based on the review conducted by the staff, the information provided in the application meets the applicable acceptance criteria of Section 2 of NUREG-2126. The NRC staff concludes that the licensee's updates to site characterization meets 10 CFR 40.31(h), which requires completeness and accuracy in all materials provided by the licensee.

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3.0 Description and Design of the Facility

3.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that the equipment and processes used for conventional mills during operation at the KUC facility meet the relevant requirements of 10 CFR 20, "Standards for Protection Against Radiation," and 10 CFR 40, "Domestic Licensing of Source Material."

3.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the renewal application against the applicable requirements of 10 CFR Part 40 using the guidance and acceptance criteria in Section 3 of NUREG-2126.

3.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps the licensee has submitted in its LRA (KUC, 2014), as updated. The following sections present the staff's review and analysis of the facility's description and design.

3.3.1 Mill Facility Overview

The licensee stated that the facility was acquired by the Green Mountain Mining Venture (a joint venture between Rio Tinto's Kennecott Uranium Company and U.S. Energy Corporation) on June 23, 1992, in expectation of milling ore mined from its uranium reserves in Green Mountain or milling third-party uranium ores on a toll basis (KUC, 2014). The current license renewal application remains unchanged with regard to Green Mountain as the potential ore source for milling (KUC, 2016a). The grade for the ore mined from Green Mountain is estimated as 0.2 percent U_3O_8 (Kennecott, 1994). The licensee states in Section 1.8 of the LRA (KUC, 2014) that milling operations "are expected to begin when the uranium market permits."

The licensee described the constructed facility in Section 3.0 of the LRA (KUC, 2014) by referring to previous information provided in the 1994 Environmental Report (KUC, 1994) and the 1999 Environmental Assessment (NRC, 1999b). The site covers approximately 580 ha (1,432 ac), consisting of a mill, ancillary buildings, existing tailings impoundment, and the area of proposed new impoundments, evaporation ponds, and diversion channels. The mill and ancillary buildings contain:

- offices and a laboratory,
- warehouse, change room, and maintenance shop,
- grinding, leaching, and counter-current decantation equipment,
- thickener tanks,
- scrubber emission control, stacks,
- solvent extraction equipment, and
- equipment, tire, and lubrication bay.

Upon resumption of milling operations, a slurry pipeline will transport tailings to a lined, partially below-grade 16-hectare (40-acre) tailings impoundment to be constructed east of the mill. The pumped slurry will flow onto a tailings beach with outflow points moved regularly to maintain a

moist surface. A small pool of free-standing fluid will be maintained within the impoundment at the downstream side of the tailings beach.

The licensee (KUC, 2017) indicated that, other than the removal of a formerly-used catchment basin, "there have been no changes to the facility or to its programs since the last license renewal." The staff previously considered the description of the mill facility in granting the prior license renewal (NRC, 2004, 1999a). As there have been no changes to the mill facility, the NRC staff finds, consistent with its previous reviews and confirmed by inspections since the last license renewal, that KUC's description of the mill facility is acceptable.

3.3.2 Design of Surface Impoundments

As described by the licensee in Section 2.0 of the LRA (KUC, 2014), the original tailings impoundment used by the facility in the 1980s will not be used for future tailings disposal and was partially converted after 2004 into a series of evaporation pond cells built on top of the regraded tailings. These evaporation pond cells receive contaminated groundwater from Corrective Action Program (CAP) activities for the site (the CAP is discussed in Chapter 7 of this SER). As described in the 1999 EA (NRC, 1999b), the original impoundment is underlain by a single, 36-mil synthetic liner and is not equipped with a leak detection or recovery system.

Upon resumption of operations, the licensee plans to construct a new tailings impoundment and evaporation ponds at the site (LRA, 2014). The evaporation ponds and new tailings impoundment will be lined with a layered system composed of 2 flexible membrane synthetic liners (60-mil and 40-mil in thickness, respectively) over a 1 m (3 ft) minimum thickness of compacted clay and will be equipped with leak detection and recovery systems, as specified in Final Design Volumes I, IV, and VII (KUC, 1997a,b,c). No revisions are proposed by the licensee to the previously-approved design for the new tailings impoundment and evaporation ponds. The NRC staff previously concluded that the "liner design meets the requirements of Appendix A, Criterion 5A(2)" and that the "[s]tability of the synthetic liner system was addressed by the licensee's testing and placement plans (Volume IV, Section 3.3) (NRC, 1999a). With regard to geotechnical design aspects, the NRC staff previously concluded that: "The earth construction and geotechnical engineering designs of the ponds and impoundment meet … the requirements of 10 CFR 40, Appendix A, for stability and longevity" (NRC, 1999a).

The licensee (KUC, 2017) indicated to the NRC that, other than the removal of a formerly-used catchment basin, "there have been no changes to the facility or to its programs since the last license renewal." As no revisions have been made to the previously approved design for the new tailings impoundment and evaporation ponds (NRC, 2004; 1999a), the NRC staff finds, consistent with its previous reviews, that the surface impoundments would meet the requirements of 10 CFR Part 40, Appendix A for stability and longevity.

3.3.3 Uranium Recovery Process

In Section 1.8 of the LRA (KUC, 2014), the licensee described the uranium recovery process that will be used during milling operations as unchanged from that previously reviewed and approved by the NRC staff (NRC, 1999a). A detailed description of the process is provided in Section 3.3 of the LRA (KUC, 2014) based on KUC (1994). Section 2.2 of the 1999 SER (NRC, 1999a) generally summarizes the description given by the licensee of the milling process as follows: (1) ore weighing, sampling and stock piling, (2) grinding, (3) acid leaching, (4) recovery of "pregnant" solution by IX and discharge of tailings to the impoundment, (5) conventional solvent extraction of the uranium, (6) precipitation, washing and drying of the yellow cake, and

(7) packaging of the yellowcake in 55-gallon drums. The licensee requested a license amendment for an IX plant in 1989 (MEC, 1989). The licensee indicated that the IX plant will be used to reduce the uranium content in MEC's mining pit lake located at the facility. License Condition 9.4 authorizes the licensee to operate an IX uranium recovery facility. License Condition 9.4 further states that the licensee is not authorized to produce any uranium concentrates other than through use of the IX plant with respect to reducing the uranium concentration in the pit lake until a pre-operational inspection has been completed and any safety issues resolved. The NRC staff determined that the IX facility will also be subject to a preoperational inspection. As noted previously, the licensee stated in Section 1.8 of the LRA (KUC, 2014) that milling operations "are expected to begin when the uranium market permits."

As the licensee stated in Section 1.8 of the LRA (KUC, 2014), the projected annual production of 1,800,000 kilograms (4,100,000 lb) of U_3O_8 is unchanged from that stated in the KUC (1994). As also stated by the licensee in Section 3.3 of the LRA (KUC, 2014), a detailed water balance for the facility upon resumption of operations was previously provided in KUC (1997c).

The licensee (KUC, 2017) indicated to the NRC that, other than the removal of a formerly-used catchment basin, "there have been no changes to the facility or to its programs since the last license renewal." The staff previously evaluated the facility's uranium recovery process in granting the prior license renewal and change to stand-by status (NRC, 2004; 1999a). As there are no changes to the uranium recovery process for the facility, the NRC staff finds, consistent with its previous findings, that KUC's description of its uranium recovery processes is acceptable.

3.3.4 Waste Management

Unless otherwise stated, the information reviewed in this section is from information, data, and maps that the licensee submitted in its LRA (KUC, 2014a), as updated. The following sections present the NRC staff's review and analysis of the KUC standby and operational effluent and waste program.

3.3.4.1 Standby

The KUC facility has operated in standby mode since 1983, and no production of yellowcake and associated generation of 11e.(2) solid, liquid wastes, or gaseous effluents has occurred at the site. During inspections, the NRC staff verified that the licensee has not shipped or received radioactive material (NRC 2009, 2011, 2013, and 2016).

The NRC staff concluded in the 2013 NRC inspection (NRC, 2013) that the 24-hectare (60-acre) tailings impoundment contains approximately 2.5 million tons of tailings material. As shown in the maps and drawings in Appendix 4 to the LRA (KUC, 2014), the tailings impoundment has been largely covered with fluid-filled lined lagoons that minimize windblown tailings. Radon flux results are used to determine the total activity of released radon from the impoundment for required reporting under 40 CFR Part 61, Subpart W. These results are included in the semi-annual effluent monitoring reports under 10 CFR 40.65 (KUC, 2012, 2013, 2014b. 2015b, and 2016b), and shown on Table 4-1 below. The licensee stated in the LRA (KUC, 2014) that the average radon flux rates for the impoundment are similar to background radon fluxes for the area (KUC, 2014). By comparison, the average background radon flux, as measured in the 1977/1979 period, was 4.72 ± 5.03 pCi/m^2-sec (KUC, 1994). The NRC staff reviewed the tailings impoundment radon flux results in relation to the background radon flux reported in the

Revised Environmental Report (KUC, 1994) and finds that the background flux data are consistent.

Table 3. Results reported from radon flux testing of the tailings impoundment

Year	Date Monitored	Average Flux Rate (pCi/m^2-sec)	Total Quantity of Radon Released (curies/yr)	ADAMS Accession Number
2016	August 2-3, 2016	6.52	32.1	ML16176A064
2015	August 4-5, 2015	7.13	35.5	ML15258A079
2014	August 6-7, 2014	8.97	44.5	ML15012A355
2013	July 30-July 31, 2013	8.56	42.6	ML14251A199
2012	July 31-August 1, 2012	4.31	21.4	ML13232A058
2011	August 9-10, 2011	2.17	10.7	ML13268A372

Reclamation activities on site after 1983 have generated 11e.(2) wastes that are not related to yellowcake production. Contaminated groundwater pumped in connection with the site's approved groundwater Corrective Action Program (discussed in Section 7 of this SER) is placed in evaporation pond cells constructed on top of the tailings in the existing tailings impoundment. In addition, as documented in the 2007 NRC Inspection Report (NRC, 2007), approximately 233,000 cubic yards of soil contaminated with hydrocarbons and radionuclides, along with associated concrete, pipe, and miscellaneous debris, were removed during reclamation of the former onsite catchment basin and placed in the tailings impoundment. This soil contamination resulted from the percolation of process fluids into the subsurface from the unlined catchment basin during the operational period at the facility, as reported by the licensee (KUC, 2003). The NRC staff approved the contaminated soil and debris removal and disposal plan for the catchment basin in May 2005 (NRC, 2005). The NRC staff's analysis of the catchment basin remediation results are discussed in Section 7 of this SER.

The NRC has reviewed the updated information submitted by the licensee related to standby waste disposal at the site using the review procedures in Section 3.5.2 of NUREG-2126. The NRC staff finds that the licensee has provided adequate and complete information regarding the waste management program in standby and the information is therefore acceptable in accordance with the acceptance criteria in Section 3.5.3 of NUREG-2126.

3.3.4.2 Operations

Liquid and Solid Waste

In Section 4.0 of the LRA (KUC, 2014), the licensee stated that during operations, solid wastes from the uranium recovery process will go to the tailings impoundment whereas liquid wastes will be sent to the evaporation ponds, for recycling back into the process, or disposed of in the tailings impoundment. As described by the licensee in the LRA (KUC, 2014), the handling of liquid wastes from the process was initially discussed in the Section 3.4 of the 1994 Revised Environmental Report (KUC, 1994) and later modified in Final Design Volume VII (KUC, 1997c) to include a mill water balance study and plans to recycle some processing fluids to reduce the volume of fluid requiring evaporation. This modification was approved by the NRC staff as part of its review of Final Design Volume VII (KUC, 1997c) in a 1999 SER (NRC, 1999a). NRC staff determined that no liquids will be discharged offsite to the environment during operations. The licensee described the solid wastes generated during operations in Section 4.2 of the LRA (KUC, 2014) and in the Supplement to Licensee's Environmental Report (KUC, 2016a) by

reference to the 1994 Environmental Report (KUC, 1994). Contaminated mill equipment needing replacement will be placed in the existing tailings impoundment. Tailings are identified as the primary 11e.(2) solid wastes generated during operations and their disposal was previously addressed in Final Design Volume VII (KUC, 1997c) which was approved by the NRC staff for the 1999 SER (NRC, 1999a) and EA (NRC, 1999b). As no revisions are proposed by the licensee to the liquid and solid waste management program during operations, the NRC staff finds, consistent with its previous findings, that KUC's program for waste management is acceptable.

Gaseous Effluent Waste

Air Particulates

KUC stated that they plan to use methods described in ANSI/HPS N13.1-2011, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities" (KUC, 2017). KUC indicated that the stack gas velocity and volumetric flow rate will be measured using 40 CFR Part 60, Appendix A, Method 1, "Sample and Velocity Traverses for Stationary Sources," and particulate matter will be sampled using 40 CFR Part 60, Appendix A, Method 17, "Determination of Particulate Matter Emission from Stationary Sources." This method will be incorporated into Kennecott's Procedure EP-15. Radionuclides, specifically natural uranium, Th-230, Ra-226, and Pb-210, contained with the Particulate Matter (PM) collected using Method 17 will be quantified by sending the glass fiber filter used to collect the PM to a vendor laboratory for isotopic analysis (KUC, 2017).

KUC stated that it will sample the stacks listed in Table 1 and Figure 2 (KUC, 2017) for air particulates on a frequency recommended by Regulatory Guide 4.14 (NRC, 1980). KUC will analyze stack air samples for natural uranium, Th-230, Ra-226, and Pb-210 consistent with Regulatory Guide 4.14 (NRC, 1980). KUC will compute the quantity of each principal radionuclide, in Curies (Ci), and these release estimates will be the basis for reporting of radionuclide emissions as required by 10 CFR § 40.65. The effluent quantities will also be used to evaluate compliance with the public dose limits in 10 CFR 20.1301, 40 CFR Part 190 and 10 CFR 20.1101. KUC will perform time trends of the emission data to evaluate the performance of emission control systems (KUC 2017). The NRC staff has determined that the licensee has adequately described an acceptable method for sampling air particulate effluent from defined locations onsite consistent with ANSI/HPS N13.1-2011, and for computing: (1) the quantities of principal radionuclides as required by 10 CFR 40.65; and (2) public dose to determine compliance with 10 CFR 20.1301. The NRC staff determined that the licensee will monitor for trends to ensure that radionuclide emissions from operations are ALARA.

Radon

KUC stated that it plans to use 40 CFR Part 60, Appendix A, Method 3, Gas Analysis for the Determination of Dry Molecule Weight, to collect a portion of the effluent stream from each stack for the analysis of radon-222, an inert gas. A 5-liter (grab) sample will be pumped from the stack into a leak free flexible bag. The gas in the bag will be analyzed for radon-222 concentrations using a radon monitoring system to determine the radon-222 concentration in the bag. Very low level readings can then be corrected for background, bringing the detection threshold of the radon monitoring system below 0.02 pCi/L. All radon-222 concentrations and stack flow velocities will be corrected to standard temperature and pressure conditions (KUC, 2017).

KUC stated that they will sample the stacks listed in Table 2 and Figure 2 (KUC, 2017) for radon on a frequency recommended by Regulatory Guide 4.14 (NRC, 1980). KUC will analyze for radon-222 consistent with Regulatory Guide 4.14 (NRC, 1980) for stack sampling. KUC will compute the quantity of each principal radionuclide, in Curies (Ci). and these release estimates will be the basis for reporting of radionuclides emissions required by 10 CFR 40.65 and used to evaluate compliance with the public dose limits in 10 CFR 20.1301, 40 CFR Part 190 and 10 CFR 20.1101. KUC will perform time trends of the emission data to evaluate performance of emission control systems (KUC 2017). The NRC staff has determined that the licensee has adequately described an acceptable method for sampling radon effluent from defined locations on-site consistent with ANSI/HPS N13.1-2011, for purposes of computing: (1) the quantities of principal radionuclides in effluents required by 10 CFR 40.65; and (2) public dose to demonstrate compliance with 10 CFR 20.1301. The NRC staff determined that the licensee will monitor for trends to ensure that radionuclide emissions from operations are ALARA.

KUC will used Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Program (NRC, 2007) as guidance for the quality assurance plan for air particulate and radon (KUC, 2014).

The NRC staff has determined that the licensee has adequately described the air particulate and radon effluent monitoring program to measure and quantify principal radionuclides in accordance with 10 CFR 40.65 and the information computed from the air effluent monitoring program will be used to demonstrate compliance with 10 CFR Part 20, Subpart D.

The NRC staff finds that air effluents are adequately described to demonstrate compliance with 10 CFR Part 20, Subpart B and all effluents will be reduced to ALARA consistent with 10 CFR Part 40, Appendix A, Criterion 8.

3.4 Evaluation Findings

The licensee has provided a description of all the major equipment at the facility and there are no proposed changes to the facility process or operation upon resumption of milling activities. As no revisions have been made to the facility description and operational waste management information reviewed for previous license renewals (NRC, 1999a,b, 2004), the NRC staff finds, consistent with its previous reviews, that KUC's standby and operational waste management program and facilities are adequate consistent with the review criteria in Section 3.5.2 and acceptance criteria in Section 3.5.3 of NUREG-2126.

3.5 References

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KUC, 2016a, Supplement to Licensee's Environmental Report, Sweetwater Project, Docket Number 40-8584, Source Material License Number SUA-1350, June 2016 (ADAMS Accession No. ML16160A410), Revised November 2016 (ADAMS Accession No. ML16335A183).

KUC, 2016b, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated February 1, 2016, ML16176A064

KUC, 2015b, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated January 29, 2015, ML15072A355

KUC, 2014a, “Sweetwater Uranium Project—Docket Number 40-8584, Source Material License No. SUA-1350—Request for a Renewal Source Material License SUA-1350 for a Ten (10) Year Term,” Kennecott Uranium Company, July 24, 2014. (ADAMS Accession No. ML14251A113). (package)).

KUC, 2014b, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated January 23, 2014, ML14077A338

KUC, 2013, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated February 11, 2013, ML13232A060

KUC, 2012, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated January 30, 2012, ML13268A385

KUC, 2011, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated February 24, 2011, ML110730197

KUC, 2010, Sweetwater Uranium Project, Docket Number 40-8584, Source Material License SUA-1350, Semi-Annual 10 CFR 40.65 Report Airborne Effluents, dated January 25, 2010, ML17199015

KUC, 2004, “Sweetwater Uranium Project - Request for Amendment to License Condition 9.10 - Mill Decommissioning Addendum,” May 12, 2004 (ADAMS Accession No. ML041480493).

KUC, 2003, “Status Report - Catchment Basin Contamination,” October 15, 2003 (ADAMS Accession No. ML032930287)

KUC, 1997a, “Final Design Volume I – Executive Summary,” October 1997 (ADAMS PLL Accession No. 9710220267 (microform)).

KUC, 1997b, “Final Design Volume IV – Liner Design Report,” July 1997 (ADAMS PLL Accession No. 9708010280 (microform)).

KUC, 1997c, “Final Design Volume VII – Operations Plan,” September 26, 1997 (ADAMS PLL Accession No. 9710010164 (microform)).

KUC, 1994, “Revised Environmental Report for the Sweetwater Uranium Project, Sweetwater County, Wyoming,” prepared for Kennecott Uranium Company, August 1994 (ADAMS Accession No. ML081010327).

MEC, 1989, Request for License Amendment IX Plant, September 28, 1989 (ADAMS Accession N0. ML080800079)

NRC, 2016, NRC Inspection Report 040-08584/2016-001, October 3,, 2016 (ADAMS Accession No. ML16273A138).

NRC, 2014, NUREG-2126, “Standard Review Plan for Conventional Uranium Mill and Heap Leach Facilities”, Draft Report for Comment, November 2014.

NRC, 2013, NRC Inspection Report 040-08584/2013-001, September 23, 2013 (ADAMS Accession No. 13266A426).

NRC, 2011, NRC Inspection Report 040-08584/2011-001, October 12, 2011 (ADAMS Accession No. 11285A443).

NRC, 2009a, NRC Inspection Report 040-08584/2009-001, September 4, 2009 (ADAMS Accession No. 092470618).

NRC, 2009b, Environmental Assessment for Source Material License SUA-1350, Renewal for Operations and Amendment for the Reclamation Plan (Revision 1), Sweetwater Uranium Company, Sweetwater County Wyoming, July 1999 (ADAMS Accession No. ML081500512).

NRC, 2007, NRC Inspection Report 040-08584/07-001, August 10, 2007 (ADAMS Accession No. 072220332).

NRC, 2005, “Amendment of Source Materials License SUA-1350 to Remediate Catchment Basin Contamination at the Kennecott Uranium Company's Sweetwater Project, Amendment 21 (TAC LU0073).” letter dated May 23, 2005, with Technical Evaluation Report attachment, to Mr. Oscar Paulson, Sweetwater Uranium Facility, Kennecott Uranium Company, Riverton, WY (ADAMS Accession No. ML051510387).

NRC, 2004, “Renewal of Source Material License SUA-1350 and Surety Update for the Kennecott Uranium Company’s Sweetwater Uranium Mill Site, Amendment 20 (TAC LU0045),” letter dated November 10, 2004, to Mr. Oscar Paulson, Sweetwater Uranium Facility, Kennecott Uranium Company, Riverton, WY (ADAMS Accession No. ML043170668).

NRC, 1999a, Letter from NRC to Kennecott, “Renewal of Source Material License SUA-1350 for Operation and Approval of the Reclamation Plan and Surety Amount for the Kennecott Uranium Company, Sweetwater Uranium Project, Sweetwater County, Wyoming,” August 18, 1999 (ADAMS Accession No. ML080590244).

NRC, 1999b, Environmental Assessment for Safety Evaluation Report for Renewal of Source Material License No. SUA-1350, Kennecott Uranium Company, Sweetwater Uranium Mill, Sweetwater County, Wyoming. ADAMS PLL Accession No. 9908230110 (microform), Enclosure 5).

4.0 Management

4.1 Corporate Organization and Management Programs

4.1.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that its corporate organization and administrative and operating procedures for the KUC facility are consistent with the requirements in 10 CFR 40.32(b), which require that the licensee be qualified through training and experience to use source materials. Other applicable provisions are 10 CFR 40.32(c), which requires that the licensee's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life or property, and 10 CFR 20.1101, which requires an adequate radiation protection program. This section of the SER discusses key personnel in the KUC organization, management controls, and audits/inspection procedures.

4.1.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff review in this section was performed in accordance with the regulatory guidance presented in Section 4 of NUREG-2126 (NRC, 2014).

4.1.3 Staff Review and Analysis

4.1.3.1 Standby

The KUC facility has operated in standby mode since 1983, and no major activities have occurred at the site. Activities at the site have been limited to reclamation of several areas within the licensed boundary. This reclamation is a cleanup process and is not related to yellowcake production. The staff reviewed the licensee's corporate organization and administrative procedures to determine if they are adequate to provide health and safety to the workers, public, and the environment commensurate with a uranium milling facility.

The LRA (KUC, 2014), as updated, provides that the site staff for standby periods consists of the following:

- The facility supervisor, who is also the radiation safety officer (RSO)
- An administrative coordinator;
- A site operations technician responsible for maintenance of the mill and tailings facility, operation of site equipment, and maintenance of other infrastructure; and
- A senior facility technician responsible for environmental monitoring, equipment operation, and site maintenance.

The NRC staff has determined that the facility supervisor (and RSO) manages and directs the staff at the facility. As defined in Appendix 12 to the LRA (KUC, 2014), the facility supervisor reports to the general manager at Rio Tinto Energy. The licensee is not proposing any changes to the standby staffing levels. In letter from the licensee dated September 28, 2017 (KUC, 2017), the licensee explained that there have been no changes to the facility or its programs since the last license renewal. The licensee states in the LRA (KUC, 2014) that the only organizational change from the 2004 license renewal application is administrative in nature, whereby the headquarters (office of the company president) for Kennecott Uranium Company President is now located in Melbourne, Australia, rather than Gillette, Wyoming. NRC site

inspection reports have concluded that the above-described level of staffing is sufficient staff for maintaining compliance with the requirements of the license while the mill remains in standby (NRC, 2007b; NRC, 2009; NRC, 2011; NRC, 2013, and NRC, 2016).

A complete set of Standard Operating Procedures, including Health Physics and Environmental Procedures, are maintained for the site. These procedures embody the facility's Radiation Safety and Environmental Monitoring Programs. These procedures have been reviewed during mill inspections by NRC staff and found acceptable (NRC, 2007b; NRC, 2009; NRC, 2011; NRC, 2013, and NRC, 2016)..

The LRA (KUC, 2014) states that during periods of non-operation, including the current standby period, the facility supervisor (also the RSO) conducts an annual ALARA audit and submits it to the NRC during the first quarter of the following year. The licensee has also submitted 10 CFR 40.65 semi-annual effluent reports, radiation protection audit and ground water corrective action reports annually since the last license renewal.

The NRC staff previously concluded in the 1999 SER (NRC, 1999) that KUC's current "program, as currently practiced during standby mode, provides adequate protection." The staff also previously considered the standby organizational structure and administrative and operating procedures in granting the prior license renewal (NRC, 2004). Given that the applicant is not proposing any changes to the previously approved corporate organization and administrative and operating procedures for standby and the licensee's current compliance, the NRC staff finds, consistent with these previous findings, that KUC's standby site staffing is acceptable.

4.1.3.2 Operations

For periods when the facility is in operation, the 1999 SER (NRC, 1999) reviewed the organizational structure for the facility as consisting of:

- Office headquarters and Director of Technical Services with responsibility for the overall policy and management of the mill;
- On-site Facility Manager, responsible for enforcing corporate policies and for mill management;
- RSO responsible for radiation and industrial safety, occupational monitoring, quality assurance and environmental monitoring programs; and
- Environmental Assistant responsible for conducting elements of the radiation and environmental monitoring program.

The licensee states in the LRA (Kennecott, 2014) that the only organizational change from the 2004 renewal is administrative in nature, whereby the headquarters (office of the company president) for Kennecott Uranium Company is now located in Melbourne, Australia, rather than Gillette, Wyoming.

Regarding operating procedures, the 1999 SER (NRC, 1999) states:

> Written operating procedures have been established for routine production activities involving the handling and processing of radioactive material and include routine radiation safety practices.

Further, the 1999 SER states that:

> The NRC staff…recommends renewal of KUC's Source Material SUA-1350 as a performance-based license with the understanding that prior to operation of the mill and as part of the pre-operational inspection, the operational SOPs will be reviewed to confirm that they comply with current (at that time) regulations or there is reasonable assurance that compliance can be demonstrated with the proposed procedures.

No safety-related revisions have been made or are proposed by the licensee (KUC, 2014) to the previously approved corporate organization and administrative and operating procedures for operations. The NRC staff previously found this operational organizational structure and administrative and operating procedures acceptable in the 1999 SER (NRC, 1999). The staff also previously considered the operational organization in granting the prior license renewal (NRC, 2004). As no revisions are proposed by the licensee (KUC, 2004) to the previously approved corporate organization and administrative and operating procedures during operations, the NRC staff finds, consistent with its previous findings, that KUC's site staffing during operations is acceptable.

4.1.4 Evaluation Findings

The NRC staff previously accepted the licensee's corporate organization and administrative and operating procedures for both standby and operations (NRC, 2004; 1999a). As no safety-related revisions have been made to the previously approved program for the facility and given the licensee's compliance with the standby requirements, the NRC staff finds, consistent with its previous findings, that KUC's site staffing plans for both operations and standby modes are acceptable and will provide reasonable assurance of adequate protection of worker and public health and safety.

4.2 Qualifications of Personnel Conducting the Radiation Safety Program

4.2.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that the qualifications of personnel conducting the KUC facility radiation safety program meet the requirements of 10 CFR 20.1101 and 10 CFR 40.32(b).

4.2.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC reviewed the renewal application against the applicable requirements in 10 CFR Part 20 and 10 CFR Part 40 using the acceptance criteria presented Section 4 of NUREG 2126 (NRC, 2014). Regulatory Guide (RG) 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities Will Be as Low as Is Reasonably Achievable," Revision 1, issued May 2002 (NRC, 2002a) provides recommendations for technical qualifications of radiation safety staff. The licensee is required by License Condition 9.4 to follow RG 8.31 (NRC, 2002).

4.2.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps the licensee submitted in its LRA (KUC, 2014), as updated. This section describes the qualifications of key personnel conducting the facility radiation safety program. With regard to the qualifications of these key personnel, the licensee must demonstrate that its radiation safety

program complies with 10 CFR 20.1101, which defines the radiation protection program requirements, and 10 CFR 40.32(b), which provides requirements for licensee qualifications. RG 8.31 (NRC, 2002) provides recommendations for the technical qualifications of radiation safety staff, including the RSO and health physics technician.

In either standby or operational mode, the facility operates with staff commensurate with the activities being performed at the facility. The LRA (KUC, 2014) states that the qualification requirements for the RSO are unchanged since the last renewal in 2004. NRC staff has determined that the licensee continues to maintain a qualified Radiation Safety Officer (RSO) on site. The current RSO is also the Facility Supervisor. The LRA (KUC, 2014) states that the RSO is maintained onsite and possesses the qualifications described for RSOs in RG 8.31.

During NRC site inspections, the NRC staff reviewed the qualification of the personnel conducting the facility radiation safety program and verified that the qualification was in conformance with applicable license requirements and regulations (NRC, 2007b; NRC, 2009; NRC, 2011; NRC, 2013, and NRC, 2016). The staff has determined that the licensee radiation safety program personnel qualifications are consistent with RG 8.31 and 10 CFR Part 20.

4.2.4 Evaluation Findings

The NRC staff previously accepted the qualifications of personnel conducting the radiation safety program during standby (NRC, 2004; 1999a). As no revisions are proposed by the licensee (KUC, 2004) to the personnel qualifications during operations and given the licensee's current compliance, the NRC staff, consistent with its previous findings, concludes that KUC radiation protection staffing in standby mode are acceptable.

4.3 Radiation Safety and Transportation Training

4.3.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that its radiation safety training program for the KUC facility meets the requirements in 10 CFR 20.1101 and 10 CFR 40.32(b).

4.3.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC reviewed the renewal application against the applicable requirements of 10 CFR Part 20 and 10 CFR Part 40 using the acceptance criteria presented in Section 4 of NUREG-2126 (NRC, 2014).

4.3.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps the licensee submitted in its LRA (KUC, 2014), as updated

The LRA (KUC, 2014) stated that the radiation safety training program is unchanged since the November 2004 license renewal with the exception of the addition of radioactive material transport training, as required by the U.S. Department of Transportation (DOT). The NRC staff reviewed the LRA and NRC inspection reports (NRC, 2007b; NRC, 2009; NRC, 2011; NRC, 2013, and NRC, 2016) to verify that the radiation safety training program is unchanged since the November 2004 license renewal.

The LRA (KUC, 2014) stated that all employees are instructed by means of an established training course on the inherent risks of exposure to radiation and the fundamentals of protection against exposure to uranium and its daughters before beginning their jobs. The LRA identified the following course titles (KUC, 2014):

- Fundamentals of Health Protection
- Personal Hygiene at Uranium Mills
- Facility Provided Protection
- Health Protection Measurements
- Radiation Protection Regulations
- Mill Emergency Procedures

The LRA (KUC, 2014) stated that each worker takes a written or oral test with questions directly relevant to the principles of radiation safety and health protection in uranium milling covered in the training course. The licensee maintains the test, results, and a list of attendees with training materials on file. The LRA (KUC, 2014) stated that all new workers, including supervisors, receive specialized instruction on the health and radiation safety aspects of the specific jobs they will perform.

As documented in the applicable NRC site inspections reports, the NRC inspectors reviewed the KUC facility's annual radiation safety and transportation training program, and verified that the program was in conformance with applicable license requirements and regulations including Regulatory Guide 8.31 (NRC, 2002) and 10 CFR 20 (NRC, 2007b; NRC, 2009; NRC, 2011; NRC, 2013, and NRC, 2016). In addition to verifying that the radiation safety training program is unchanged, the NRC inspectors reviewed the new information regarding radioactive material transport training, as required by the U.S. Department of Transportation. Eleven of the licensee's staff and contractors received radioactive material transportation training in January 2010 and are certified to ship radioactive material in accordance with 49 CFR 172.704 (NRC, 2011). The LRA (KUC, 2014) stated that anyone involved in the shipping of radioactive materials from the site shall have had radioactive material transportation training within the last 3 years in accordance with 49 CFR 172.704, "Training Requirements." This training is provided by an outside contractor or by the RSO when groups are small. During inspections, the NRC staff verified that the licensee has not shipped or received radioactive material (NRC, 2009, 2011, 2013, and 2016).

The NRC staff has determined that the licensee has incorporated the transportation regulations in 49 CFR Part 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans" into its radiation safety training program.
NRC staff reviewed the radiation safety training program in 1999 and determined that the KUC radiological protection training program encompasses basic radiation protection training for new employees and contractors, on-the-job training, and annual refresher training for all permanent employees. Training received will be documented and records of training will be maintained on-site The training program itself applies to standby and operations. NRC staff has determined that the radiation safety training program proposed by KUC is in accordance with staff guidance and is acceptable (NRC, 1999).

As no revisions are proposed by the licensee (KUC, 2014) to the radiation safety training program during standby or operations, the NRC staff finds, consistent with its previous analyses, that the radiation safety training is acceptable.

4.3.4 Evaluation Findings

In its inspections and oversight of the licensee, the NRC has found that the KUC facility's standby annual radiation safety and transportation training program are in conformance with applicable license requirements and regulations, including Regulatory Guide 8.31 and 10 CFR Part 20 (NRC, 2007b; NRC, 2009; NRC, 2011; NRC, 2013; NRC, 2016). The NRC staff also determines that during standby the licensee has incorporated the transportation regulations as defined in 49 CFR Part 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans," into the radiation safety training program.

The NRC staff previously reviewed the licensee's radiation safety training program during operations (NRC, 2004; 1999a). No revisions are proposed by the licensee (KUC, 2014) to radiation safety training program during operations. The NRC staff finds, consistent with its previous evaluations, that the radiation safety training program for the facility during operations is acceptable.

4.4 Security

4.4.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee's LRA meets all applicable requirements of 10 CFR Part 20.

4.4.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the renewal application against the applicable requirements in 10 CFR Part 20, using the acceptance criteria presented in Section 4 of NUREG-2126 (NRC, 2014).

4.4.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps the licensee submitted in its LRA (KUC, 2014), as updated.

As required in 10 CFR Part 20, Subpart I, "Storage and Control of Licensed Material," licensees shall secure from unauthorized removal or access licensed materials that are stored in controlled or uncontrolled areas, and licensees shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage. License Condition 9.4 permits the licensee to possess byproduct material in the form of uranium wastes and other uranium byproduct waste generated by the licensee's milling operations authorized by the license.

4.4.3.1 Standby

The LRA (KUC, 2014) states that during standby periods, as defined by License Condition 9.4, either a KUC employee or a contract security employee must be present on the site at all times.

The licensee stated that it maintains trailers outside of the site fence to serve as residences for KUC or contract employees present on the site during non-working hours to provide security (KUC, 2014).

In addition to the presence of an onsite security guard during non-working hours, staff employees maintain security during normal operating hours, and the licensee maintains a security fence and gate around the licensed area of the site to prevent unauthorized access. The security fence is shown in the Sweetwater Uranium Project Revised Site Contour Map, November 2013 (KUC, 2014).

All entrances into buildings are locked and secured and the licensee uses a security fence, gate, and locked doors to prevent unauthorized removal or access to licensed material. Personnel are onsite 24 hours daily to maintain constant surveillance of licensed material. All visitors must sign in at the administration building. The licensee maintains onsite communication services (e.g., telephones) to contact law enforcement for additional security if needed. This is consistent with 10 CFR 20 Subpart I and 10 CFR 20 Subpart H.

Because the licensee has adequate security to prevent unauthorized removal or access of licensed material during standby, the staff finds that the facility security program during standby meets 10 CFR Part 20, Subpart I and 10 CFR 20 Subpart H, and is consistent with the acceptance criteria in Section 4 of NUREG-2126 (NRC, 2014).

4.4.3.2 Operations

The licensee stated during operations, the mill would operate 24 hours a day. The presence of mill operators would provide some security. License Condition 9.5 requires that security personnel will be on the property at all times. The SOP “Instructions for All Security Personnel” states that doors to the mill and SX buildings shall be kept closed and locked unless someone is working or a tour is being conducted. The yellowcake storage area is within the mill building and the tailings pile is within the fenced area. The remote location of the facility is also a consideration in evaluating the security plan.

The NRC staff previously accepted the licensee’s security program during operations (NRC, 2004; 1999a). No revisions are proposed by the licensee (KUC, 2004) to the security program during operations. The NRC staff finds, consistent with its previous evaluations, that the security program during operations is acceptable.

4.4.4 Evaluation Findings

The NRC staff finds that, because the licensee has adequate security to prevent unauthorized removal or access of licensed material during standby, and has described an acceptable security program for operations, that the facility security program meets 10 CFR Part 20, Subpart I and 10 CFR 20 Subpart H, and is consistent with the acceptance criteria in Section 4 of NUREG-2126 (NRC, 2014).

4.5 Quality Assurance Program

4.5.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that the proposed quality assurance (QA) program meets the requirements in 10 CFR 20.1101 and 10 CFR Part 20, Subparts L and M.

4.5.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the current licensing basis for compliance with the applicable requirements in 10 CFR Part 20 using the acceptance criteria presented in Section 4 of NUREG-2126 (NRC, 2014). RG 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment," Revision 2, issued July 2007 (NRC, 2007a), provides guidance on demonstrating compliance with the applicable regulations.

4.5.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps submitted by the licensee in its LRA (KUC, 2014), as updated.

This section discusses the proposed QA and quality control (QC) programs for radiological and non-radiological monitoring activities. QA comprises all those planned and systematic actions necessary to provide adequate confidence in the assessment of monitoring results. QC, which is included in QA, comprises those actions that provide a means to measure and control the characteristics of measurement equipment and processes to meet established standards. QA is necessary to ensure that all radiological and non-radiological measurements that support the radiological and non-radiological monitoring programs are reasonably valid and of a defined quality.

Because the QA program does not vary between standby and operations, the NRC staff review and analysis encompasses both.

The licensee performs periodic calibration of radiation monitoring and air samplers. The LRA (KUC, 2014) stated that radiation monitoring of equipment is performed semiannually or at the manufacturer's suggested interval, and air sampling equipment is performed quarterly. The RSO reviews the QA programs for outside commercial laboratories contracted to perform sample analyses and dosimetry at the site. The QA program for the calibration of radiation monitoring and air sampling units remains unchanged from the program the NRC reviewed previously (NRC 2004).

The NRC staff conducted periodic inspections and determined that the calibration of radiation monitoring equipment was conducted in accordance with site standard operating procedures (NRC, 2007b; NRC, 2009; NRC, 2011; NRC 2013, NRC, 2016). Based upon its evaluation and inspection of the licensee's calibration program, the staff has reasonable assurance that the licensee is conducting periodic calibration of radiation monitoring and air sampling equipment in accordance with site standard operating procedures. The NRC's inspection reports concluded that the calibration of radiation monitoring and air sampling equipment was conducted in accordance with the radiation protection program as defined in 10 CFR 20.1101.

Based upon its review of KUC's QA program, inspection results, and its prior review of the program, which has not been changed since the NRC's review in 1999 (KUC, 2014), and as described in its prior reviews (NRC 2004, 1999), the NRC staff finds that the radiation protection and environmental monitoring procedures used by the licensee to ensure consistency and accuracy in monitoring activities. KUC calibrates all radiation monitoring equipment semiannually or at the manufacturer's suggested interval, all air sampling equipment is calibrated quarterly, and the RSO reviews the QA programs for outside commercial laboratories contracted to perform sample analysis. Therefore, NRC staff concludes that the quality assurance and calibration programs for the facility are acceptable.

4.5.4 Evaluation Findings

The NRC staff has completed its review of the QA program at the facility in accordance with Section 4 of NUREG-2126. The staff has determined that the licensee's QA program is consistent with 10 CFR 20.1101(d).

4.5 References

KUC, 2017, Letter from Kennecott Uranium Company to NRC, Responses to the June 26, 2017 Requests for Additional Information (RAIs), dated September 28, 2017 (ML17277A074)

KUC, 2014, "Sweetwater Uranium Project—Docket Number 40-8584, Source Material License No. SUA-1350—Request for a Renewal Source Material License SUA-1350 for a Ten (10) Year Term," Kennecott Uranium Company, July 24, 2014. (ADAMS Accession No. ML14251A113 (package)).

NRC, 2016, NRC Inspection Report 040-08584/2016-001, October 3, 2016 (ADAMS Accession No. ML16273A138).

NRC, 2014, NUREG-2126, "Standard Review Plan for Conventional Uranium Mill and Heap Leach Facilities, Draft Report for Comment," November 2014.

NRC, 2013, NRC Inspection Report 040-08584/2013-001, September 23, 2013 (ADAMS Accession No. 13266A426).

NRC, 2011, NRC Inspection Report 040-08584/2011-001, October 12, 2011 (ADAMS Accession No. 11285A443).

NRC, 2009, NRC Inspection Report 040-08584/2009-001, September 4, 2009 (ADAMS Accession No. 092470618).

NRC, 2007a, Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment," Revision 2, July 2007.

NRC, 2007b, NRC Inspection Report 040-08584/07-001, August 10, 2007 (ADAMS Accession No. 072220332).

NRC, 2004, "Renewal of Source Material License SUA-1350 and Surety Update for the Kennecott Uranium Company's Sweetwater Uranium Mill Site, Amendment 20 (TAC LU0045),"

letter dated November 10, 2004, to Mr. Oscar Paulson, Sweetwater Uranium Facility, Kennecott Uranium Company, Riverton, WY (ADAMS Accession No. ML043170668).

NRC, 2002, Regulatory Guide 8.31, “Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities will be As Low As Reasonably Achievable,” Revision 1, May 2002. (ADAMS Accession No. ML021260630).

NRC, 1999, Renewal of Source Material License SUA-1350 for Operation and Approval of the Reclamation Plan and Surety Amount for the Kennecott Uranium Company, Sweetwater Uranium Project, Sweetwater County, Wyoming, dated August 18, 1999 (ADAMS Accession No. ML080590244).

5.0 Environmental Monitoring Program

5.1 Regulatory Requirements

The purpose of this section is to determine whether the LRA meets all applicable requirements in: 10 CFR Part 20, Subpart B ,"Radiation Protection Programs," Subpart D, "Radiation Dose Limits for Individual Members of the Public," and Subpart F, "Surveys and Monitoring," and; 10 CFR § 40.31(h), § 40.32(c), § 40.32(d), and § 40.65.

5.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the renewal application against the applicable requirements of 10 CFR Part 20 and 10 CFR Part 40, using the acceptance criteria presented in Section 5 of NUREG-2126 (NRC, 2014).

5.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps the licensee submitted in its LRA (KUC, 2014a), and as updated.

The purpose of the environmental monitoring program is to detect radioactive material that was inadvertently released from the facility to the environment, demonstrate that effluent controls are effective, that radioactive materials that are released from the facility are protective of the health and safety of the public, and demonstrate that the program is in compliance with regulatory standards and applicable guidance during operations.

Details of the NRC staff evaluation of the environmental monitoring at the facility are presented below.

5.3.1 Air Particulate, Radon, Soil, Vegetation, and Direct Radiation

5.3.1.1 Standby

The facility has not been in operation since 1983. During standby, the licensee conducts a limited environmental monitoring program that consists of one air particulate sampling station, two radon sampling stations, and two direct radiation measurements. No soil or vegetation monitoring is performed during standby. This program was approved by the NRC in 1999 (NRC, 1999).

The licensee provided historical information on the current environmental monitoring program in standby twice per year as semi-annual effluent reports consistent with 10 CFR 40.65 (KUC, 2005, KUC, 2006, KUC, 2007, KUC, 2008, KUC, 2009, KUC, 2010, KUC,2011, KUC, 2012, KUC, 2013, KUC, 2014c, KUC, 2015c, KUC, 2016d, KUC, 2017b). The reports include the results of air particulate, radon, and direct radiation during standby. NRC staff reviewed these results and noted that the environmental radon concentrations exceeded the 10 CFR 20, Appendix B, Table 2 Rn-222 effluent concentrations with daughters removed (1 E-10 uCi/ml or 0.1 pCi/L). When it issued its revised standards for protection against radiation in 1991 (56 FR 23360), NRC was aware that some categories of licensees, such as uranium mills and in-situ uranium mining facilities, may experience difficulties in determining compliance with the values in Appendix B, Table 2 for certain radionuclides, such as radon-222.

The licensee did not provide a calculated radon concentration from radon emitted from the existing tailings impoundment in the LRA (KUC, 2014a). The NRC staff sent an RAI (NRC, 2015) requesting that the licensee calculate the annual average Rn-222 concentration at several receptor points using the computer code MILDOS-AREA with radon flux measurements (and release rate) from the tailings impoundment inventory as reported from the 2014 semi-annual effluent report (NRC, 2015). MILDOS-AREA is a publicly available computer code developed by the NRC to calculate air concentrations and radiation doses at uranium recovery facilities. The purpose of the RAI was to obtain sufficient information to assess whether the concentration of radon in air from the facility at the selected receptor points were below the effluent concentrations in 10 CFR 20, Appendix B, Table 2 for Rn-222 with daughters present. The licensee calculated the estimated Rn-222 concentrations at several receptor locations from emissions from the facility, and all the results were below the effluent concentrations in 10 CFR 20, Appendix B, Table 2 for Rn-222 with daughters present (KUC, 2015a, KUC, 2015b). The licensee showed by calculation using MILDOS-AREA that the amount of Rn-222 from the facility is very small and below the 10 CFR 20 Appendix B, Table 2 effluent concentrations for Rn-222 with daughters present during standby. Therefore, the NRC staff has reasonable assurance that Rn-222 air concentrations, as contributed from the emissions of the tailings impoundment, are below the limits as defined in 10 CFR 20, Appendix B, Table 2, for Rn-222 with daughters present.

The NRC staff independently reviewed the environmental monitoring program performed by the licensee during site inspections (NRC, 2007, NRC, 2009, NRC 2011, NRC, 2013, and NRC, 2016). The inspections found no violations.

As evaluated above, the NRC staff finds that KUC's standby environmental monitoring methodology is acceptable, and that the results for particulates and radon are below the 10 CFR 20, Appendix B, Table 2 effluent concentrations and the public dose limits as defined in 10 CFR 20 Subpart D. Therefore, the NRC staff finds the environmental monitoring program acceptable for standby.

5.3.1.2 Operations

In the LRA (KUC, 2014) and referenced documents, KUC committed that during operations, direct radiation will be sampled quarterly, vegetation will be sampled three times during the grazing season, and soil will be sampled annually. The licensee indicated that air particulate and soils are analyzed for natural uranium, Ra-226, Th-230, and Pb-210; Rn-222 is analyzed; and direct gamma radiation is measured (KUC, 1994). Vegetation samples will be analyzed for Ra-226 and Pb-210. The locations, frequency, and isotopic analyzes is consistent with Regulatory Guide 4.14. The NRC staff approved this program in 1999 (NRC, 1999).

The NRC staff reviewed these monitoring stations (air particulate, radon, soil, vegetation, and direct radiation) for operations against the wind rose provided in a Revised Supplement to Licensee's Environmental Report, dated November 2016 (KUC, 2016b) and determined that one monitoring station (GS-3) was not in the correct location, and was positioned inconsistent with the recommendation for monitoring locations in the three highest airborne concentrations as defined in Regulatory Guide 4.14. NRC staff issued a Request for Additional Information (RAI) and the licensee provided a revised map showing an updated location for GS-3. NRC staff found the response acceptable. The NRC staff has determined that the air particulate, radon, soil, vegetation, and direction radiation for operation is consistent with Regulatory Guide 4.14, and with the relocation of one sampling location, the air particulate, radon, soil, and direct radiation did not change since the previous analysis in 1999 for operations. Therefore, NRC

staff finds that the environmental monitoring program for air (particulate and radon), soil, vegetation, and direct radiation is acceptable for operations.

5.3.2 Ground Water and Surface Water Monitoring Programs

The ground and surface water monitoring programs for the KUC facility during operations and standby periods are summarized in Section 5.10 of the LRA (KUC, 2014a).

The NRC's staff evaluation of the standby and operational surface ground water monitoring programs is discussed below.

5.3.2.1 Surface Water Monitoring

Standby

As indicated in Table 5-1 of KUC's Final Design Volume VII (KUC, 1997, 1998, 1999a), surface water and related sediment monitoring is not required during standby. The NRC staff approved the standby surface water monitoring programs described in Section 5 of KUC's Final Design Volume VII (KUC, 1997), as revised (KUC, 1998; 1999a,b), and summarized in Table 5-1 of that document. The most recent version of Table 5-1 (KUC, 2005) contains no revisions related to standby surface water monitoring from the versions previously approved by the NRC staff.

The licensee (KUC, 2017a) has indicated to the NRC staff that, other than the removal of a formerly used catchment basin, "there have been no changes to the facility or to its programs since the last license renewal." The NRC staff finds, based on the staff's review of the information in the LRA (KUC, 2014a), that consistent with its previous analyses, KUC's surface water monitoring program at the facility in standby is acceptable.

Operations

The surface water monitoring program to be implemented at the KUC facility during operations is summarized in Section 5.10.2 of the LRA (KUC, 2014a). During operations, three surface water locations (BS1, BS2 and BS3) are required to be sampled monthly when flowing and not frozen and quarterly if standing water that is not frozen is present in accordance with Table 5-2 (as revised on June 21, 1999) of KUC's Final Design Volume VII (KUC, 1999a). The NRC staff approved the standby surface water monitoring programs described in Section 5 of KUC's Final Design Volume VII (KUC, 1997), as revised (KUC, 1998; 1999a,b), and summarized in Table 5-2 of that document.

The licensee (KUC, 2017a) has indicated to the NRC that, other than the removal of a formerly used catchment basin, "there have been no changes to the facility or to its programs since the last license renewal." The NRC staff finds, based on the staff's review of the information in the LRA (KUC, 2014a), consistent with its previous analyses, that KUC's operational surface water monitoring program for the facility is acceptable.

5.3.2.2 Ground Water Monitoring

Corrective Action Program – Legacy Ground Water Contamination

The ground water monitoring currently being performed at the facility while it is on standby is associated with ongoing Corrective Action Program (CAP) activities to address legacy

groundwater contamination from the existing tailings impoundment and former catchment basin. The CAP is discussed in Section 7.3.1 of this SER.

Because the ground water monitoring associated with the CAP must continue regardless of the operational status of the facility until the CAP objectives are met, the NRC staff is modifying license condition 11.5 (which references standby monitoring Table 5-1) to clarify these monitoring requirements for "Point of Compliance Wells," "Tailings Monitor Wells" and "Pumpback Wells" in license condition 11.3.

While addressed and discussed in this SER for completeness, the sufficiency of the current CAP with respect to legacy contamination is a subject of ongoing regulatory oversight, and is not directly related to license renewal beyond the NRC staff's review of the sufficiency of the licensee's CAP program generally.

Operations – New Tailings Impoundment and Evaporation Ponds

The NRC staff previously approved an operational ground water monitoring program (NRC, 1999) for the new tailings impoundment and evaporation ponds to be built at the site prior to re-starting operations (NRC, 1999). The NRC's staff current evaluation of the previously approved program is documented in the technical evaluation report (TER) included as Attachment B to this SER. The TER concludes that the current ground water operational monitoring requirements specified in Table 5-2 for the new tailings impoundment and evaporation ponds do not comply with the ground water monitoring criteria in 10 CFR Part 40, Appendix A. The current operational monitoring requirements are based on previous information and assumptions about local ground water conditions that are no longer valid. The issues identified in the TER may be summarized as follows:

- Monitoring well TMW-64, specified in Table 5-2 as a point of compliance well for the new tailings impoundment, is within the existing combined radium-226/228 ground water plume;

- Conductivity values for new tailings impoundment monitoring wells TMW-31, TMW-75, and TMW-78 (for which the NRC previously approved the monitoring of conductivity, pH, and chloride as early detection parameters (Table 5-2)) have consistently and significantly exceeded the NRC-approved 350 µmho/cm conductivity standard;

- Monitoring well TMW-50, located north of the evaporation ponds, was intended to measure background water quality upgradient of the ponds. However, this well: (a) is currently situated downgradient of the pond locations (due to CAP pumping activities), (b) is located within the existing combined radium-226/228 ground water plume, and (c) has consistently exceeded the NRC-approved 350 µmho/cm conductivity detection standard.

In a public teleconference held on August 18, 2016, NRC staff explained that the licensee must propose to the NRC a detection monitoring plan that would allow for detection of any new contamination from the new tailings impoundment and evaporation ponds (NRC, 2016a,b). In response, pursuant to the general provisions in 10 CFR 40, Appendix A, allowing for alternatives to the specific Appendix A requirements, the licensee provided a "leak detection and early warning" proposal to the NRC on October 18, 2016 for review (KUC, 2016a). This proposal included introducing a potassium bromide tracer into the impoundments that could be detected if a leak occurred. Based on its review of this document, the NRC staff issued RAI's to

the licensee on June 26, 2017, asking for further details on the iuse of the tracer (NRC, 2017). The licensee responded to the RAIs on September 28, 2017 (KUC, 2017a).

KUC proposes a multi-tiered approach to ground water monitoring for the new tailings impoundment and evaporation ponds during operations, as follows:

(1) Injection of bromide into the tailings stream to create a unique chemical signature in the tailings solution;

(2) Monitoring of the leak detection and recovery (LDR) systems for the new tailings impoundment and evaporation ponds;

(3) Monitoring of perched well TMW-65 (located near the southwest comer of the new tailings impoundment and completed above a clay layer in the unsaturated zone) for the presence of bromide-bearing fluids; and

(4) Ground water monitoring of the Battle Spring Aquifer. For ground water monitoring of the Battle Spring Aquifer (#4) during operations, the licensee proposes the following:

Tailings Impoundment Ground Water Monitoring. For early detection monitoring, the licensee proposes to monitor for bromide (only) in wells TMW-31, TMW-64, TMW-75, TMW-78 and TMW-85, all located south of the new tailings impoundment. The frequency of monitoring would be monthly for the first year then quarterly afterward. TMW-64 would continue to serve as the point of compliance well (pursuant to 10 CFR 40, Appendix A, Criterion 5B(1)) and be monitored semiannually for arsenic, beryllium, bromide, cadmium, chromium, Pb-210, nickel, combined Ra-226/228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, and TDS.

Evaporation Ponds Ground Water Monitoring. For early detection monitoring, the licensee proposes to monitor for bromide (only) in wells TMW-3 and TMW-50, respectively south and north of the evaporation ponds, and three new wells to be located south, southwest and west of the ponds, respectively. The frequency of monitoring would be monthly for the first year then quarterly afterward. As previously approved by NRC (NRC, 1999), the new well opposite the southwest corner of the evaporation ponds location would also serve as the point of compliance well (pursuant to 10 CFR 40, Appendix A, Criterion 5B(1)) and be monitored semiannually for arsenic, beryllium, bromide, cadmium, chromium, Pb-210, nickel, combined Ra-226/228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, and TDS.

Details of the NRC staff evaluation of these respective components of the ground water monitoring program for operations proposed by the licensee (KUC, 2017a) are presented below.

In its evaluation of supporting hydrogeologic analysis provided by the licensee, the NRC staff recognizes that, given the effects of pumping related to the ongoing CAP, the licensee has "assumed the observed groundwater gradients and directions would be similar to those observed today" (KUC, 2017a). Because ground water conditions could change with changes to the CAP, the staff is adding a requirement to license condition 11.4 that the licensee monitor ground water flow directions to ensure detection monitoring and point of compliance wells remain downgradient of impoundments. This license condition is presented in Section 5.4 of this SER.

The following element-by-element evaluation by the NRC staff of the multi-tiered approach proposed by the licensee for ground water monitoring during operations corresponds to the order in which they were described above.

Evaluation of (1)

The licensee has provided literature references that support the applicability of bromide (in potassium bromide form) as a conservative (non-reactive) ground water tracer. Although the tracer has not been specifically applied for the purpose of detecting leaks from tailings impoundments and evaporation ponds, the NRC staff has reasonable assurance of its effectiveness for this purpose based on its review of analagous applications and the conservative chemical characteristics of bromide.

Assuming a leak from the tailings impoundments and evaporation ponds, the licensee applied a Darcy flux analysis to compute advective flow dilution factors in the aquifer and calculate the resulting concentration of bromide at the source that would result in detectable concentrations (0.05 mg/L) in the monitoring wells (discussed in D below). The licensee's analysis indicates that the necessary concentration value would be on the order of 0.1 mg/L but this value was conservatively increased to 10 mg/L.

The licensee provided mass balance calculations of the concentration and volumetric rate at which potassium bromide would have to be injected into the tailings discharge to achieve a concentration of bromide in the new tailings impoundment and evaporation ponds of at least 10 mg/L. The licensee calculates that 1,343 kg (1.48 tons) of potassium bromide entering the tailings impoundment in the first month (approximately 1.8 kg/hr (4 lb/hr)) will achieve a bromide concentration of 10 mg/L in the impoundment and evaporation ponds. After this concentration is achieved, the licensee argues, the amount of potassium bromide needed to maintain a bromide concentration of 10 mg/L in the tailings impoundment will decrease due to the recycling of bromide-bearing water back into the mill. The licensee calculates that 1,025 kg (1.13 tons) of potassium bromide per month (approximately 1.4 kg/hr (3 lb/hr)) will be sufficient thereafter to maintain a bromide concentration of 10 mg/L in the impoundment and ponds. The licensee proposes measuring actual fluid concentrations weekly in the tailings impoundment and one of the evaporation ponds weekly using a portable probe with a detection limit of 0.5 mg/L so as to allow adjustments in the tailings injection rate as needed to maintain the target concentration of at least 10 mg/L. In addition, the licensee commits to submitting a sample from the tailings impoundment and one of the evaporation ponds monthly to a laboratory for ion chromatography analysis (0.63 mg/L detection limit).

The NRC staff has reviewed the references provided and finds them to be from appropriate sources and pertinent to the proposed application. Staff has also reviewed the numerical calculations provided by the licensee, as described above, and finds them to be acceptable. The NRC staff considers that the proposed verification monitoring of the tailings impoundment and evaporation ponds to ensure that the target bromide concentration is achieved is part of an acceptable approach.

Evaluation of (2)

Double liners with LDR systems were incorporated into the design of the new tailings impoundment and evaporation ponds previously reviewed and approved by the NRC staff (NRC, 1999). This design is required under 10 CFR 40, Appendix A, Criterion 5E(1) "in addition to the ground water monitoring program conducted as provided in Criterion 7" and thus should

not be construed as being part of a program to satisfy the requirements of Criterion 7. Thus, the NRC staff finds that the license's inclusion of the LDR systems associated with the new tailings impoundment and evaporation ponds as part of the ground water monitoring program for the impoundment and ponds is required and therefore does not inform the NRC staff's analysis of the licensee's proposed ground water monitoring program.

Evaluation of (3)

Based on information in the Annual Corrective Action Program Review and Groundwater Monitoring Reports (e.g., KUC, 2016c), the NRC staff has verified that monitoring well TMW-65 is approximately 24 m (78 ft) deep and located approximately 82 m (270 ft) from the southwest corner of the new tailings impoundment to be built upon resumption of operations. The NRC staff has also verified from the geologic cross-sections previously submitted by the licensee (KUC, 1995) that this well is completed above a perching clay layer. During the September 20, 2016 site inspection of the facility, the NRC staff confirmed through direct measurement that well TMW-65 contained no water (NRC, 2016b).

Based on this analysis, the NRC staff finds that monitoring of perched well TMW-65 as part of a ground water detection monitoring program for the new tailings impoundment is part of an acceptable approach.

Evaluation of (4)

Tailings Impoundment Ground Water Monitoring

The licensee has proposed the addition of well TMW-85 to the four other wells (TMW-31, TMW-64, TMW-75 and TMW-78) previously approved in 1999 by NRC for ground water early detection monitoring (NRC, 1999). The NRC staff has determined that these wells are situated hydraulically downgradient of the new tailings impoundment location under the current, CAP-influenced ground water flow regime, as indicated by current potentiometric surface maps (KUC, 2016c) and the flow analysis provided by the licensee in the response to RAIs. These wells are spaced along an east-west line within or adjacent to the southern slope of the to-be-built new tailings impoundment. Because these wells remain downgradient of the tailings impoundment, the NRC staff considers that they remain suitable for early detection of leaks from the impoundment into the ground water system. The NRC staff finds the addition of well TMW-85 to the four other wells part of an acceptable approach for providing early leak detection monitoring.

For early detection purposes, the licensee proposes sampling these five wells for bromide (only) monthly for the first year then quarterly afterward. The NRC staff notes that the minimum travel time for bromide to reach a well 26.1 m (85.6 ft) distant is estimated by the licensee from aquifer dispersion calculations to be 65 days. The licensee has also calculated that the travel time of the bromide to reach the water table if a leak were to occur in the synthetic liner of the impoundment would be approximately 0.03 years (11 days). For purposes of this calculation, the licensee conservatively ignored the presence of the additional clay liner that will be placed under the tailings impoundment. The NRC staff has reviewed these calculations and finds them to be acceptable and consistent with the NRC staff's understanding of applicable flow rates. Based on these travel times, the NRC staff finds the proposed monthly bromide sampling frequency acceptable because it provides a high likelihood for prompt detection of the tracer given the magnitude of the travel time.

The NRC staff has also reviewed and does not accept the licensee's proposal to only monitor bromide for early detection purposes at the wells specified. As documented in the TER (Attachment A to this SER), of the three early detection monitoring parameters (conductivity, pH and chloride) previously approved by NRC (NRC, 1999), only conductivity has exceeded the NRC-approved detection standard in wells TMW-31, TMW-75, and TMW-78. The NRC staff therefore considers it appropriate for ground water protection that, upon resumption of operations, wells TMW-31, TMW-64, TMW-75, TMW-78 and TMW-85 should be sampled for chloride and pH in addition to bromide at the same frequency as the licensee proposes for bromide sampling. The detection standards for these parameters shall continue to be those previously approved by the NRC (NRC, 1999); namely 23 mg/L for chloride and ≥6.67 for pH.

The NRC staff has also evaluated the proposed retention of well TMW-64, as previously approved (NRC, 1999), as the point of compliance well for the new impoundment. Staff observes, as previously noted, that the location of this well remains hydrologically downgradient of the impoundment location under the existing CAP-influenced ground water flow field. Thus, the NRC staff finds that use of this well as the point of compliance is acceptable and that, upon resumption of operations, well TMW-64 should be sampled in accordance with the specifications for "Point of Compliance Well, Tailings impoundment" in Table 5-2 of the Final Design Volume VII, submitted (page change) June 21, 1999 (KUC, 1999a), as revised in the September 28, 2017 response to RAIs (KUC, 2017a). The ground water protection standards for the parameters monitored in well TMW-64 shall be the same as those specified in license condition 11.3.

The NRC staff notes that well TMW-64 is currently inside the existing plume of combined radium 226/228 contamination, as are all the wells currently downgradient of the new tailings impoundment location (see Attachment A to this SER). Because of its location inside the existing contamination plume, this well cannot currently fulfill the compliance monitoring requirements of 10 CFR 40, Appendix A, 5B(5) with respect to the new tailings impoundment. This contamination is being addressed by the ongoing CAP, as discussed in Section 7.3.1 of this SER.

Evaporation Ponds Ground Water Monitoring

As previously described, the licensee proposed that early detection monitoring of the evaporation ponds be performed in wells TMW-3, TMW-50, and three new wells to be located south, southwest and west of the ponds. These are the well locations that were previously approved by NRC in 1999 (NRC, 1999).

For early detection purposes, the licensee proposed sampling the wells identified for bromide (only) monthly for the first year then quarterly afterward. Based on its review of the travel time calculations provided by the licensee, as discussed in the evaluation of (4), the NRC staff finds the proposed bromide sampling frequency acceptable. However, for the same reasons specified in its evaluation of (4), the NRC staff does not accept the licensee's proposal to only monitor bromide. Staff considers it appropriate for ground water protection that, upon resumption of operations, the wells identified in the discussion below should be sampled for chloride and pH in addition to bromide at the same frequency as the licensee proposes for bromide sampling. The detection standards for these parameters shall continue to be those previously approved by the NRC (NRC, 1999); namely 23 mg/L for chloride and ≥6.67 for pH.

In addition to the early detection monitoring wells identified above, the NRC previously approved the use of the new well opposite the southwest corner of the evaporation ponds location as the point of compliance well for the ponds (NRC 1999). The NRC staff observes that, due to CAP-related pumping at the site, the hydrologic positions of all the wells relative to the location of the evaporations ponds has changed drastically from the time of that approval. As identified in the TER included as Attachment A to this SER, ground water flow was formerly from northeast to southwest, thus TMW-3 and the new well locations were downgradient of the evaporation ponds locations, and was TMW-50 upgradient. Under current ground water flow conditions, as documented by the flow analysis provided by the licensee in the response to RAIs, ground water flow currently diverges from the east to the northwest, west, and southwest across the evaporation pond areas.

Given the current ground water flow directions, NRC staff finds that: (1) all of the monitoring wells utilized for early detection monitoring should also be point of compliance wells, and (2) well TMW-50, which is currently inside the combined radium 226/228 plume, should be replaced with well TMW-49, which is outside of the plume and closer to the location of the evaporation ponds. The staff observes that the flow path to TMW-49, rather than to the more distant TMW-50, was calculated by the licensee in the flow analysis provided to NRC in the response to RAIs.

The NRC staff finds that, upon resumption of operations, wells TMW-3, TMW-49 and the three new monitoring wells should be employed for compliance monitoring (i.e., in addition to early detection monitoring) as specified in modified license condition 11.4 included in Section 5.4 of this SER.

5.4 Evaluation Findings

The NRC staff has completed its review of KUC's Environmental Monitoring Program. For standby mode, the staff determined that KUC's methodology is acceptable and the results for particulates and radon are below the 10 CFR 20, Appendix B, Table 2 concentration limits and the public dose limits as defined in 10 CFR 20 Subpart D.

The staff has also determined that the air particulate, radon, soil, vegetation, and direct radiation monitoring during operations is consistent with Regulatory Guide 4.14. Therefore, the NRC staff finds that the environmental monitoring program for air (particulate and radon), soil, vegetation, and direct radiation is acceptable for operations.

Therefore, the NRC staff has determined that KUC's environmental monitoring program is in compliance with 10 CFR 40, Appendix A, Criterion 7 for operations (and standby). NRC staff also finds that the licensee provides semi-annual effluent reports consistent with 10 CFR Part 40.65.

The NRC staff has also completed its review of the surface water standby and operational monitoring programs previously approved for the facility by the NRC (NRC, 1999) and finds that, consistent with previous evaluations, KUC's surface water monitoring program is acceptable. The ground water monitoring currently being performed at the facility while it is in standby mode is compliance monitoring associated with ongoing Corrective Action Program (CAP) activities to address legacy ground water contamination from the existing tailings impoundment and former catchment basin. The CAP is discussed in Section 7.3.1 of this SER.
The NRC staff has completed its review an alternate proposal, submitted by the licensee pursuant to the general requirements of 10 CFR 40 Appendix A, for ground water detection monitoring (10 CFR 40, Appendix A, Criterion 7) of the tailings impoundment and evaporation

ponds during operations. Staff finds, based its analysis of the supporting documentation submitted by the licensee, that the proposed approach is acceptable with respect to (1) the use of bromide as a tracer, and (2) monitoring of the perched zone below the tailings impoundment using well TMW-64. The NRC staff approves the licensee's elimination of conductivity as an early detection monitoring parameter given that, due to the existence of legacy contamination at the site, this parameter has chronically exceeded the detection standard previously approved by NRC (NRC, 1999), as discussed in Attachment A to this SER. However, the NRC staff does not accept the licensee's proposed elimination of chloride and pH as early detection parameters given that neither of these parameters has exceeded the detection standards previously set by NRC (NRC, 1999) and they would provide additional detection capability. The NRC staff finds that monitoring these two additional parameters would provide an appropriate margin of ground water protection.

The NRC staff also does not accept the license's inclusion of the LDR systems for the new tailings impoundment and evaporation ponds within the ground water monitoring program for the impoundment and ponds. Such systems are separately required under 10 CFR 40, Appendix A, Criterion 5E(1), which provides that "in addition to the ground water monitoring program conducted as provided in Criterion 7," and thus such systems are not properly included as part of a program to satisfy the requirements of Criterion 7.

The NRC staff has evaluated the use of wells previously approved by NRC (NRC, 1999) for monitoring ground water near the tailings impoundment, and the addition of well TMW-85 to the monitoring network in the context of current ground water flow field characteristics at the site. The staff finds these wells acceptable. For ground water monitoring of the evaporation ponds, the NRC staff has concluded from its analysis of the existing flow field that: (1) well TMW-49 should be substituted for well TM-49 and (2) all early detection ground water monitoring wells previously approved by the NRC (NRC, 1999) should also be employed as point of compliance wells, pursuant to the requirements pursuant to 10 CFR 40, Appendix A, Criterion 5B(1), using the parameters and ground water protection standards in Final Design Volume VII (KUC, 1997), as revised (KUC, 1998; 1999a,b; 2005), as approved by NRC (NRC, 1999; NRC 2005).

The NRC's staff findings regarding the operational and standby ground water monitoring programs approved for the facility are captured in the following modified license conditions:

11.4 Upon resumption of milling operations, the licensee shall implement a ground-water detection and compliance monitoring program for the tailings impoundment and evaporation ponds in accordance with the standards stipulated in the Addendum to the Revised Environmental Report~~,--~~Background Ground Water Quality and Detection Standards, dated January 1996, as revised by the submittals of January 8, 1998, and March 25, 1999, and the following table:

Category	Locations	Frequency	Analytical Parameters
Tailings Liquid	Tailings Impoundment	Weekly	Bromide tracer† (required concentration ≥ 10 mg/L)
Evaporation Ponds Liquid	Evaporation Ponds (one cell)	Weekly	Bromide tracer† (required concentration ≥ 10 mg/L)
Monitoring Wells, Tailings Impoundment	TMW-31, TMW-64, TMW-65*, TMW-75, TMW-78, TMW-85	Monthly for first year, quarterly thereafter	Bromide tracer† Chloride pH
Monitoring Wells, Evaporation Ponds	TMW-3, TMW-49, plus three new wells (per Figure 6 in ML ML17277A074)	Monthly for first year, quarterly thereafter	Bromide tracer† Chloride pH
Point of Compliance Well, Tailings Impoundment	TMW-64	Semiannually	Arsenic, beryllium, bromide, cadmium, chromium, Pb-210, nickel, combined Ra-226 and -228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, TDS
Point of Compliance Well, Evaporation Ponds	TMW-3, TMW-49, plus three new wells (per Figure 6 in ML ML17277A074)	Semiannually	Arsenic, beryllium, bromide, cadmium, chromium, Pb-210, nickel, combined Ra-226 and -228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, TDS
*Perched well; fluids to be analyzed if present †The reporting limit for bromide is 0.05 mg/L			

Within 1 year of resumption of milling operations, and annually thereafter, the licensee shall perform an evaluation to determine whether each detection monitoring and point of compliance well is downgradient of its associated impoundment. For each detection or point of compliance well found not downgradient, the licensee shall, within 6 months, install or place in service, a downgradient well.

For non-ground water environmental monitoring, upon resumption of milling operations, the licensee shall conduct a monitoring program in accordance with the pertinent on-file SOPs for environmental monitoring and the relevant requirements in Table 5-2 of the Final Design Volume VII, submitted (page change) June 21, 1999.

11.5 During ~~any~~*the current period* of mill standby, the licensee shall conduct an environmental monitoring program in accordance with on-file SOPs for environmental

monitoring, and in accordance with Table 5-1 of the Final Design Volume VII, submitted (page change) June 21, 1999, as revised January 18, 2005*, except for the requirements in Table 5-1 pertaining to wells associated with "Tailings Impoundment Point of Compliance," "Catchment Basin Compliance Monitoring," "Tailings Monitor," "Tailings Impoundment Pumpback" and "Catchment Basin Pumpback" which are superseded by the requirements in license condition 11.3.*

For environmental monitoring during any future, post-operations mill standby period, the licensee must submit a license amendment application to NRC for review and approval.

5.5 References

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6.0 Radiation Safety Program

6.1 Regulatory Requirements

The purpose of this chapter is to assess whether KUC has demonstrated that the radiation safety program meets the applicable requirements of 10 CFR Part 20 Subpart B, 10 CFR Part 20 Subpart C, 10 CFR Part 20 Subpart F, 10 CFR Part 20 Subpart H, 10 CFR Part 20 Subpart L, 10 CFR Part 20 Subpart M, and 10 CFR 40.61.

6.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the renewal application against the applicable requirements of 10 CFR Part 20 and 10 CFR Part 40 using the acceptance criteria presented in Section 6 of NUREG-2126 (NRC, 2014), Regulatory Guide 8.30 (NRC, 2002a), Regulatory Guide 8.31 (NRC, 2002b), Regulatory Guide 8.22 (NRC, 1988), and Regulatory Guide 8.15 (NRC, 1976).

6.3 Staff Review and Analysis

The purpose of the radiation safety program is to protect the workers, members of the public, and the environment from radioactive materials and exposure to radioactive materials that may be harmful. The radiation safety program at Kennecott consists of in-plant external radiation monitoring, in-plant airborne monitoring, exposure calculations, personnel dosimetry, bioassay, and contamination control. The NRC staff's evaluation of the licensee's environmental monitoring program is provided in Chapter 5 of this SER.

In 1999, the NRC staff approved a radiation safety program for operations and a comparably reduced radiation protection program for standby mode (NRC, 1999).

6.3.1 In-Plant External Radiation Monitoring Program

The purpose of the in-plant external radiation monitoring program is to measure and record external radiation levels in the plant. The measurements are used for posting and for ensuring that workers do not exceed 10 CFR 20.1201, occupational dose limits to adult.

The licensee indicated that gamma surveys during operation of the mill is conducted semiannually at 18 locations, and during non-operational periods (i.e., standby), gamma surveys are conducted semiannually at the locations listed on the Mill Gamma Survey and Ion Exchange Gamma Survey form (KUC, 2014). The licensee conducts the semiannual gamma surveys with a Ludlum 44-10 NaI detector and 2350-1 rate meter, Ludlum Model 19 NaI detector (or a Model 12S detector), and calibrates all instruments on an annual basis (KUC, 2014). The NRC staff determined that the in-plant external radiation monitoring program for standby did not change from the program the NRC staff previously evaluated in 1999. The LRA identified radiation instruments used to conduct gamma radiation surveys. The NRC staff has determined that the licensee does have adequate radiation instrumentation to conduct in-plant external radiation monitoring and has reasonable assurance that adequate radiation instrumentation is used to measure radiation levels. During standby, the licensee conducts a scaled-down version (fewer locations) of the in-plant external radiation monitoring program because a majority of the radioactive material has been removed from the facility and, therefore, accessible spaces have lower radiation exposure levels.

The licensee provided annual average gamma exposure rates (uR/Hr) for the IX Areas, Mill Areas, Tailings Impoundment, including one measurement for the Catchment Basin Excavation (2006), as well as calculated annual external dose estimates and personnel dosimetry results from 2004 to 2013 (KUC, 2014). NRC staff reviewed the exposure rates and finds that the licensee conducted surveys consistent with 10 CFR Part 20 Subpart F, "Surveys and Monitoring," and exposure rates did not exceed the posting requirements identified in 10 CFR Part 20, Subpart J, "Precautionary Procedures."

The NRC staff independently reviewed in-plant external radiation results performed by the licensee during site inspections (NRC, 2007, NRC, 2009, NRC 2011, NRC, 2013, and NRC, 2016). The inspections found no violations.

The NRC previously approved a reduced in-plant radiation safety program for periods of standby (NRC, 1999). Surveys will be conducted in locations where both routine and non-routine work is performed so that whole body radiation exposure can be estimated. Survey results will be used to determine if a particular area should be posted as a "radiation area" and to identify sources of elevated gamma radiation levels. The licensee is not proposing any changes to the in-plant external radiation monitoring program (KUC, 2014). Therefore, the NRC staff finds, consistent with its previous evaluations, that KUC's in-plant external radiation monitoring program is acceptable and meets applicable requirements.

6.3.2 Personnel External Dosimetry

The purpose of the personnel dosimetry program is to measure and record external radiation levels to workers in the plant. The purpose of the personnel dosimetry program, as well as the in-plant external radiation monitoring program, is to ensure that workers do not exceed 10 CFR Part 20, Subpart C for occupational dose limits to adults.

The licensee stated that doses to workers are estimated on an annual basis based on a combination of gamma surveys, personnel dosimeters, radon and air particulate monitoring, and bioassay sampling (KUC, 2014). The licensee has changed the type of personnel dosimeter from a thermo-luminescent dosimeter to an optical-stimulated luminescent dosimeter. The licensee continues to maintain adequate sensitivity because both types of dosimeters are able to measure small quantities of external radiation well below regulatory limits, and the change in the type of dosimeter does not affect the personnel dosimetry program. While the program would remain unchanged, during operations, the number of workers being monitored would be higher. During operations at the mill, each employee working at the facility will be issued dosimetry and required to wear them while working in the mill complex (NRC, 1999). The licensee will also monitor airborne uranium and radon in conjunction with employee time to determine internal radiation exposures (NRC, 1999). The NRC staff finds that the licensee continues to measure exposure to workers.

The licensee provided annual dose and uranium intake data for the maximum exposed worker from 2004 to 2013 in the license renewal application (KUC, 2014). The data includes calculated external dose estimates, personnel dosimeter results, radon dose, air particulate dose, Total Effective Dose Equivalent (TEDE), calculated soluble natural uranium intake, and bioassay results from natural uranium. The TEDE is the sum of both internal and external radiation doses to a worker. NRC staff reviewed the data and determined that the TEDE did not exceed the 10 CFR Part 20 Subpart C limit of 5000 mrem per year per worker. The NRC staff finds these results acceptable.

NRC staff also independently reviewed the personnel dosimetry results and program performed by the licensee during site inspections (NRC, 2007, NRC, 2009, NRC 2011, NRC, 2013, and NRC 2016). These inspections found no violations. The NRC staff finds these results acceptable.

Based upon the above, the NRC staff finds KUC's radiation personnel external dosimetry program acceptable.

6.3.3 In-Plant Airborne Radiation Monitoring Program

The purpose of the in-plant airborne radiation monitoring program is to characterize the airborne uranium and radon daughter concentrations at various locations in the plant to ensure that workers are adequately monitored for and protected from internal radiation exposures, and that areas are adequately posted in accordance with the applicable regulations in 10 CFR Part 20. The program consists of airborne uranium particulate monitoring, radon daughter concentration monitoring, and respiratory protection.

6.3.3.1 Airborne Particulate Matter

The licensee stated that air sampling is conducted at the ore crushing and yellowcake areas semi-annually during periods of non-operation (KUC, 2014). The NRC staff determined from information in the LRA (KUC, 2014) that during standby the licensee conducts a scaled down version (i.e., less locations) of the in-plant airborne radiation monitoring program because much of the radioactive material that would be present during operations has been removed from the facility and therefore, lower airborne exposure levels are expected. In connection with the overall radiation safety program for the facility during standby, the NRC staff previously concluded in the 1999 SER (NRC, 1999) that "the proposed reduction in the program, as currently practiced during standby mode provides adequate protection." During operations, high-volume air particulate sampling will be done at least monthly at a minimum of 15 locations and in the yellowcake drying and packaging area. Breathing zone air sampling to detect uranium-bearing dust will be done at least weekly (NRC, 1999).

The licensee provided annual average air concentrations for the mill facility and the impoundment area. The results consisted of annual average air concentrations for uranium natural, Th-230, and Ra-226 from 2004 to 2013, and Pb-210, and Po-210 from 2011 to 2014 (KUC, 2014). NRC staff reviewed the results of the annual average air concentration for each radionuclide and determined that the results are below the limits of 10 CFR 20, Appendix B, Table 1. The NRC staff finds that the in-plant airborne radiation monitoring program meets 10 CFR Part 20, Subpart F for surveys and monitoring, and determined that the in-plant airborne monitoring program for air particulate is acceptable.

6.3.3.2 Radon

The licensee identified several locations for in-plant radon daughter (radon decay product) sampling during operations and these locations are sampled quarterly or monthly depending on the location using the modified Kusnetz method (KUC, 2014). During non-operations (standby), the licensee conducts a scaled down version (i.e., less locations) of its radon sampling program because a majority of the radioactive material has been removed from the facility. During operations radon daughter (decay products) monitoring will be performed in compliance with Regulatory Guide 8.30 in selected process areas (NRC, 1999)). Also, additional radon daughter

sampling is conducted if results exceed the radon concentrations as identified in Regulatory Guide 8.30 (KUC, 2014).

The licensee provided annual average radon and radon daughter data in the LRA with the results expressed in working levels (WL) (KUC, 2014). The NRC staff determined from review of the annual average radon and radon daughter data provided by the licensee that all annual average radon decay product concentration results were below the WL limit as identified in 10 CFR 20, Appendix B, Table 1.

The NRC staff independently reviewed in-plant air (particulate and radon) sampling results during NRC inspections (NRC, 2007, NRC, 2009, NRC, 2011, NRC, 2013, and NRC, 2016) and determined that all air concentrations for each radionuclide were below the limits in 10 CFR 20, Appendix A, Table 1. The inspections found no violations.

Based upon the evaluation above, consistent with its previous findings, the NRC staff finds that KUC's radon sampling program during both standby and operational modes to be acceptable.

6.3.3.3 Respiratory Protection

The purpose of the respiratory protection program is to provide workers with additional protection from elevated airborne concentrations that may exist in the facility. Although the licensee is in a standby mode and is not operating, this does not affect or change the respiratory protection program. As stated in the LRA (2014), the licensee conducts a respiratory protection program based on Regulatory Guide 8.15 (NRC, 1976). This program includes written operating procedures that address: a) air sampling sufficient to identify the potential hazards, and permit proper equipment selection, b) surveys and bioassays, as appropriate to evaluate actual intakes, c) testing of respirators immediately prior to each use, d) selection, fitting, issuance, maintenance and testing of respirators, as well as supervision and training of personnel, monitoring, and recordkeeping, and e) physical examination requirements (KUC, 2014). The NRC staff finds that the respiratory protection program is consistent with the requirements in 10 CFR 20, Subpart H because the program is based on Regulatory Guide 8.15.

6.3.4 Exposure Calculations

In this section, the NRC staff evaluates the licensee's methodologies, during both standby and operations, for calculating the exposures to radioactive materials by personnel in work areas where airborne radioactive materials could exist. Workers may be exposed to radioactive material in the air or loose surface contamination within the restricted area, which may result in an intake of radioactive material into the body. The restricted area is defined in 10 CFR 20.1003 as an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. This may include radioactive material in the air, loose surface contamination, or radioactive material that may be stored or processed inside equipment or components. In addition to general exposure calculations for workers, this section also addresses exposure calculations for female workers who declare pregnancy and the calculation of dose to the embryo/fetus.

The following sections discuss the exposure calculations, which include internal and external occupational radiation dose, as well as radiation doses to the embryo/fetus.

As stated in the LRA (KUC, 2014), the licensee computes the intake (I) and the internal dose (E) for particulate exposure (KUC, 2014a). The internal dose method requires an intake value. The intake and internal dose equations for particulates are shown below:

$$I_i = [((A/V)/DAC_i) \times T]/PF \quad \text{(Intake Equation)}$$

$$E = (\Sigma I_i/2{,}000 \text{ DAC Hours per ALI})*(5 \text{ REM per ALI}) \quad \text{(Exposure Equation)}$$

Where,

I_i = inhalation intake in DAC hours for radionuclide i.
DAC_i = derived air concentration for radionuclide i.
A = activity on air filter (µCi)
V = volume of air sampled in ml
T = exposure time in hours
PF = respirator protection factor (use 1 if no respirator is used).

The licensee identified values for several radionuclides (natural uranium, radon with daughters, radium-226, and thorium-230) for the annual limit of intake (ALI) and the DAC (KUC, 2014a). The licensee stated that there were no overexposures at the facility. The licensee stated that the exposure calculation program has not changed since the November 2004 license renewal. During the NRC site inspections, the NRC staff verified that no overexposures occurred at the facility (NRC, 2007; NRC, 2009; NRC, 2011; NRC, 2013; NRC, 2016).

The NRC staff reviewed the exposure calculation methodology described by the licensee as detailed above and found it to be consistent with the acceptance criteria in Section 5 of NUREG-2126 and Regulatory Guide 8.30. Therefore, the NRC staff finds the exposure calculation methodology provided in the LRA (KUC, 2014) to be acceptable.

6.3.5 Bioassay Program

The purpose of the bioassay program under both standby and operations is to measure the amount of radioactive material that may have been taken into the body by a worker. The results from the bioassay program are used to determine the internal radiation exposure to a worker and demonstrate compliance with 10 CFR 20 Subpart C. Results from the in-plant airborne radiation monitoring program can also be used to estimate the amount of radioactive material that may have been taken into the body by a worker. Respiratory protection can be used to mitigate and reduce the amount of radioactive material that can be taken into the body by a worker.

Under the facility's bioassay program as described in the LRA (KUC, 2014) and the 1999 SER evaluating the same program (NRC, 1999), all workers directly involved in tasks associated with airborne yellowcake provide urine samples at least monthly. Baseline urinalysis is performed on employees who work in such conditions and areas. Procedures for collection, preparation, and analysis of urine samples are maintained on site. The licensee commits to following the action levels and quality assurance program as presented in Regulatory Guide 8.22. In-vivo body counting for lung burden of natural uranium or U-235 is conducted at least once every 2 years for all mill employees and for maintenance personnel routinely assigned to work in the mill. Monitoring by an in-vivo body counter will be performed if urinalysis results exceed 30 ug/L for any two consecutive samples, or exceeds 80 ug/L for any one sample (NRC, 1999b).

The NRC staff's current findings regarding the program during standby and operations are presented below.

The LRA (KUC, 2014) states that historically, bioassay results (2004-2013) have been less than 5 ug/L of natural uranium. The licensee stated that no bioassay has exceeded the lower limit of detection of 5 ug/L of natural uranium since August 1999 (KUC, 2004). Regulatory Guide 8.22 (NRC, 1999b) recommends that the historical results are below the action level as defined by Regulatory Guide 8.22 (NRC, 1988). The NRC staff reviewed the bioassay results and found them to be below 5 ug/L of natural uranium.

The licensee calculated soluble natural uranium, expressed in mg (milligrams), in the LRA and the results did not exceed 10 mg (KUC, 2014). The highest reported annual calculated soluble natural uranium intake was reported as 2.0 mg. The NRC staff evaluated this data and determined that the calculated soluble natural uranium is below the limit of 10 mg per individual per week as defined in 10 CFR 20 Subpart C.

The NRC staff reviewed the licensee's bioassay results during inspection and determined that no results exceeded 5 ug/L of urine (NRC, 2007, NRC, 2009, NRC, 2011, NRC, 2013, and NRC, 2016). NRC staff determined that the calculated soluble natural uranium intake and the bioassay results reviewed during inspections support the bioassay results of less than 5 ug/L. Therefore, the NRC staff finds that the bioassay program is consistent with Regulatory Guide 8.22 and 10 CFR 20 Subpart C, and therefore the bioassay program is acceptable.

6.3.6 Contamination Control

This section evaluates the licensee's contamination control program. This program is designed to detect radiological contaminants that have escaped the boundary of the restricted area. Contamination can take the form of loose surface contamination found on structures, material, and personnel in a restricted area. The purpose of the program is to ensure that contamination is identified, confined, and monitored in the restricted areas and to prevent the movement or spread of contamination to unrestricted areas.

The licensee indicated in the LRA (KUC,2014) that the contamination control program will continue to survey personnel, surface areas, and surveys of equipment and materials prior to releases to an unrestricted areas and apply limits consistent with Regulatory Guide 8.30 (NRC, 2002).

In 1999 and 2004 the NRC staff accepted the licensee's contamination control program. Beta radiation surveys were not included in the contamination control program previously approved by NRC (NRC, 1999), but its addition is currently being proposed by the licensee in the LRA (KUC, 2014). The contamination control program previously approved by NRC consisted of total alpha, removable alpha, and gamma radiation surveys.

6.3.6.1 Standby

Given the non-production of yellow cake during standby removable and total alpha radiation sampling is performed semi-annually at a reduced number of locations within the facility (KUC, 2014).

In connection with the overall radiation safety program for the facility during standby, the NRC staff previously concluded in the 1999 SER (NRC, 1999) that "the proposed reduction in the

program, as currently practiced during standby mode provides adequate protection." As previously stated, beta radiation surveys were not included in the contamination control program previously approved by NRC (NRC, 1999), but its addition is being proposed by the licensee in the LRA (KUC, 2014). The use of alpha surveys is consistent with guidance in Regulatory Guide 8.30 (NRC, 2002). The addition of beta surveys is consistent with guidance in Guidance Directive FC 83-23, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," which requires that separate limits for alpha-emitting and beta/gamma-emitting radionuclides be met independently. NRC finds the addition of beta radiation surveys to the total alpha, removable alpha, and gamma radiation surveys already included in the contamination control program to be in compliance with 10 CFR 20 Subpart F and therefore acceptable.

6.3.6.2 Operations

As stated in the LRA (KUC, 2014) and the 1999 SER (NRC, 1999), during operations the clothing and skin of employee's working in yellowcake areas or involved in maintenance in these areas will be monitored for alpha contamination. Alpha contamination greater than 1,000 dmp/100 cm^2 shall be cause for decontamination. Unrestricted areas will be randomly surveyed weekly for total alpha radiation and decontamination performed if contamination levels exceed 250 dpm/100 cm^2. Weekly visual inspection of unrestricted areas will also be performed to detect visual contamination such as yellow cake dust.

As explained in Section 6.3.6.1 of this SER, the NRC staff finds that the total alpha, removable alpha, beta, and gamma radiation surveys in the contamination control program meet 10 CFR 20 Subpart F and are therefore acceptable.

6.4 Evaluation Findings

The NRC staff reviewed the exposure rates for the in-plant external radiation monitoring program and determined that the licensee conducted surveys consistent with 10 CFR Part 20 Subpart F, "Surveys and Monitoring," and exposure rates did not exceed the posting requirements identified in 10 CFR Part 20, Subpart J, "Precautionary Procedures." The NRC previously approved a reduced in-plant radiation safety program for periods of standby (NRC, 1999). As evaluated above, the NRC staff finds, consistent with its previous findings, that KUC's in-plant external radiation monitoring program is acceptable.

NRC staff reviewed the licensee's personnel dosimetry data and determined that the TEDE did not exceeded the 10 CFR Part 20 Subpart C limit of 5000 mrem per year. The NRC previously approved a reduced radiation safety program for periods of standby (NRC, 1999). The NRC staff finds, consistent with its previous evaluations and inspection findings, that KUC's personnel dosimetry program is acceptable.

The NRC staff reviewed the results of the annual average air concentration for particulates for each radionuclide and determined that the results are below the limits of 10 CFR 20, Appendix B, Table 1. The NRC staff determined that the in-plant airborne radiation monitoring program meets 10 CFR Part 20, Subpart F for surveys and monitoring, and finds that the in-plant airborne monitoring program for air particulate is acceptable.

The licensee provided annual average radon and radon daughter data in the LRA with the results expressed in working levels (WL) (KUC, 2014). NRC staff determined from review of the

annual average radon and radon daughter data provided by the licensee that all annual average radon decay product concentration results were below the WL limit as identified n 10 CFR 20, Appendix B, Table 1. Based upon its evaluation above, the NRC staff finds, consistent with its previous analyses, that KUC's radon sampling program is acceptable.

NRC staff finds that the respiratory protection program is consistent with the requirements in 10 CFR 20, Subpart H because the program is consistent with guidance in Regulatory Guide 8.15.

The NRC staff reviewed the licensee's exposure calculation methodology and found it to be consistent with the acceptance criteria in Section 5 of NUREG-2126 and Regulatory Guide 8.30.

The licensee calculated soluble natural uranium, expressed in mg (milligrams), in the LRA and the results did not exceed 10 mg (KUC, 2014). The NRC staff evaluated this data and determined that the calculated soluble natural uranium is below the limit of 10 mg per individual per week as defined in 10 CFR 20 Subpart C and is consistent with Regulatory Guide 8.22.

Beta radiation surveys were not included in the contamination control program previously approved by NRC (NRC, 1999, 2004) but its addition is being proposed by the licensee in the LRA (KUC, 2014). The addition of beta surveys is consistent with guidance in Guidance Directive FC 83-23, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," which requires that separate limits for alpha-emitting and beta/gamma-emitting radionuclides be met independently. The NRC staff finds the addition of beta radiation surveys to the total alpha, removable alpha, and gamma radiation surveys already included in the contamination control program to be in compliance with 10 CFR 20 Subpart F and therefore acceptable.

NRC staff reviewed the licensee's radiation safety program, which consists of in-plant external radiation monitoring, in-plant airborne monitoring, exposure calculations, personnel dosimetry, bioassay, and contamination control. During standby, the facility is not producing yellowcake and the number of staff is much lower than during operations. Therefore, the relative risk is much smaller and justifies a reduced program during standby. NRC staff has determined that the radiation safety program during standby and for operations is protective of the health and safety of the workers is acceptable and meets 10 CFR 20.1101.

As discussed above, several licensee radiation protection program elements will scaledepending upon the operational status of the facility, and the associated exposure risk. With respect to each program element evaluated above, the NRC staff finds that the licensee's radiation protection program meets the requirements of 10 CFR Parts 20 and 40.

6.5 References

KUC, 2014, "Sweetwater Uranium Project—Docket Number 40-8584, Source Material License No. SUA-1350—Request for a Renewal Source Material License SUA-1350 for a Ten (10) Year Term," Kennecott Uranium Company, July 24, 2014. (ADAMS Accession No. ML14251A113 (package)).

KUC, 1994, "Revised Environmental Report for the Sweetwater Uranium Project, Sweetwater County, Wyoming," prepared for Kennecott Uranium Company, August 1994 (ADAMS Accession No. ML081010327).

NRC, 2016, NRC Inspection Report 040-08584/2016-001, October 3,, 2016 (ADAMS Accession No. ML16273A138).

NRC, 2013, NRC Inspection Report 040-08584/2013-001, September 23, 2013 (ADAMS Accession No. 13266A426).

NRC, 2011, NRC Inspection Report 040-08584/2011-001, October 12, 2011 (ADAMS Accession No. 11285A443).

NRC, 2009, NRC Inspection Report 040-08584/2009-001, September 4, 2009 (ADAMS Accession No. 092470618).

NRC, 2007, NRC Inspection Report 040-08584/07-001, August 10, 2007 (ADAMS Accession No. 072220332).

NRC, 2004, “Renewal of Source Material License SUA-1350 and Surety Update for the Kennecott Uranium Company’s Sweetwater Uranium Mill Site, Amendment 20 (TAC LU0045),” letter dated November 10, 2004, to Mr. Oscar Paulson, Sweetwater Uranium Facility, Kennecott Uranium Company, Riverton, WY (ADAMS Accession No. ML043170668).

NRC, 2002, Regulatory Guide 8.30, Health Physics Surveys in Uranium Recovery Facilities, Rev. 1, May 2002

NRC, 1988, Regulatory Guide 8.22, ‘Bioassay at Uranium Mills,” Revision 1, August 1988.

NRC, 1999, Letter from NRC to Kennecott, “Renewal of Source Material License SUA-1350 for Operation and Approval of the Reclamation Plan and Surety Amount for the Kennecott Uranium Company, Sweetwater Uranium Project, Sweetwater County, Wyoming,” August 18, 1999 (ADAMS Accession No. ML080590244).

NRC, 1976, Regulatory Guide 8.15, Acceptable Programs for Respiratory Protection, October, 1976.

7.0 Decommissioning and Reclamation

7.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that the proposed decommissioning plans and financial assurance for KUC meet the requirements in 10 CFR Part 40.

7.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the renewal application against the applicable requirements for 10 CFR Part 40 using the guidance is Section 7 of NUREG-2126 (NRC, 2014).

7.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps submitted by the licensee in its LRA (KUC, 2014), as updated. In the following sections, the NRC staff evaluates, among other things: (1) the licensee's current ground water corrective action program; (2) the licensee's May 2016 request to postpone initiation of the decommissioning process (KUC, 2016); and (3) the NRC staff's recent approval of the licensee's annual surety update (NRC, 2017). As explained in detail below, the NRC staff evaluated the licensee's current ground water corrective action program (CAP) as part of the 2014 license renewal request (KUC, 2014), as updated. The NRC staff identified deficiencies in the current CAP that are addressed by a revised license condition that requires the license to characterize ground water contamination and provide a revised CAP. As required by 10 CFR 40.42(f), the NRC staff may grant the licensee's request to postpone initiation of the decommissioning process if the NRC staff determines that such relief is not detrimental to the public health and safety and is otherwise in the public interest. This determination will take into consideration the information provided in the licensee's May 26, 2016, letter (KUC, 2016), and may take into consideration other information provided to the NRC as part of this license renewal request or other actions. In any case, the NRC staff will continue to ensure that the licensee provides adequate surety for its operations, and complies with NRC requirements with respect to its decommissioning and reclamation activities, including changes resulting from the revised CAP.

7.3.1 Ground Water Corrective Action Program

Section 6 of the LRA (KUC, 2014) describes the CAP in effect at the site to clean up ground water contamination associated with the tailings impoundment and former catchment basin. License Condition 11.3 (see NRC, 2015a) specifies the requirements for the CAP, including ground water protection standards to be achieved.

The NRC staff performed a technical review of historical monitoring data to evaluate CAP performance. This review is documented in a technical evaluation report included as Attachment B to this SER. The staff has concluded from its analysis that the current CAP is not achieving compliance with the ground water protection standard limits identified in License Condition 11.3. Furthermore, the licensee has not characterized the extent to which contamination may extend beyond the western boundary of the bonded area. Based on this evaluation, the NRC staff is modifying License Condition 11.3 to require the licensee to fully characterize the current extent of ground water contamination and provide a revised plan to

bring the ground water into compliance with the ground water protection standards. The modified license condition is presented in Section 7.4 of this SER.

7.3.2 Decommissioning and Reclamation Plan

The mill decommissioning plan and the reclamation plan for impoundments and ponds was previously reviewed by the NRC staff and the evaluation documented in a TER, as part of the previous licensing action (NRC, 1999; 2004). The decommissioning plan calls for demolition of the mill buildings and separation of reusable materials and equipment which can be released to the public or to another licensed facility from those materials that require disposal in the tailings impoundment. The plan also provides proposed soil cleanup and verification information, and the reclamation plan includes the design for stabilization of the tailings impoundments and reclamation of the evaporation ponds. KUC will be required by License Condition 9.10 to perform reclamation of the site in accordance with the NRC-approved plans. (NRC, 1999). As explained in Section 7.3.1 of this SER, the licensee will be required by revised license condition 11.3 to revise its ground water CAP. However, this does not affect the NRC staff's assessment of decommissioning and reclamation plans regarding surface facilities.

The LRA (KUC, 2014) states that the structures, systems, and equipment on the site are unchanged since the NRC granted the performance-based operating license in August 1999 and the license renewal in November 2004. License Condition 9.10 addresses decommissioning and reclamation of the Sweetwater facility and states that the decommissioning of the facility shall be performed as presented in the Final Design, Volume VI, Part 2—Mill Decommissioning Addendum to the Existing Impoundment Reclamation Plan, submitted May 28, 1998, as supplemented by the response to comment submitted February 3, 1999, and the Catchment Basin Remediation plan dated May 12, 2004, as revised July 22, 2004, December 15, 2004, January 18, 2005, and October 3, 2006. The KUC facility continues to operate in a standby mode. With the exception of the completion of the catchment basin reclamation in 2008, the NRC staff has determined that there are no changes to the decommissioning and reclamation plan.

The licensee requested a revision to the language in License Condition 9.10 to reflect the completion of the Catchment Basin Remediation Plan (KUC, 2014). The remediation of the catchment basin was based on the cleanup criteria in two documents dated May 12, 2004 (KUC, 2004), and January 18, 2005 (KUC, 2005), for Ra-226 at the surface and subsurface, and natural uranium and Th-230. The remediation plan and the cleanup release criteria were approved by the NRC in 2005 (NRC, 2005). In July 2006, the excavation of the catchment basin was completed, and the licensee submitted its Catchment Basin Excavation Completion Report in 2008 (KUC, 2008). The NRC staff reviewed the Completion Report and requested the licensee to perform a radium benchmark dose calculation (NRC 2008a). The Completion Report did not provide a radium benchmark dose calculation. The licensee subsequently provided three calculations (KUC, 2009). The first two calculations included the radiation dose for surface and subsurface (i.e., the radium benchmark dose). In the third dose calculation, KUC demonstrated that the dose to a critical group (i.e., residential farmer) standing on the top of the backfilled excavated area is below the radium benchmark dose defined in 10 CFR 40, Appendix A, Criterion 6(6). The NRC staff considered the possible impacts to a critical group due to some future activity (i.e., construction) that may cause soils to be removed from the bottom of the excavation and brought to the surface. Although this scenario is plausible, given the remoteness of the site, its industrial use, and the relatively small size of the excavation surface, the probability that soils will be removed from the excavation area and brought to the surface, thereby affecting the critical group, is very small. Therefore, NRC staff determined that

the language in License Condition 9.10 should be revised to reflect remediation of the catchment basin. A revised License Condition 9.10 is presented in Section 7.4 of this SER.

KUC submitted requests for 5 Year Postponement of Initiation of Decommissioning in 2001, 2006, and 2011 and received approval by the NRC after each submittal (NRC, 2001, NRC, 2006a, and NRC, 2011b). KUC submitted a 5 Year Postponement of Initiation of Decommissioning in 2016 (KUC, 2016). This submittal is under review by the NRC. A decision on that request may be informed by the completion of the NRC's review of the current license renewal application.

7.3.3 Financial Assurance

The licensee has prepared and submitted two 5-year baseline reports and annual surety updates, covering the period from 2004–2014. In 2014, the licensee submitted the annual surety and 5-year rebaseline estimate for the KUC facility (KUC, 2014). The licensee estimated the reclamation and decommissioning costs for the facility based on plans approved by the NRC. The licensee prepared cost estimates for the following items:

- mill area decommissioning
- ground water remediation
- cleanup of contaminated soils
- existing impoundment reclamation
- radiological survey and monitoring
- project management and mobilization/demobilization
- long-term surveillance fee
- contingency

The NRC staff reviewed the financial assurance surety and 5-year rebaseline estimate for decommissioning and reclamation, and determined that the licensee adequately described its decommissioning and reclamation activities and provided reasonable cost estimates for each activity (NRC, 2015b). The staff reviewed the surety report and determined that the proposed new surety adequately demonstrated compliance with the requirements in 10 CFR Part 40, Appendix A, Criteria 9 and 10.

The NRC staff also reviewed the licensee's annual surety update submittals based on the Consumer Price Index from 2005–2008 and 2010–2016 and found them all to be acceptable (NRC, 2005; NRC, 2006b; NRC, 2007; NRC, 2008b; NRC, 2010; NRC, 2011a; NRC, 2012; NRC, 2013; NRC, 2015; NRC, 2016). This is consistent with License Condition 9.7 and 10 CFR Part 40, Appendix A, Criteria 9 and 10.

In the most recent annual surety submittal by the licensee (KUC, 2017), the NRC staff evaluated the surety update and determined that the Kennecott surety cost estimate for the Sweetwater Uranium facility adequately reflects the decommissioning activity, unit costs, contingency fee and long-term surveillance fees as required by 10 CFR Part 40, Appendix A and License Condition 9.7 (NRC, 2017). The NRC staff determined that the current Consumer Price Index (CPI) calculation increase as provided by KUC (KUC, 2017) adequately demonstrates compliance with the requirements of 10 CFR Part 40, Appendix A, Criteria 9 and 10. Therefore, as described in Section 7.4 of this SER, the NRC staff is revising license condition 9.7 to reflect the recent annual surety provided by KUC, in which the surety amount is $12,033,000 as stated in NRC, 2017..

7.4 Evaluation Findings

The NRC staff has completed its review of the licensee's decommissioning and reclamation program in accordance with Section 7 of NUREG-2126. The decommissioning and reclamation program includes decommissioning and financial assurance. The licensee has provided ground water results from the CAP for decommissioning and reclamation, and financial data for financial assurance. As described in Section 7.3.2 of this SER, the text in license condition 9.10 will be revised to reflect remediation of the catchment basin as follows:

9.10 Decommissioning of the facility shall be performed as presented in the Final Design, Volume VI, Part 2-Mill Decommissioning Addendum to the Existing Impoundment Reclamation Plan, submitted May 28, 1998, as supplemented by the response to comments submitted February 3, 1999, and the catchment basis remediation plan dated May 12, 2004 *(ML041480493)*, as revised July 22, 2004 *(ML042110348)*, December 15, 2004 *(ML043520255)*, January 18, 2005 *(ML050350266)*, and October 3, 2006 *(ML062930067 and ML062860031)*. ~~The verification results of this remediation are to be submitted to NRC for approval, as soon as reasonably possible.~~ The catchment basin verification report and NRC's approval letter shall be referenced in the Final Status Survey Report. Residual contamination remaining under structural foundations after the catchment basis remediation shall be removed at the time the structures are decommissioned. The NRC shall be notified and detailed SOPs for decommissioning (land and buildings) shall be available for review at least three (3) months before decommissioning begins.

Based on the staff's review of the information in the application, with the exception of the CAP with respect to legacy contamination, meets the acceptance criteria in Section 7 of NUREG-2126, and 10 CFR Part 40, which defines financial assurance. The staff concludes that the financial assurance information is acceptable and is updating license condition 9.7 as follows:

9.7 The licensee shall maintain an NRC-approved financial surety arrangement, consistent with 10 CFR 40, Appendix A, Criteria 9 and 10, adequate to cover the estimated costs, if accomplished by a third party for decommissioning and decontamination of the mill and mill site, reclamation of any existing or approved tailings or waste disposal areas, reclamation of approved evaporation ponds, groundwater restoration, and the long-term surveillance fee. With submittal of a revised reclamation/decommissioning plan, the licensee shall submit, for NRC review and approval, a proposed revision to the financial surety arrangement, if estimated costs in the proposed plan exceed the amount covered in the existing financial surety. The NRC-approved revision to the cost estimate shall be incorporated into the next annual surety amount.

For approved reclamation plan referenced in License Contion 10.5, the license shall provide the NRC-approved surety amount (adjusted for inflation) for reclamation of the proposed structures associated with resumption of mill operation (e.g., tailings impoundment, evaporation ponds, and diversion channels) before commencement of construction of any of these structures.

Annual updates to the surety amount required by 10 CFR 40, Appendix A, Criteria 9 and 10, shall be submitted to the NRC at least three (3) months prior to the anniversary date (October 30) of the approved surety arrangement. If the NRC has not approved a proposed revision to the surety coverage thirty (30) days prior to the expiration date of

the existing surety arrangement, the licensee shall extend the existing surety arrangement. The revised surety amount will be in effect within three (3) months of written NRC approval.

The licensee's currently NRC-approved surety (performance bond) shall be continuously maintained in an amount no less than *$12,033,000* for the purpose of complying with 10 CFR 40, Appendix A Criteria 9 and 10, for decommissioning costs related to the existing facility, until a replacement amount is authorized by the NRC.

The NRC staff has completed its review of the CAP in accordance with the acceptance criteria in Section 7 to NUREG-2126. The licensee provided annual ground water data under the CAP. However, the staff reviewed the ground water data and determined that the results do not comply with the ground water protection standards as defined in License Condition 11.3. Furthermore, the licensee has not characterized the extent to which contamination may extend beyond the western boundary of the bonded area. The NRC staff is, therefore, modifying License Condition 11.3 as follows:

11.3 The licensee shall *fully characterize the areal extent of ground water contamination associated with the site and prepare and submit a revised corrective action program (CAP) to the NRC for review and approval that will achieve compliance with the approved ground water protection standards for the site. The revised CAP shall propose acceptable methods to achieve and demonstrate compliance for those parameters in exceedance of the corresponding ground water protection standard and also include a time limit to reach compliance. The licensee shall submit a report on the full areal extent of ground water contamination to NRC for review and approval within 6 months of receipt of the approved license. The licensee shall submit a revised CAP to the NRC for review and approval within 6 months of NRC's approval of the aforementioned ground water contamination report. The effectiveness of the licensee's CAP will inform the pre-operational inspection that is required before the licensee can resume milling activities.*

Until a revised CAP is approved by NRC, point of compliance (POC), monitoring, and pumpback wells for the existing tailings impoundment shall continue to be sampled at the locations, at the frequency, and for the parameters provided in Table 5-1 (for the existing impoundment) of the Final Design Volume VII, submitted (page change) June 21, 1999, as revised January 18, 2005 (ML050350266). The ground-water protection standards at point of compliance (POC) Wells TMW-15, 16, 17, and 18 are: arsenic = 0.05 mg/L, beryllium = 0.01 mg/L, cadmium = 0.01 mg/L, chromium = 0.05 mg/L, lead-210 = 8.9 pCi/L, nickel = 0.01 mg/L, combined radium-226/228 = 5.8 pCi/L, selenium = 0.01 mg/L, thorium-230 = 7.0 pCi/L, natural uranium = 36.0 pCi/L, and gross alpha = 15.0 pCi/L, manganese = 0.2 mg/L, and iron = 0.6 mg/L. Reporting limits for sampled constituents shall be as provided in Table 5-11 of the Final Design Volume VII, submitted April 13, 1998.

Also, until the NRC approves a revised CAP, ~~The~~ *the* catchment basin pumpback wells and monitoring Wells TMW-92, 93, 94, 95, 97, 98, 99, 100, 101, 104, 111, 112, 113, and 115 will be sampled quarterly for diesel range and gasoline range organics and volatile organic compounds, in addition to the ~~above~~ constituents *specified above for the existing tailings impoundment*. The *additional* ground water protection standards to be used to assess data from these wells are as follows: 1,1-dichloroethane = 3.0 mg/L,

1,1-dichloroethene = 0.007 mg/L, DRO = 10 mg/L, GRO = 10 mg/L, naphthalene = 1.5 mg/L, toluene = 1 mg/L, 1,1,1-trichloroethane = 0.20 mg/L, 1,2,4-trimethylbenzene = 0.012 mg/L, 1,3,5-trimethylbenzene = 0.012 mg/L, m+p xylenes = 10 mg/L, manganese = 0.2 mg/L, aluminum =1.8 mg/L, and iron = 0.6 mg/L.

7.5 References

KUC, 2017, Sweetwater Uranium Project Source Materials License Condition 9.7 for Surety Submittal, July 19, 2017. (ADAMS Accession No. ML17207A247)

KUC, 2016, "Request for a Five (5) Year Postponement of the Initiation of the Requirements of Timeliness in Decommissioning Pursuant to 10 CFR 40.42(f) for the Sweetwater Uranium Project," Kennecott Uranium Company, May 26, 2016. (ADAMS Accession No. ML16160A360).

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KUC, 2009, Surety Rebaselining Report for Sweetwater Uranium Facility SUA-1350, Sweetwater County, Wyoming, July 24, 2009 (ADAMS Accession No. ML092150089).

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NRC, 2017 U.S. Nuclear Regulatory Commission Verification of 2017 Surety Update, Kennecott Uranium Company, Sweetwater County, WY, Docket Number 040-08584, Source Material License Number SUA-1350, October 31, 2017 (ADAMS Accession No. ML17283A172)

NRC, 2016, License Amendment No. 34 Annual Surety Update 2016 for Kennecott Uranium Company's Sweetwater Uranium Project, Source Materials License No. SUA-1350, December 31, 2016 (ADAMS Accession No. ML16312A446)

NRC, 2015a, License Amendment No. 33, Kennecott Uranium Company, Sweetwater Uranium Facility Source Materials License No. SUA-1350, February 2, 2015 (ADAMS Accession No. ML15008A256).

NRC, 2015b, "Technical Evaluation Report for Kennecott Uranium Company's Proposed for 2014 Surety and Re-Baseline Estimate for the Sweetwater Uranium Facility," January 7, 2014 (ADAMS Accession No. ML15008A185).

NRC, 2014, NUREG-2126, "Standard Review Plan for Conventional Uranium Mill and Heap Leach Facilities, Draft Report for Comment," November 2014.

NRC, 2013, License Amendment No. 32, 2013 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, 2013, August 8, 2013 (ADAMS Accession No. ML13217A051).

NRC, 2012, License Amendment No. 31, 2012 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, 2012, September 27, 2012 (ADAMS Accession No. ML12262A493).

NRC, 2011a, License Amendment No. 30, 2011 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, December 15, 2011 (ADAMS Accession No. ML113290012).

NRC, 2011b, Sweetwater Uranium Mill (SUA-1350), Five (5) Year Postponement of Initiation of Decommissioning, October 4, 2011 (ADAMS Accession No. ML112270574)

NRC, 2010, License Amendment No. 29, 2010 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, 2010, October 7, 2010 (ADAMS Accession No. ML102430335).

NRC, 2009, License Amendment No. 28, Kennecott Uranium Company Surety Submittal/5-Year Rebaseline Report, December 23, 2009 (ADAMS Accession No. ML093230569).

NRC, 2008a, Email to Kennecott from NRC, Request for Additional Information, dated 11/19/2008, (ADAMS Accession No. ML083370012).

NRC, 2008b, License Amendment No. 27, 2008 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, September 5, 2008 (ADAMS Accession No. ML082390964).

NRC, 2007, License Amendment No. 26, 2007 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, October 3, 2007 (ADAMS Accession No. ML072400063).

NRC, 2006a, Sweetwater Uranium Mill (SUA-1350), Five (5) Year Postponement of Initiation of Decommissioning, September 25, 2006 (ADAMS Accession No. ML062640098)

NRC, 2006b, License Amendment No. 24, 2006 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, September 19, 2006 (ADAMS Accession No. ML062610008).

NRC, 2005, License Amendment No. 23, 2005 Annual Surety Update for the Kennecott Uranium Company, Sweetwater Uranium Project, July 29, 2005 (ADAMS Accession No. ML052160230).

NRC, 2001, Sweetwater Uranium Mill (SUA-1350), Five (5) Year Postponement of Initiation of Decommissioning, July 17, 2001 (ADAMS Accession No. ML011980484)

8.0 Accidents

8.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has addressed potential accidents at the KUC facility and demonstrated that the facility meets the requirements in 10 CFR 40.32(c), which require that the licensee to implement procedures adequate to protect public health and minimize danger to life or property should an accident occur.

8.2 Regulatory Acceptance Criteria

Unless indicated otherwise, the NRC staff reviewed the renewal application against the applicable requirements in 10 CFR Part 40 using the acceptance criteria presented in Section 8 of NUREG-2126 (NRC, 2014).

8.3 Staff Review and Analysis

This section addresses potential radiological, transportation, and non-radiological accidents that could occur at the KUC facility, the designs and measures proposed by the licensee to prevent those accidents, and the licensee's proposed plans (including training) to cope with the possible occurrence of those accidents. Unless indicated otherwise, the information reviewed for this section is from Section 7 of the LRA (KUC, 2014), as updated.

The environmental assessment being performed by the NRC staff in support of the Commission's review of the license renewal also evaluates impacts from potential accidents at the site and the various systems designed to mitigate them with respect to their potential environmental impacts.

8.3.1 Accidents Involving Radioactivity

In the LRA, the licensee identifies the failure of the existing tailings impoundment, constructed in the late 1970s, as a possible accident scenario (KUC, 2014). As stated by the licensee (KUC, 2014), this tailings impoundment was used during previous milling operations but is now inactive, the main tailings delivery piping from the mill to the impoundment has been removed, and the impoundment will not be reused for the disposal of any tailings in the future.

In 1999 the NRC staff reviewed the licensee's evaluation in the renewal application of a "variety of potential site accidents" and stated that: "Measures to be taken to prevent radiological and other types of accidents, spills, etc., are addressed in SOPs that have been developed by KUC following NRC and other guidance" (NRC, 1999). In 1999 the NRC staff also reviewed the licensee's Emergency Response Plan that "identifies the actions to be carried out at the mill site in the event of an earthquake, severe weather accidents, or bomb threat." The NRC staff previously accepted the licensee's accident analyses and accident response procedures (NRC, 2004; 1999). Consistent with those previous approvals, the NRC staff finds that KUC's accident evaluation and response programs are acceptable.

8.3.2 Transportation Accidents

In 1999 the NRC staff reviewed the licensee's evaluation in the renewal application of a "variety of potential site accidents" and stated that, "Measures to be taken to prevent radiological and other types of accidents, spills, etc., are addressed in SOPs that have been developed by KUC

following the NRC and other guidance" (NRC, 1999). In 1999 the NRC staff also reviewed the licensee's Emergency Response Plan that "identifies the actions to be carried out at the mill site in the event of an earthquake, severe weather accidents, or bomb threat." The NRC staff previously accepted the licensee's accident analyses and accident response procedures (NRC, 2004; 1999). NRC inspections have found that there are no shipments of yellowcake from the mill to a uranium hexafluoride conversion facility or any other processing facility, and because there are no operations currently occurring at the site, there are no shipments of ore from the mine pit to the mill. Further, there is only a small quantity of ammonia (less than 227 kg (500 lb)) on site (as discussed in Section 10.3.3 of this SER), and there are no large or frequent quantities of chemicals from suppliers to the mill. Consistent with its previous reviews, the NRC staff finds that KUC's accident response and emergency response programs for transportation accidents are adequate.

8.3.3 Non-radiological Accidents

8.3.3.1 Standby

Section 7.2 of the LRA (KUC, 2014) states that during the current standby period there are no large quantities of chemicals stored on the site that could impact radiological health and safety. Chemicals stored on site consist of small quantities of reagents used to preserve water samples and a small amount of ammonia under 227 kg (500 lb) stored in the site's ammonia tank to prevent the accumulation of moisture and corrosion inside the tank (KUC, 2014). Section 7.1.4 in NUREG-0706 (NRC, 2003) provides current guidance on the accidents not involving radioactivity. The quantity of ammonia expected to be stored in relatively large quantities at a model mill site is 60,000 liters (16,000 gallons) of ammonia. The analysis in NUREG-0706 determined that a break in the ammonia tank's external piping would result in only a minor release. NUREG-0706 also evaluates a rupture of the line carrying ammonia from the truck tank to the storage tank, and it assumes a release rate limited to 100 grams (0.2 lb) per second of vapor. The resulting concentration of ammonia at the closest residence (1,981 m (6,500 ft)) is conservatively estimated to average approximately 35,000 micrograms per cubic meter over the entire period of release. This concentration is less than the minimum concentration of 40,000 micrograms per cubic meter that produces a detectable odor and the recommended limit of 69,000 micrograms per cubic meter for prolonged human exposure, but is greater than the short-term air quality standard of 600 microgram per cubic meter derived from typical State regulations (at 1/30 threshold limit values). The analysis in NUREG-0706 determined that the ammonia would pose no substantial health risk.

The quantity of ammonia kept at the facility in a standby mode (under 227 kg (500 lb)) , which is used to prevent the accumulation of moisture and corrosion inside the ammonia tank, is substantially below the expected storage quantity (60,567 liters (16,000 gallons)) and thus does not pose a significant health risk.

8.3.3.2 Operations

In 1999 the NRC staff reviewed the licensee's evaluation in the renewal application of a "variety of potential site accidents" and stated that: "Measures to be taken to prevent radiological and other types of accidents, spills, etc., are addressed in SOPs that have been developed by KUC following NRC and other guidance" (NRC, 1999). In 1999 the NRC staff also reviewed the licensee's Emergency Response Plan that "identifies the actions to be carried out at the mill site in the event of an earthquake, severe weather accidents, or bomb threat." The NRC staff

previously accepted the licensee's accident analyses and accident response procedures (NRC, 2004; 1999).

Consistent with its previous reviews, the NRC staff finds that KUC's accident and emergency response programs for non-radiological accidents is acceptable.

8.4 Evaluation Findings

The NRC staff has completed its review of potential accident scenarios (accidents involving radioactivity, transportation, and non-radiological) at the KUC facility in accordance with Section 8 of NUREG-2126. Consistent with its previous findings, the NRC staff finds that KUC's accident and emergency response programs for radiological, transportation, and non-radiological accidents is acceptable.

8.5 References

KUC, 2016, Email from O. Paulson to J. Webb (NRC), RE: Kennecott Tailings Impoundment, August 30, 2016 (ADAMS Accession No. ML16244A172).

KUC, 2014, "Sweetwater Uranium Project—Docket Number 40-8584, Source Material License No. SUA-1350—Request for a Renewal Source Material License SUA-1350 for a Ten (10) Year Term," Kennecott Uranium Company, July 24, 2014. (ADAMS Accession No. ML14251A113 (package)).

KUC, 1994, "Revised Environmental Report for the Sweetwater Uranium Project, Sweetwater County, Wyoming," prepared for Kennecott Uranium Company, August 1994 (ADAMS Accession No. ML081010327).

NRC, 2014, NUREG-2126, "Standard Review Plan for Conventional Uranium Mill and Heap Leach Facilities, Draft Report for Comment," November 2014.

NRC, 2003, NUREG-0706, Volumes I–III, "Final Generic Environmental Impact Statement on Uranium Milling, Project M-25," October 2003 (ADAMS Accession No. ML032751661 (package)).

NRC, 1999, Letter from NRC to Kennecott, "Renewal of Source Material License SUA-1350 for Operation and Approval of the Reclamation Plan and Surety Amount for the Kennecott Uranium Company, Sweetwater Uranium Project, Sweetwater County, Wyoming," August 18, 1999 (ADAMS Accession No. ML080590244).

NRC, 1978, NUREG-0505, Final Environmental Statement related to operation of Sweetwater Uranium Project, Minerals Exploration Company, December 1978. ADAMS PLL Accession No. 7901100473 (microform)).

ATTACHMENT A
TECHNICAL EVALUATION REPORT
FOR
KENNECOTT URANIUM COMPANY
SWEETWATER OPERATIONAL GROUND WATER MONITORING

DOCKET NO.: 40-8584

LICENSE NO.: SUA-1350

DATE: TBD

FACILITY: SWEETWATER URANIUM PROJECT

TECHNICAL REVIEWER: Jose Valdes

PROJECT MANAGER: James Webb

SUMMARY:

In July 2014, the Kennecott Uranium Company (KUC) submitted a license renewal application for Source Materials License No. SUA-1350. License Condition 11.4 in the current license requires the licensee to implement a ground water detection and compliance monitoring program for a new tailings impoundment and evaporation ponds to be built for renewed operations at the site. The NRC staff has determined that the current operational monitoring requirements for the new tailings impoundment and evaporation ponds pursuant to Appendix A to 10 CFR, Part 40, are based on previous information and assumptions about local ground water conditions that are no longer valid.

BACKGROUND:

The information presented in the license renewal application dated July 14, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14251A115), indicates that resumption of operations at the facility would involve the construction of a new tailings impoundment equipped with a double liner and a leak-detection system, unlike the original tailings impoundment. Section 1.8.4 of the license renewal application states the following:

> Waste management and disposal methods are unchanged from those discussed in Sections 3.4 Sources of Mill Wastes and Effluents, 3.5 Controls of Mill Wastes and Effluents and Section 3.6 Sanitary and Other Mill Waste Systems in the August 1994 Revised Environmental Report with the exception of some revisions incorporated in the Final Design Tailings Management Plan.

The 1994 Revised Environmental Report, issued August 1994 (ADAMS Accession No. ML081010327), stated that “[m]illing operations are expected to begin in the mid- to late-1990's,” and describes the disposal of tailings resulting from operations as follows:

> A slurry pipeline will transport tailings to lined, partially below grade 40-acre tailings impoundments, located east of the mill, for permanent disposal. The

> pumped slurry will flow onto a tailings beach with outflow points moved regularly to maintain a moist surface. A small pool of free-standing fluid will be maintained within the impoundment at the downstream side of the tailings beach. The impoundments will be lined with a double liner system composed of geomembrane and clay members and drainage layers. A process water recovery system located immediately over the liner will remove process water to an evaporation/mill recycle pond.

The locations of the proposed tailings impoundment and evaporation ponds are shown in Figure 1 in Appendix A to this attachment (see ADAMS PLL Accession No. 980423 (microform))

The KUC license renewal application briefly summarizes environmental monitoring during operations:

> The Environmental Monitoring Program for operations is unchanged since the November 2004 license renewal and the original August 1999 performance based license.

License Condition 11.4 in the current license states the following:

> Upon resumption of milling operations, the licensee shall implement a ground water detection and compliance monitoring program for the tailings impoundment and evaporation ponds to ensure compliance with 10 CFR 40, Appendix A, in accordance with the Addendum to the Revised Environmental Report, Background Ground Water Quality and Detection Standards, January 1996, as revised by the submittals of January 8, 1998, and March 25, 1999; and conduct an environmental monitoring program in accordance with on-file SOPs for environmental monitoring, and in accordance with Table 5-2 of the Final Design Volume VII, submitted (page change) June 21, 1999.

The NRC staff has identified several technical issues regarding implementation of operational monitoring at the KUC facility upon resumption of operations.

TECHNICAL EVALUATION:

Proposed Tailings Impoundment

Appendix B to this attachment includes Table 5.2, "NRC Operational Environmental Monitoring Summary, Mill, New Tailings Impoundment and Evaporation Ponds," from KUC's Final Design Volume VII (ADAMS PLL Accession Nos. 9907120306, 9904010320, and 9904010323 (microform)).* The table identifies four existing monitoring wells for the new tailings impoundment:

- Well TMW-64 (identified on the table as "Point of Compliance Well, Tailings Impoundment") with analytical parameters consisting of combined radium-226/228 and natural uranium along with 15 other parameters

* The June 21, 1999, version of Table 5-2 differs from that shown in this report (submitted on May 25, 1999) only in referencing specific SOPs within the table (see ADAMS PLL Accession No. 9907120306 (microform)).

- Wells TMW-31, TMW-75, and TMW-78 (identified as "Monitoring Wells, Tailings Impoundment") with pH, conductivity, and chloride as the analytical parameters. Detection standards for these parameters are presented in Table 6 of the "Addendum to the Revised Environmental Report, Background Ground Water Quality and Detection Standards," issued January 1996 (ADAMS PLL Accession No. 9622090095A (microform)) and revised in January 1998 (ADAMS PLL Accession No. 9801230321 (microform)). Appendix B to this attachment provides a copy of the latter.

Figure 2 in Appendix A to this attachment shows the location of these wells in relation to the proposed tailings impoundment and the existing combined radium-226/228 and natural uranium ground water plumes, as delineated by KUC in its 2014 Annual Corrective Action Program Review and Groundwater Monitoring Report (ADAMS Accession No. ML15072A366). As shown, well TMW-64 is within the existing combined radium-226/228 ground water plume and, along with well TMW-78, is on the edge of one of the areas of natural uranium contamination. Monitoring well TMW-75 is also within the existing combined radium-226/228 ground water plume, whereas wells TMW-35 and TMW-78 are close to the edge of the combined radium-226/228 plume. The 5.8 picocurie per liter (pCi/L) value for combined radium-226/228 and 36 pCi/L for natural uranium used for plume delineation are the respective ground water protection standards (GPSs) for these constituents KUC requested based on its February 1996 "Background Ground Water Quality and Detection Standards, Addendum to the Revised Environmental Report" (ADAMS PLL Accession No. 9622090095A (microform)). The NRC incorporated these GPSs into a 1998 license amendment and all subsequent license renewals, including the current license (ADAMS Accession No. ML15008A256). Figures 3 and 4 in Appendix A to this attachment are time series plots of the combined radium-226/228 concentrations in wells TMW-64 and TMW-75, respectively, with respect to the corresponding GPS. The data used for the plots were taken from the annual corrective action program (CAP) reviews and ground water monitoring reports that KUC submitted to the NRC. As shown, the combined radium-226/228 concentrations in both wells have exceeded and continue to exceed the GPSs.

The NRC staff issued a request for additional information (RAI), dated February 12, 2016, to KUC (ADAMS Accession No. ML16028A179) asking the licensee to identify how the proposed location of the new tailings impoundment, or an alternative location, will satisfy the detection monitoring requirements of 10 CFR Part 40, Appendix A, Criterion 7A.

In its response to the RAI issued June 2016 (ADAMS Accession No. ML16160A409), KUC made no reference to well TMW-64. With regard to wells TMW-31, TMW-75 and TMW-78), KUC stated:

> All three monitoring wells have historically (30 years of data exist for these wells) exhibited low concentrations of the three indicator parameters identified for detecting a potential leak from the new tailings impoundments.
>
> As required in 10 CFR 40, Appendix A, Criteria 7A, KUC proposed and the NRC accepted three indicator parameters for detection of a leak. These three indicator parameters were proposed in the Background Ground Water Quality and Detection Standards Addendum to the Revised Environmental Report (Shepherd Miller, Inc., 1996): 1) pH due to the acidity of the mill tailings, 2) conductivity, due to its proportionality to ions in the tailings fluid and as a ready contrast to low conductivity levels in the groundwater system, and 3) chloride, due to high concentrations in the mill tailings and its highly dispersive properties.

> These three indicator parameters provide a marked contrast between tailings fluid and the natural groundwater system, even for groundwater at the edge of the area affected by the 1983 leak. Thus, progression of a significant leak from the impoundment could be quickly detected.

The NRC staff notes that the 1999 safety evaluation report (SER) (ADAMS PLL Accession No. 9908230110 (microform)) that evaluated ground water protection at that time assumed that the plume of contaminants introduced by leaks in the 1980s from the original tailings impoundment was "shrinking" and that its restoration would be completed "within 10 years." Indeed, the plume has expanded, and restoration is neither progressing nor complete.

For those POC wells (per Table 5-2 in the Final Design Volume VII) for which the NRC approved the monitoring of conductivity, pH, and chloride as early detection parameters, the corresponding detection standards were identified in Table 6 of the January 1996 "Addendum to the Revised Environmental Report, Background Ground Water Quality and Detection Standards" (ADAMS PLL Accession No. 9622090095A (microform)), revised in January 1998 (ADAMS PLL Accession No 9801230321 (microform)). Appendix B to this attachment includes a copy of the revision. As stated in the 1999 SER (and reflected in a footnote to Table 6), KUC "committed to monthly monitoring if two of the three parameters exceeded their NRC-approved threshold limits. If this excursion occurs for three consecutive months, KUC will notify NRC." However, the 1999 SER also identifies that high conductivity values existing at POC well locations at the time would hinder the implementation of the detection standard for this parameter:

> Because the plume is shrinking, the new impoundments will not be constructed for a year or more and the new impoundments will have leak detection systems, the staff does not consider the elevated conductivity as a problem.

For the purpose of this technical evaluation report, as shown in Figure 5 in Appendix A to this attachment, the NRC staff plotted period-of-record time series of conductivity values for the three POC wells previously designated to monitor this parameter. The data used for the plots were taken from the annual CAP review and ground water monitoring reports KUC submitted to the NRC. But conductivity values for all three wells have continued to consistently and significantly exceeded the previously approved 350 µmho/cm detection standard. This analysis thus indicates the following:

- Expected decreases in conductivity over time have not been substantiated.
- The representation made by KUC in its June 2016 RAI response (namely, that the three designated POC wells "have historically…exhibited low concentrations of the three indicator parameters") is not accurate.

Proposed Evaporation Ponds

License Condition 11.4 also references Table 5-2 of the Final Design Volume VII for the specifics of operational environmental monitoring of the proposed evaporations ponds, which KUC plans to install south of the existing tailings impoundment (see Figure 1 in Appendix A to this attachment). Table 5-2 (reproduced in Appendix B to this attachment) identifies existing well TMW-50 as one of the POC wells to be used for the operational environmental monitoring of the evaporation ponds.

Section 5.2 of the April 1998 Final Design Volume VII (ADAMS PLL Accession No. 9804230006 (microform)) provides the following with respect to Well TMW-50 (pp. 22–23):

> An upgradient monitoring well is proposed for the evaporation ponds, the existing TMW-50, completed in an interval from [30 to 46 m] 100 to 150 feet below the surface that may allow the establishment of a baseline ground water quality assessment to indicate how ground water in this vicinity is affected by the previous leak from the existing impoundment. Baseline water quality for the evaporation ponds will be the water quality in TMW-50 prior to resumed operations. The existing water quality in TMW-50 has been affected by seepage from the existing tailings impoundment. TMW-50 currently (as of 9/2/97) is above baseline as defined by TMW-5 water quality, exhibiting a TDS of 1170 ppm, while TMW-5 exhibits a TDS of 157 ppm (7/9/97). This contaminated water would be the baseline water quality condition for the evaporation ponds.

Thus, the intended use of well TMW-50 at the time was as an upgradient monitoring well to the evaporation ponds, given that ground water flow was toward the southwest (as stated on page 21 of the same document). The NRC staff notes that the ground water flow direction across the facility has since changed due to pumping activities related to the CAP for the site. Figure 6 in Appendix A to this attachment shows the location of well TMW-50, the potentiometric surface from the Fall of 2014, and the combined radium-226/228 and natural uranium plumes from 2014. The information in the figure was obtained from the KUC 2014 "Corrective Action Program Review and Groundwater Monitoring Report" (ADAMS Accession No. ML15072A366). As indicated by the potentiometric head contours in Figure 6 in Appendix A, ground water flow at the well location is currently toward the northeast, and the well is no longer upgradient of the proposed evaporation ponds. Also shown in the figure, Well TMW-50 is also within the combined radium-226/228 plume area. A period-of-record time series plot of combined radium-226/228 concentrations for well TMW-50 (Figure 7 in Appendix A to this attachment) shows that the well continues to exceed the GPSs. The well has also consistently exceeded the 350 µmho/cm detection standard specified in Table 6 from the previously discussed "Addendum to the Revised Environmental Report, Background Ground Water Quality and Detection Standards (see Appendix B to this attachment).

CONCLUSION:

This review finds that the current operational monitoring requirements for the new tailings impoundment and evaporation ponds pursuant to the ground water detection monitoring criteria in 10 CFR Part 40, Appendix A, are based on information and assumptions about local ground water conditions that are no longer valid. Therefore, the NRC staff is modifying license condition 11.4 to impose modified operational monitoring requirements on the licensee (see Section 5.4 of this SER).

APPENDIX A
TO ATTACHMENT A

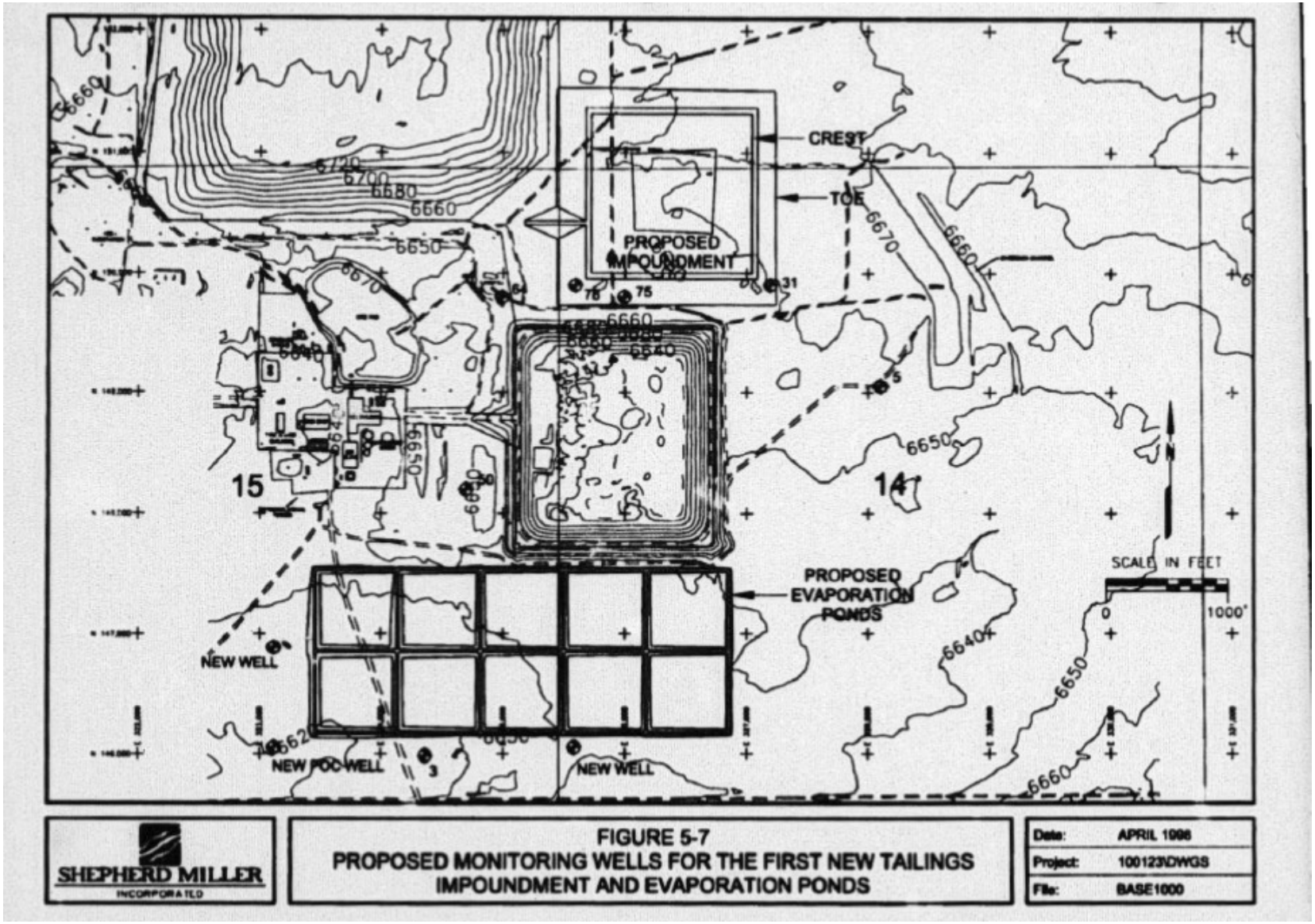

FIGURE 1. Locations of proposed tailings impoundment and evaporation ponds.

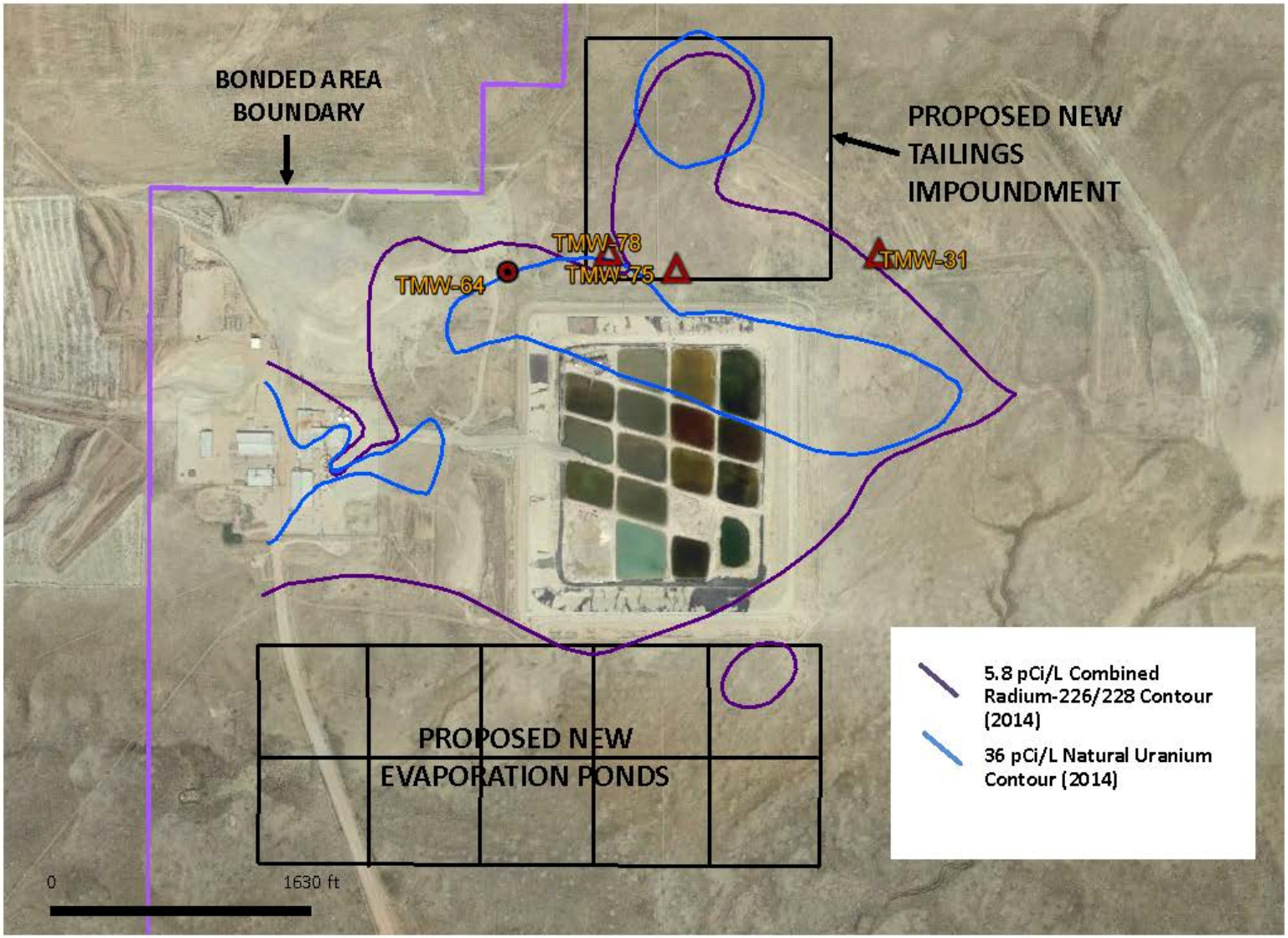

FIGURE 2. Location of operational monitoring wells in relation to site features and contamination plumes.

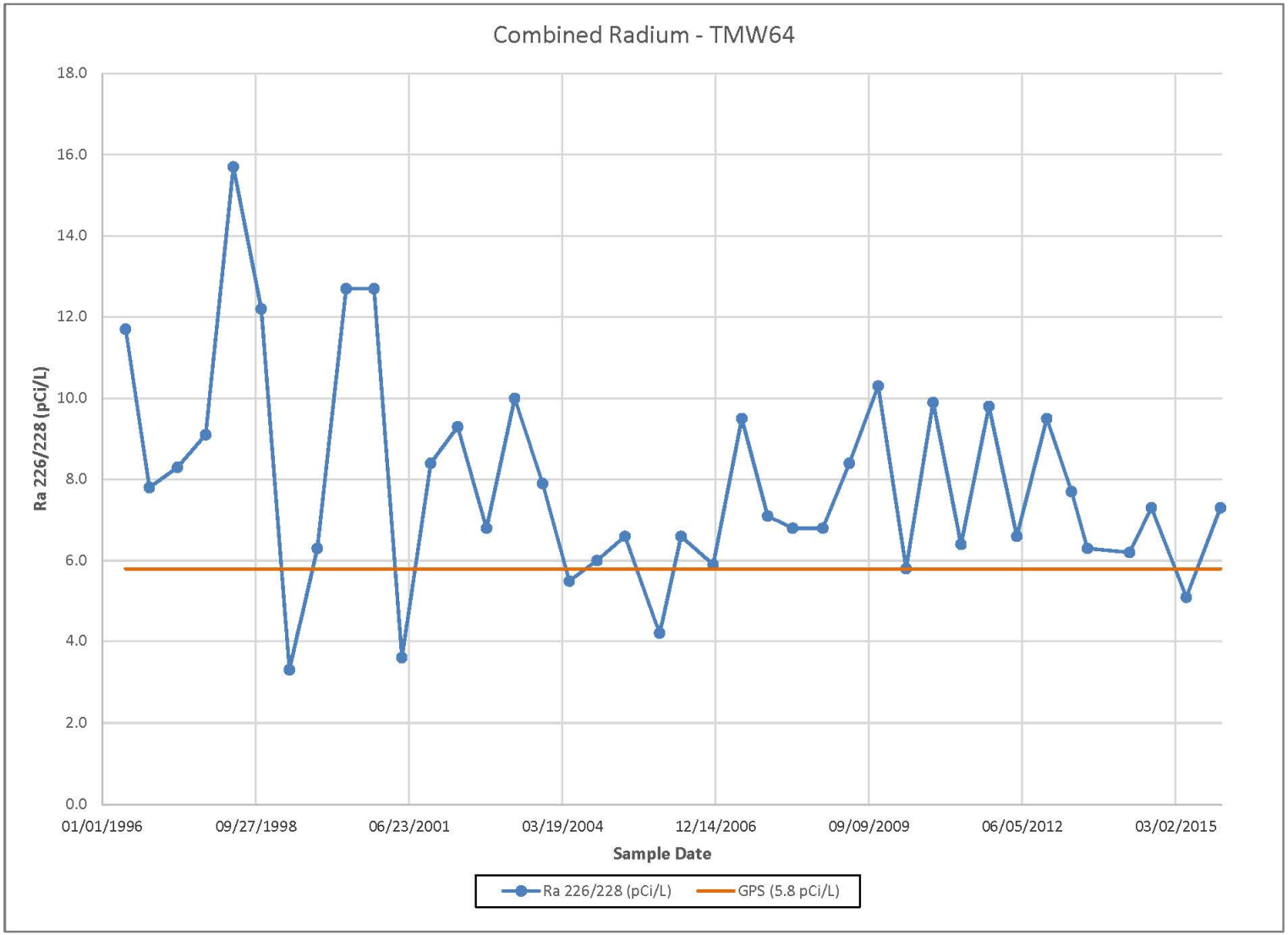

FIGURE 3. Time series of combined radium concentrations in point of compliance well TMW64.

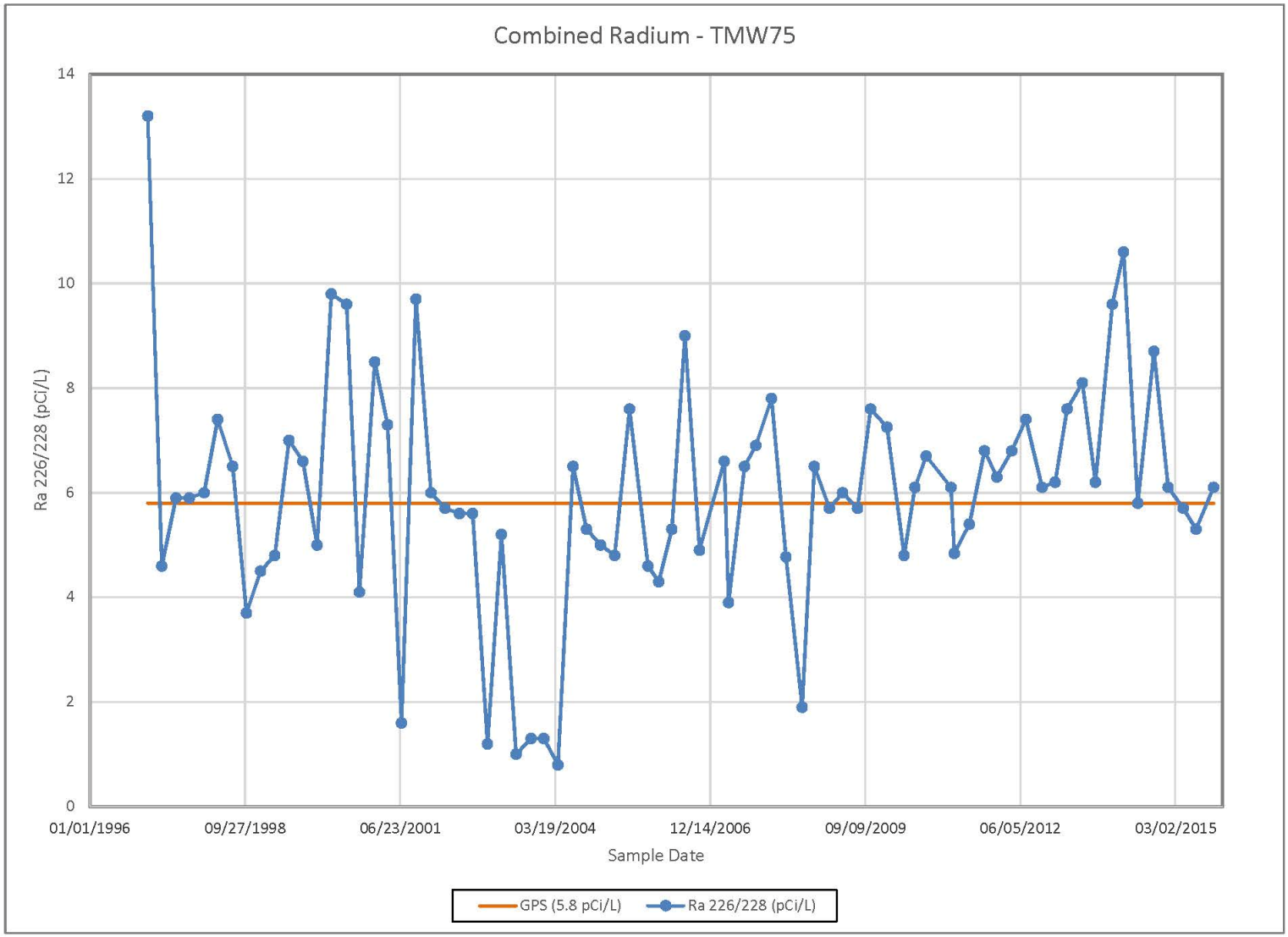

FIGURE 4. Time series of combined radium concentrations in operational monitoring well TMW75.

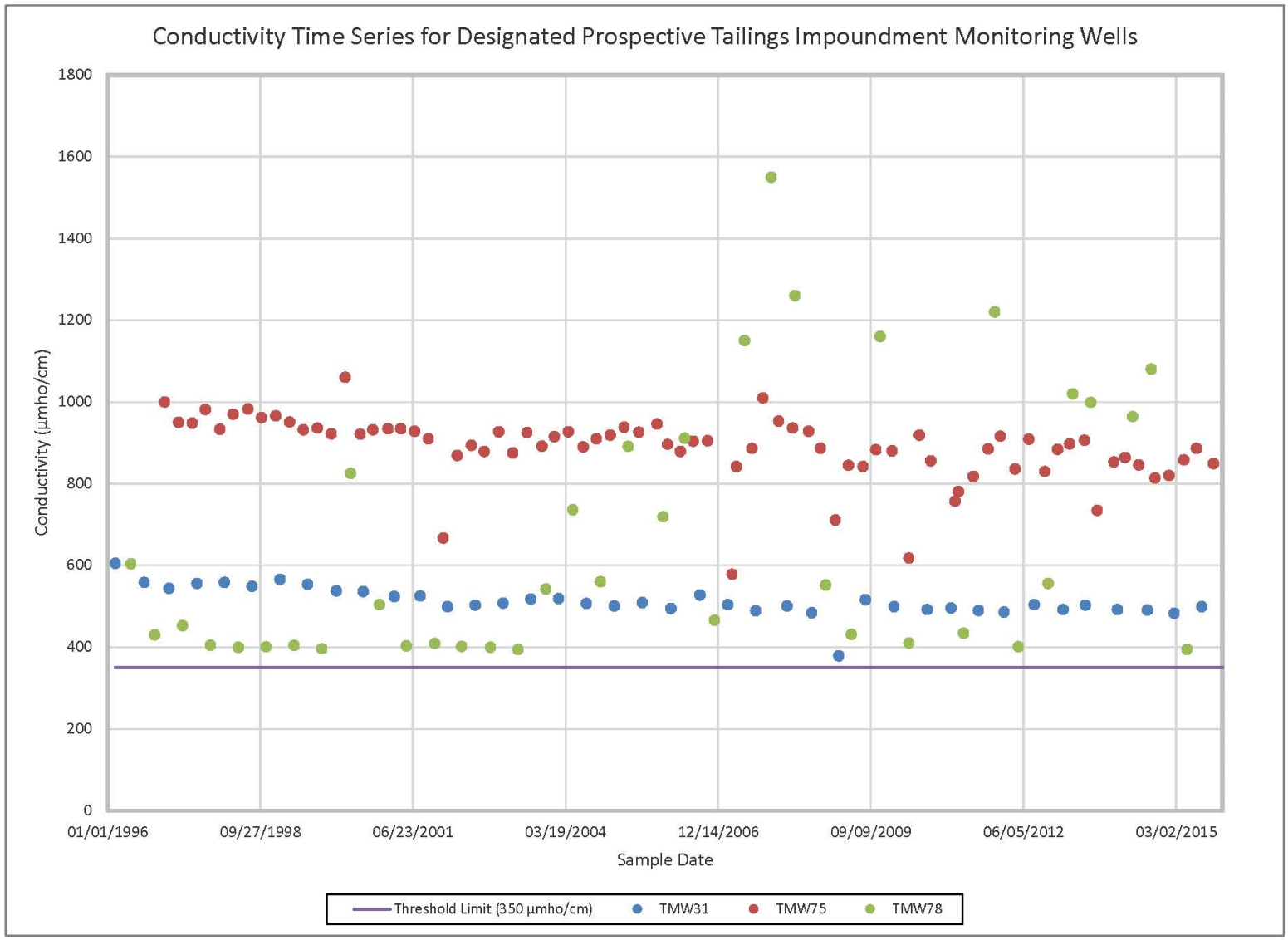

FIGURE 5. Times series of conductivity values in operational monitoring wells TMW31, TMW75 and TMW78.

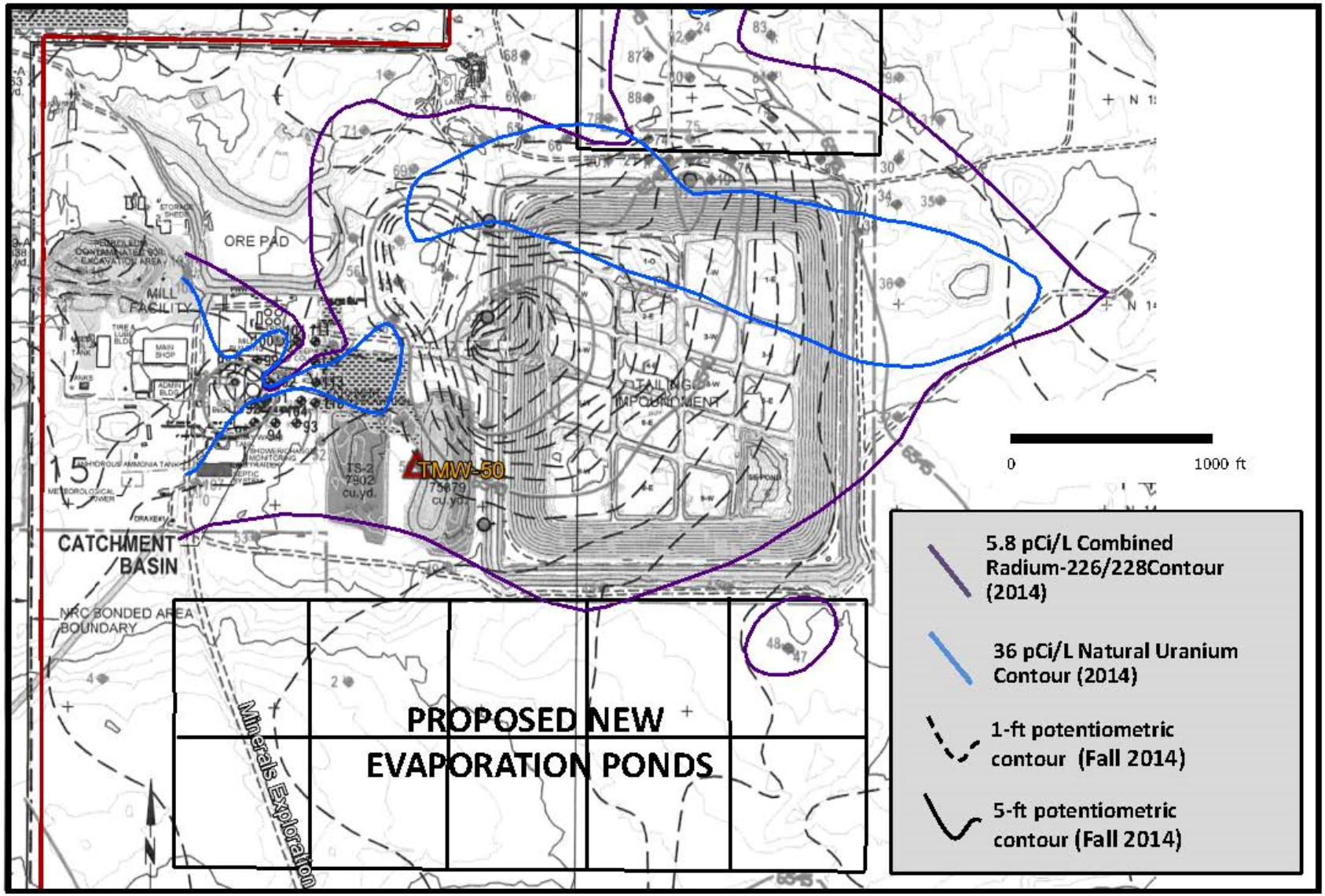

FIGURE 6. Location of evaporation ponds monitoring well TMW50 relative to potentiometric and contamination plume contours.

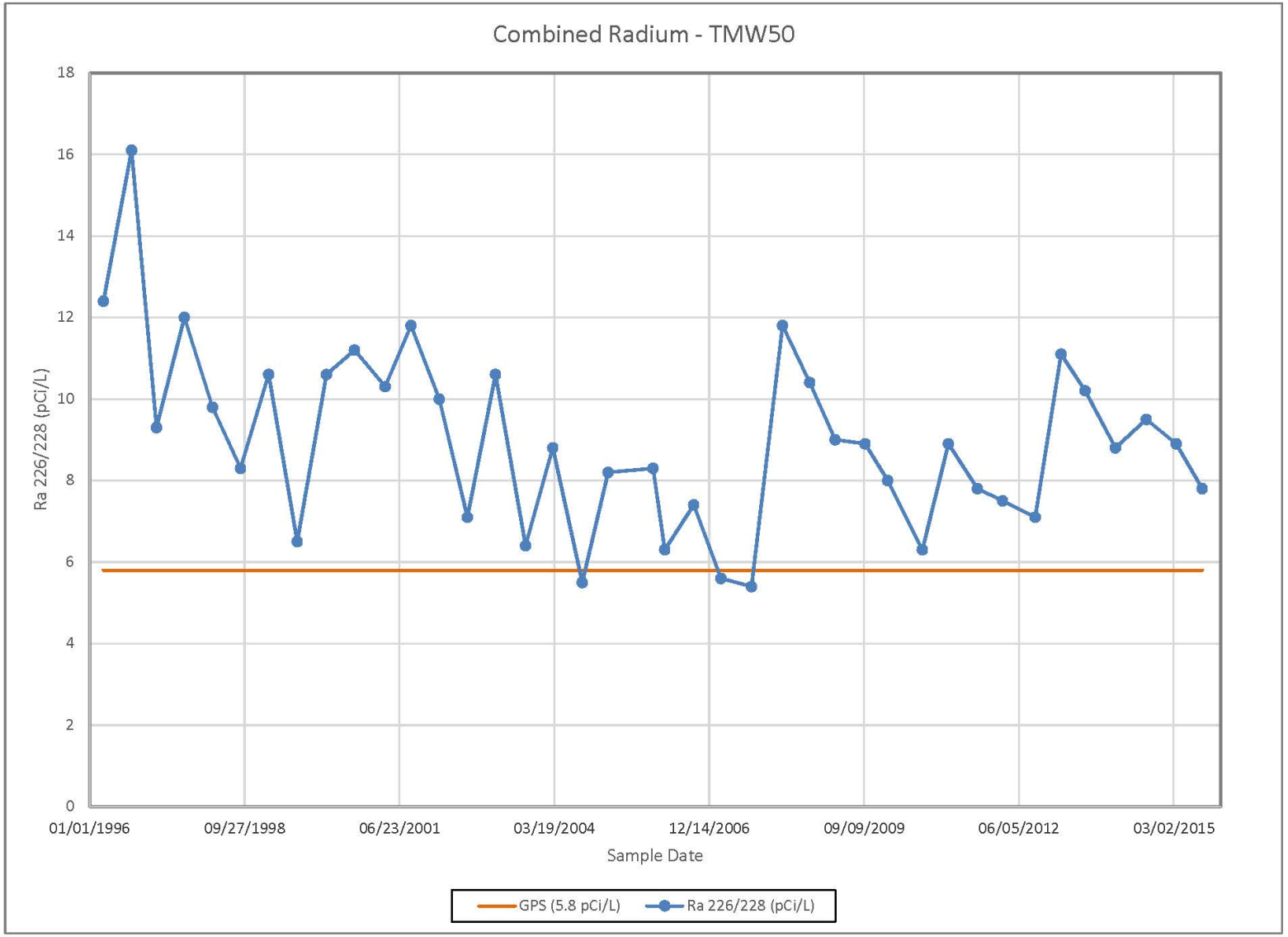

FIGURE 7. Time series of combined radium concentrations in evaporation ponds monitoring well TMW50.

APPENDIX B
TO ATTACHMENT A

Table 5-2 from KUC, Final Design Vol. III (best available quality).

Table 5-2 NRC Operational Environmental Monitoring Summary, Mill, New Tailings Impoundment and Evaporation Ponds

Category	Locations	Frequency	Analytical Parameters
Air (Particulate) EPs 3, 4, 5 and 6	4 locations: GS-1 through GS-4	Continuously; Composited Quarterly	Natural uranium, Ra-226 Th-230, Pb-210
Air (Env. Radon) EP 10	4 locations: GS-1 through GS-4	Continuously with quarterly changes	Radon-222
Gamma EP 11	4 locations: GS-1 through GS-4, Control, Admin Bldg	Continuously with quarterly changes	Environmental Gamma (TLD)
Tailings Impoundment EP 17	Tailings Impoundment 1	Weekly Daily Monthly, except when frozen	Visual inspection of condition of liner. Visual inspection of tailings and fluid distribution systems, water level in leak detection & recovery system Water level in tailings pond
Evaporation Ponds EP 22	Evaporation Ponds	Daily	Water level in leak detection and recovery system
Tailings Liquid EPs 12 and 14	Tailings Impoundment 1	Annually (1)	See Table 5-5
Background Well EPs 13 and 14	TMW-5 or new background well	Semiannually	See Table 5-5
Monitoring Wells, Tailings Impoundment EPs 13 and 14	TMW-78, TMW-75 and TMW-31	Monthly for first year Quarterly thereafter(2) (detection monitoring)	pH, conductivity and chloride
Monitoring Wells, Evaporation Ponds EPs 13 and 14	TMW-50, TMW-3, 2 new wells (Figure 5-3)	Monthly for first year Quarterly thereafter[1] (detection monitoring)	pH, conductivity and chloride
Point of Compliance Well Evaporation Ponds EPs 13 and 14	New well (Figure 5-3)	Semiannually	Arsenic, beryllium, cadmium, chromium, Pb-210, nickel, combined Ra-226 and -228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, & TDS
Point of Compliance Well Tailings Impoundment EPs 13 and 14	TMW-64	Semiannually	Arsenic, beryllium, cadmium, chromium, Pb-210, nickel, combined Ra-226 and -228, selenium, Th-230, natural uranium, gross alpha, chloride, iron, nitrate, sulfate, pH, & TDS

Table 5-2 NRC Operational Monitoring Locations and Descriptions, Continued

Category	Locations	Frequency	Analytical Parameters
Potable Water Well Quality EPs 13 and 14	3 locations: PWW-1, PWW-2, Drake 1	Quarterly	Dissolved and suspended natural uranium, Ra-226, Th-230, Pb-210
Surface Water EPs 12 and 14	3 locations: BS1, BS2, BS3	Monthly, when flowing and not frozen Quarterly (if standing water present and not frozen)	Dissolved and suspended natural uranium, Ra-226, Th-230, Pb-210
Soil EP 7	4 locations: GS-1 through GS-4	Annually	Natural uranium, Ra-226, Pb-210
Sediment EP 8	3 locations: BS-1 through BS-3	Annually	Natural uranium, Ra-226, Pb-210, Th-230
Vegetation EP 9	4 locations: GS-1 through GS-4	Three times during the grazing season	Ra-226, Pb-210
Stack Sampling EP 15	3 locations: Ore Receiving/Grinding Stack, Leach Stack, Yellowcake Dryer Stack	Semiannually (Ore and Leach Stacks) Quarterly (Yellowcake Stack)	All Stacks: Natural uranium, Ra-226, Pb-210, Th-230 Stack flow rate is to be measured for all stacks when sampled.
Meteorological Monitoring EP 18	Meteorological Station	Continuous	Wind speed and direction, sigma/theta, barometric pressure, pan evaporation, temperature (2m and 10m), precipitation.

(1) Tailings liquid monitoring would also be conducted after a change in mill process chemistry or after a significant change in the mill feed source.
(2) Frequency of monitoring the tailings impoundments and evaporation ponds via monitoring wells is recommended in NRC Regulatory Guide 4.14 (NRC, 1980).

Table 6 from KUC, Addendum to ER (best available quality).

Table 6. Proposed Detection Standards for PDC Wells

Constituent	Detection Standard
pH	6.67 *
Conductivity	350 μmho/cm
Chloride	23 mg/l

* The standard for pH is a minimum; a detection notice would exist if the pH falls below 6.67 standard pH units.

Note: Exceedence of the standard for two of the three detection parameters would trigger monthly monitoring. Exceedence of the standards for two of the three parameters for three consecutive months would require notification of the NRC.

ATTACHMENT B

TECHNICAL EVALUATION REPORT
FOR
KENNECOTT URANIUM COMPANY
SWEETWATER MILL GROUND WATER CORRECTIVE ACTION PLAN

DOCKET NO.: 40-8584

LICENSE NO.: SUA-1350

DATE: TBD

FACILITY: SWEETWATER URANIUM PROJECT

TECHNICAL REVIEWER: Jose Valdes

PROJECT MANAGER: James Webb

SUMMARY:

In July 2014, Kennecott Uranium Company (KUC) submitted a license renewal application for Source Materials License No. SUA-1350. License Condition 11.3 in the current license requires the licensee to implement a corrective action program (CAP) to address ground water contamination at the site. The NRC staff reviewed historical data from the licensee's annual CAP review and ground water monitoring reports and responses to requests for additional information (RAI). This review has determined that the current CAP is not achieving compliance with the ground water protection standard (GPS) limits identified in License Condition 11.3. Furthermore, the licensee has not characterized the extent to which contamination may extend beyond the western boundary of the bonded area. The NRC staff is modifying License Condition 11.3 to require the licensee to fully characterize the current extent of ground water contamination and provide a revised plan to bring the ground water into compliance with the GPSs.

BACKGROUND:

The KUC Sweetwater Uranium Project mill site is located in southcentral Wyoming, in Sweetwater County, approximately 68 km (42 miles) northwest of Rawlins, Wyoming. The mill was constructed in 1980 and processed ore from an adjacent open pit mine from 1981 until April 1983, from which time it has been on standby status. Figure 1 in Appendix A to this attachment shows a general site map.

The existing tailings impoundment leaked several times between 1980 and 1984 (ADAMS Accession No. ML081500512). To address the resulting ground water contamination, in 1989 the NRC approved a CAP and established GPSs (ADAMS PLL Accession No. 8910030149 (microform)). The NRC approved operational modifications to the CAP in 1994 (ADAMS PLL Accession No. 9404280036 (microform)). In February 1996, KUC submitted a statistically

based “Background Ground Water Quality and Detection Standards, Addendum to the Revised Environmental Report” (ADAMS PLL Accession No. 9622090095A (microform)), which analyzed data for 33 parameters (major ions, trace metals, and radiometric parameters) from 65 wells (15 site wells, 44 wells from the nearby ENQ uranium deposit mine site, and 6 regional wells) with a period of record of up to 20 years. Based on the findings of this study, KUC requested from NRC a license amendment to (1) change the GPSs for combined radium-226/228, natural uranium, lead-210, gross alpha, and thorium to reflect background values and (2) eliminate parameters (barium, cyanide, lead, mercury, molybdenum, silver and thallium) not found in tailings fluids or ground water at the site. In May 1998, the NRC amended the license (ADAMS PLL Accession No. 9806030108 (microform)). The modified GPSs have been incorporated into all subsequent license renewals, including the current license (ADAMS Accession No. ML15008A256). In January 2003, soil and ground water contamination were found to have occurred in the area of the unlined catchment basin as a result of the disposal of process fluids during mill operations (ADAMS Accession No. ML041450434). Organics, metals, and radionuclides in these fluids slowly migrated through the soil beneath the basin and into the upper portion of the underlying aquifer. In May 2005, the NRC approved changes to the ground water CAP requested by KUC to address the newly discovered contamination (ADAMS Accession No. ML051510387).

License Condition 11.3 under the current license (Amendment 33) for the Sweetwater facility stipulates the following:

> The licensee shall conduct a corrective action program (CAP) with the objective of returning the ground-water concentrations of chromium, natural uranium, and combined radium-226/228 to the levels referenced in Addendum to the Revised Environmental Report, Background Ground Water Quality and Detection Standards, “January 1996, as revised by page changes January 8, 1998 (approved by the NRC letter of May 28, 1998), and the catchment basin ground-water corrective action plan dated May 12, 2004, as revised July 22, 2004, December 15, 2004, and January 18, 2005.
>
> The ground-water protection standards at point of compliance (POC) wells TMW-15, 16, 17, and 18, with background being defined in the above Addendum are: arsenic = 0.05 mg/L, beryllium = 0.01 mg/L, cadmium = 0.01 mg/L, chromium = 0.05 mg/L, lead-210 = 8.9 pCi/L, nickel = 0.01 mg/L, combined radium-226/228 = 5.8 pCi/L, selenium = 0.01 mg/L, thorium-230 = 7.0 pCi/L, natural uranium = 36.0 pCi/L, and gross alpha = 15.0 pCi/L, manganese = 0.2 mg/L, and iron = 0.6 mg/L.
>
> Pump-back wells may be added or removed from service with the goal of improving the performance of the CAP. POC, monitoring, and pump-back wells shall be sampled at the locations, at the frequency, and for the parameters provided in Table 5-1 (for existing impoundment) of the Final Design Volume VII, submitted (page change) June 21, 1999. Reporting limits for sampled constituents shall be as provided in Table 5-11 of the Final Design Volume VII, submitted April 13, 1998.
>
> The catchment basin pump-back wells and monitoring wells TMW-92, 93, 94, 95, 97, 98, 99, 100, 101, 104, 111, 112, 113, and 115 will be sampled quarterly for diesel range and gasoline range organics and volatile organic compounds, in addition to the above constituents. The ground-water protection standards to be

used to assess data from these wells are as follows:
1,1-dichloroethane = 3.0 mg/L, 1,1-dichloroethene = 0.007 mg/L,
DRO = 10 mg/L, GRO = 10 mg/L, naphthalene = 1.5 mg/L, toluene =1 mg/L,
1,1,1-trichloroethane = 0.20 mg/L, 1,2,4-trimethylbenzene = 0.012 mg/L,
1,3,5-trimethylbenzene = 0.012 mg/L, m+p xylenes = 10 mg/L,
manganese = 0.2 mg/L, aluminum =1.8 mg/L, and iron = 0.6 mg/L.

In addition to an annual ground water monitoring report, License Condition 12.3 also requires an annual report that includes "a ground-water CAP review, describing the progress toward attaining the ground-water protection standards including the areal extent and concentration of hazardous constituents and estimates of the time needed to obtain compliance."

TECHNICAL EVALUATION:

In July 2015, the NRC issued a Request for Additional Information (RAI) (ADAMS Accession No. ML15167A361) resulting from review of KUC's license renewal application (ADAMS Accession No. ML14251A113), which states in Section 6.1.1.5 (citing the 1999 NRC Environmental Assessment) that as of 1998, "all the hazardous constituents have stabilized below the standards except uranium which is confined to the northern edge of the tailings cell and radium which covers approximately 51 ha (127 ac), of which nearly half is under the tailings cell." In the RAI, the NRC noted that the areal extent of combined radium-226/228 and natural uranium ground water contamination described in the license renewal application did not accurately reflect the information presented in the annual CAP review and ground water monitoring reports reviewed for 2004–2013, and that there were consistent or intermittent exceedances of the GPSs for combined radium-226/228, natural uranium, manganese, and iron in specific wells.

In October 2015, KUC responded (ADAMS Accession No. ML15293A244) to NRC's RAI regarding the areal extent of combined radium-226/228 and natural uranium contamination. KUC based its response on a report prepared by Telesto Solutions, Inc., based upon a 2009 conceptual model depicting the transport of a sulfate plume derived from releases at the catchment basin from 1985–2015. As described in the RAI response, the 2015 conceptual model prepared by Telesto for KUC assumes the following:

> Releases from the Tailings Impoundment have been contained by the pumping which is occurring under the CAP in the near vicinity of the Tailings Impoundment.

The RAI further stated the following:

> Telesto conceptualized in the 2009 model and continues to conceptualize that two plumes exist: 1) a plume resulting from 1981 through 1983 releases from the unlined Catchment Basin that began migrating westward under the influence of the relatively steep gradient created by pit dewatering; and 2) a plume beneath the Tailings Impoundment that originated slightly later (1984) and was relatively quickly contained by CAP pumping that commenced in April 1986. The Catchment Basin plume has been pulled eastward under the influence of CAP pumping and the addition of pumping wells TMW-96 and -97 and the establishment of a stable [Sweetwater ore mining] pit lake elevation.

On the basis of the Telesto 2015 conceptual model, KUC reached the following conclusions, as presented in the RAI response:

- The current extent of the combined radium-226/228 plume from the Catchment Basin and Tailings Impoundment releases are contained within the Mill-area capture zone and due to the chemical nature of radium, has not traveled as far as the sulfate plume

- The current extent of the natural uranium plume from the Catchment Basin and Tailings Impoundment releases are contained within the Mill area capture zone. Due to the chemical nature of uranium in oxidized conditions, uranium released from the Catchment Basin may have traveled in a similar manner to the sulfate plume. Uranium released from the Tailings Impoundment has been contained by CAP pumping

- Ongoing exceedances of the manganese and iron GPS are in wells that are within the Mill-area capture zone and are thus contained. As described in Telesto (2009), the exceedances of constituent concentrations above groundwater protection standards are expected to continue, but the plume will remain wholly contained within the Mill-area capture zone via pumping under the CAP[.]

KUC also makes the following statements in its RAI response:

> The uncertainty regarding the western margin of the Catchment Basin release (as represented by the sulfate plume) can be reduced by the installation and testing of monitoring wells… Focus is on the Catchment Basin releases conservatively defined by the sulfate plume because the Tailings Impoundment release has been well defined and effectively contained by pumping under the CAP since April 1986, and because of the relative uncertainty of plume extents to the west.

As discussed below, KUC's analysis is incorrect. Specifically:

- The KUC analysis assumes, rather than seeks to demonstrate, that the releases from the tailings Impoundment have been contained by the pumping in the vicinity of the tailings impoundment.

- The KUC analysis does not differentiate between containment and clean up, the latter being the overall goal of the CAP.

- The conceptualization that two plumes exist, one associated with the catchment basin and another with the tailings impoundment, overlooks the possibility of commingled plumes for specific contaminants. For combined radium-226/228 specifically, the 5.8 picocuries per liter (pCi/L) combined radium-226/228 isocontour as delineated by KUC (see subsequent discussion) does not support the 2-plume conceptualization.

- The CAP is intended to remediate existing ground water contamination from radionuclides and metals. Unlike an early detection monitoring program, the goal of a CAP is not to anticipate or contain such contamination, but to correct it. Therefore, it is

not useful to rely on the modeled behavior of a conservative ion such as sulfate to make inferences about the progress of remediation of the actual contaminants of concern.

The NRC staff has identified exceedances of the GPSs for combined radium, natural uranium, manganese, and iron in compliance wells for the 2012–2015 period (see Table C-1). As shown in the table, 17 out of 18 compliance wells continued to exceed the combined radium-226/228 GPS during this time period. All of these wells are screened in the upper 15 m (50 ft) of the saturated zone of the Battle Spring aquifer.

The NRC staff has also performed statistical analyses of the data presented by KUC using the U.S. Environmental Protection Agency's ProUCL statistical software package (version 4.1). As part of this analysis, the staff looked at trends in combined radium-226/228 and natural uranium plume areas reported by KUC for the 2004–2014 period in its annual CAP review and ground water monitoring reports. Since 2004, the areal data reported by KUC represent an aggregate of the contamination around both the catchment basin and the tailings impoundment (ADAMS Accession No. ML050670394). The combined radium-226/228 and natural uranium plume areal estimates provided by KUC for the 2004–2014 period were consistently based on the area enclosed by the 5.8 pCi/L and 36 pCi/L isocontours, respectively, as derived from the maximum concentration values observed within a given year. The presence of significantly increasing trends in the areal extent of both the combined radium-226/228 and natural uranium plumes over time is indicated by trend analysis using the Mann-Kendall method (95 percent confidence level) and ordinary linear regression (R-squared of 0.86 and 0.82, respectively) (see Figures 2 and 3 in Appendix A to this attachment).

Table C-1 Compliance Wells Exceeding the Ground Water Protection Standard during the 2012–2015 Period

Compliance Wells	GPS Exceedances (2012–2015)			
	Ra 226/228	Nat. U	Mn	Fe
Tailings Impoundment POC Wells				
TMW15	✓			
TMW16	✓	✓	✓	
TMW17	✓			
TMW18	✓		✓	✓
Catchment Basin Wells				
TMW92	✓			
TMW93	✓			
TMW94	✓			
TMW95	✓			
TMW97	✓	✓	(a)	(a)
TMW98	✓	✓	✓	
TMW99	✓	✓	✓	✓
TMW100	✓	✓	✓	
TMW101	✓			
TMW104	✓			
TMW111				
TMW112	✓	(a)	✓	✓
TMW113	✓	✓	(a)	(a)
TMW115	✓			

a. Outliers.

Further, the NRC staff constructed chemical data time series plots for the entire 11- to 19-year period of record of selected monitoring wells showing exceedances of the GPSs. The time series data from these wells were then used for trend analysis using the Mann-Kendall method with a 95 percent confidence level. For spatial evaluation of the results for combined radium-226/228 and natural uranium, the 5.8 pCi/L and 36 pCi/L isocontours, respectively, as delineated by KUC for 2014 (ADAMS Accession No. 15072A400) were used (see Figures 4 and 5 in Appendix A to this attachment).

Time series plots for combined radium-226/228 in relation to the 5.8 pCi/L GPS and the associated trend analysis results are presented in Figures 6–17 in Appendix A to this attachment. A synoptic view of these results is shown in Figure 18 in relation to KUC's delineation of the area encompassed by the 5.8 pCi/L isocontour. Especially noteworthy are the wells close to the edge of the plume, which, if the plume were shrinking, would be expected to be exhibiting decreasing trends over time. In fact, none exhibit statistical evidence of a decreasing trend. Among the tailings impoundment POC wells, only combined radium-226/228 concentrations in Well TMW-18 exhibits a statistically significant decreasing trend, although the concentrations remain at least 3 time higher than the GPS. As shown in Figures 4 and 18 in Appendix A, the combined radium-226/228 isocontour for 5.8 pCi/L is not defined on the western side of the facility within 213 m (700 ft) of the bonded area boundary. Thus, the extent to which the combined radium-226-/228 plume may extend beyond the bonded area has not been characterized. Wells TMW-73 and TMW-72 are presently the westernmost wells alongside the plume and adjacent to the edge of the bonded area. These wells are located approximately 32 m (106 ft) apart, with Well TMW-73 screened a foot deeper than Well TMW-72 (ADAMS Accession No. ML14077A340). While Well TMW-72 exhibits exceedances that are less than twice the GPS and a decreasing trend (see Figure 14 in Appendix A to this attachment), combined radium-226/228 concentrations in Well TMW-73 exhibit an increasing trend and are more than 5 times greater than the GPS (see Figure 15 in Appendix A to this attachment). The reason for these discrepancies is unknown. Further characterization of the western extent of the combined radium-226/228 plume is necessary to understand these significant discrepancies.

Time series plots for natural uranium in relation to the 36 pCi/L GPS and the associated trend analysis results are presented in Figures 19–24 in Appendix A to this attachment. A synoptic view of these results is shown in Figure 25 in relation to KUC's delineation of the areas encompassed by the 36 pCi/L isocontours. As shown in Figures 5 and 25, three distinct areas of contamination are indicated: one some distance north of the tailings impoundment, the second overlying the northern portion of the tailings impoundment, and the third in proximity to the catchment basin of undefined extent to the west within 213 m (700 ft) of the bonded area boundary. Thus, as with the combined radium plume, the extent to which the natural uranium plume may extend beyond the bonded area has not been characterized. Nearby Well TMW-72 has concentrations of natural uranium that are an order of magnitude higher than the GPS and exhibit no statistically significant trend (see Figure 21 in Appendix A to this attachment). Natural uranium concentrations in westernmost Well TMW-73, adjacent to the bonded area boundary, exhibits a decreasing trend, although it remains 2 orders of magnitude higher than the GPS (see Figure 22 in Appendix A to this attachment). In the area around the catchment basin, easternmost Well TMW-113 is characterized by natural uranium concentrations that exceed the GPS by up to a factor of 6 and exhibits no statistically significant trend. In the two northern areas, Wells TMW-16, TMW-36, and TMW-89 exceed the GPS by up to an order of magnitude, and show statistically significant upward trends.

Time series plots for manganese in relation to the 0.2-milligram per liter (mg/L) GPS and the trend analysis results for all six GPS-exceeding compliance wells identified in Table C-1 are presented in Figures 26–31 in Appendix A to this attachment. A synoptic view of these results is shown in Figure 32. Manganese values in tailings impoundment POC Well TMW-18, even disregarding the three higher outlier values, have consistently exceeded the manganese GPS over its period of record and exhibit a statistically significant upward trend. Manganese concentrations in POC Well TMW-16 show a statistically downward trend, but continue to exceed the GPS by more than a factor of 2. The remaining exceedances are observed in 4 wells around the catchment basin, out of which Wells TMW-112 and TMW-110 show statistically significant upward and downward trends, respectively.

Time series plots for iron in relation to the 0.6-mg/L GPS and the trend analysis results for all three GPS-exceeding monitoring wells identified in Table C-1 are presented in Figures 33–35 in Appendix A to this attachment. A synoptic view of these results is shown in Figure 36. Non-outlier iron values in tailings impoundment POC Well TMW-18 have consistently exceeded the iron GPS over its period of record and exhibit a statistically significant upward trend. The remaining exceedances are observed in two wells around the catchment basin, one of which (TMW-112) shows a statistically significant downward trend in iron concentrations.

DISCUSSION:

As summarized by KUC in "Annual CAP Review for 2015" (ADAMS Accession No. ML16176A068), between 1988 (when the CAP was initiated) and 1998, 47 percent of the mass of released contaminants from the tailings impoundment was calculated to have been removed by ground water pumping and returned to the tailings impoundment. Based on this assessment of the mass of released contaminants removed by pumpback operations, KUC estimated 10 years to terminate the CAP. In 2004 and 2009, the calculated total amounts of contaminants removed were updated to 58 and 83.8 percent, respectively. KUC notes in its 2015 CAP Review and Ground Water Monitoring Report that the 10-year estimate for the remediation of the tailings impoundment plume was based solely on the removal of contaminants that leaked from the tailings impoundment and did not include contaminants that escaped from the bottom of the catchment basin. But this position does not explain why contamination plumes persist around the tailings impoundment more than 27 years after the CAP was initiated.

In its 2015 CAP Review and Ground Water Monitoring Report, KUC cites the 2009 study by Telesto Solutions, Inc. as indicating the following:

> [A] common situation observed at the site is chemical concentrations that are above ground water protection standards or corrective action levels, and which are either increasing or do not show a consistent downward trend. This suggests that mechanisms exist which are continuing to introduce chemical mass into the ground water aquifer. Where this occurs, the additional time for remediation is likely to be significantly longer than 20 years.

The above observations regarding the magnitudes and trends of chemical concentrations are commensurate with the results obtained by the NRC staff in the analysis documented herein.

KUC further stated the following:

> Any estimate [of remediation time] is…subject to change depending upon future plans. For example, should operations at the mill resume, use of pumpback fluids as a source of mill feed water has been considered as a means to hasten removal of the impacted fluids.

With regard to the statement above, the NRC staff notes that remediation under the CAP is required notwithstanding any future potential operations at the facility.

CONCLUSIONS:

This review has determined that the current CAP is not achieving compliance with the GPS limits identified in License Condition 11.3. Furthermore, the licensee has not characterized the extent to which contamination may extend beyond the western boundary of the bonded area. The NRC staff is modifying License Condition 11.3 to require the licensee, within prescribed time frames, to fully characterize the current extent of ground water contamination and provide a revised CAP adequate to bring the ground water into compliance with the NRC-approved GPS for the facility (see Section 7.4 of this SER).

APPENDIX A
TO ATTACHMENT B

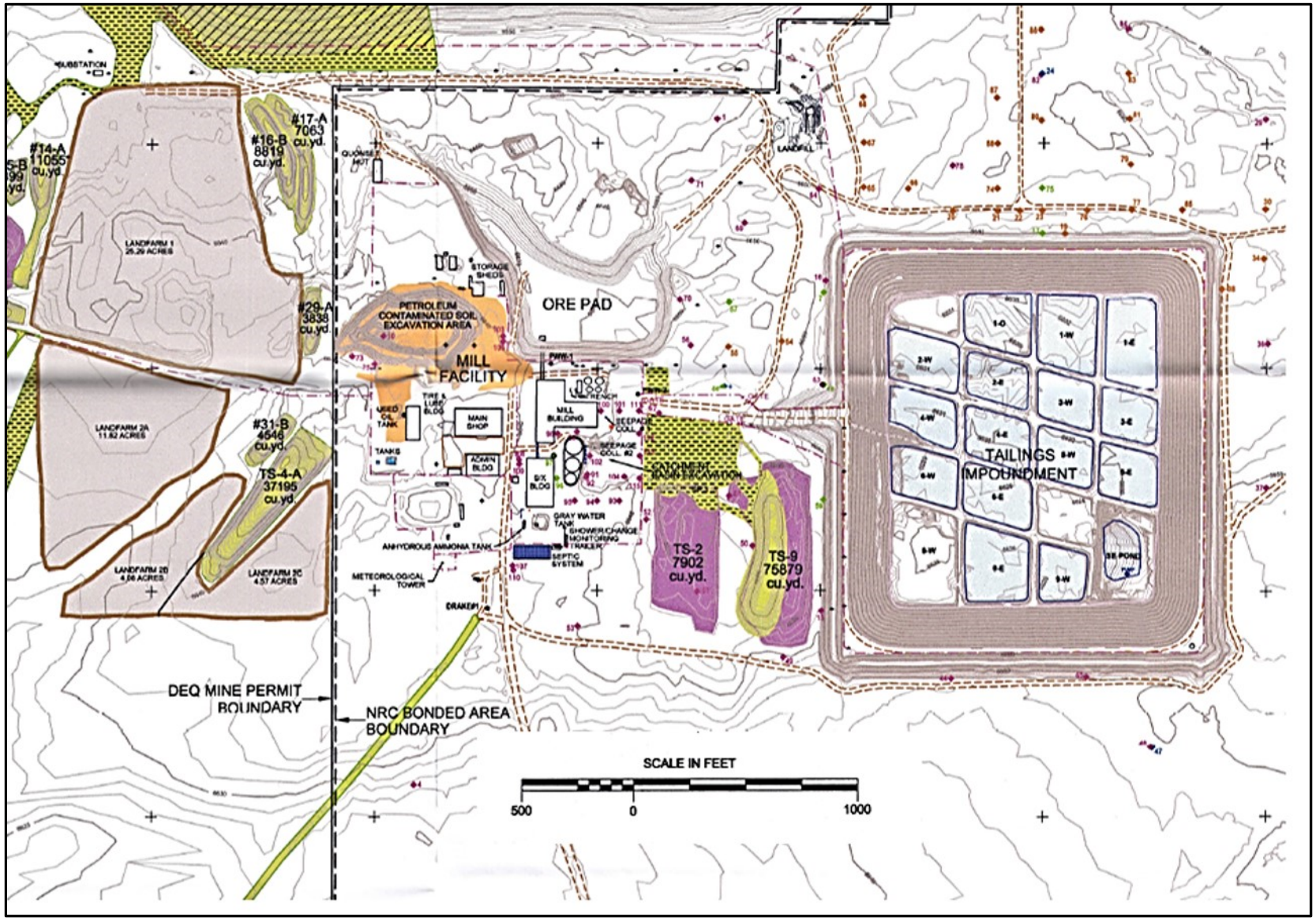

FIGURE 1. Site map.

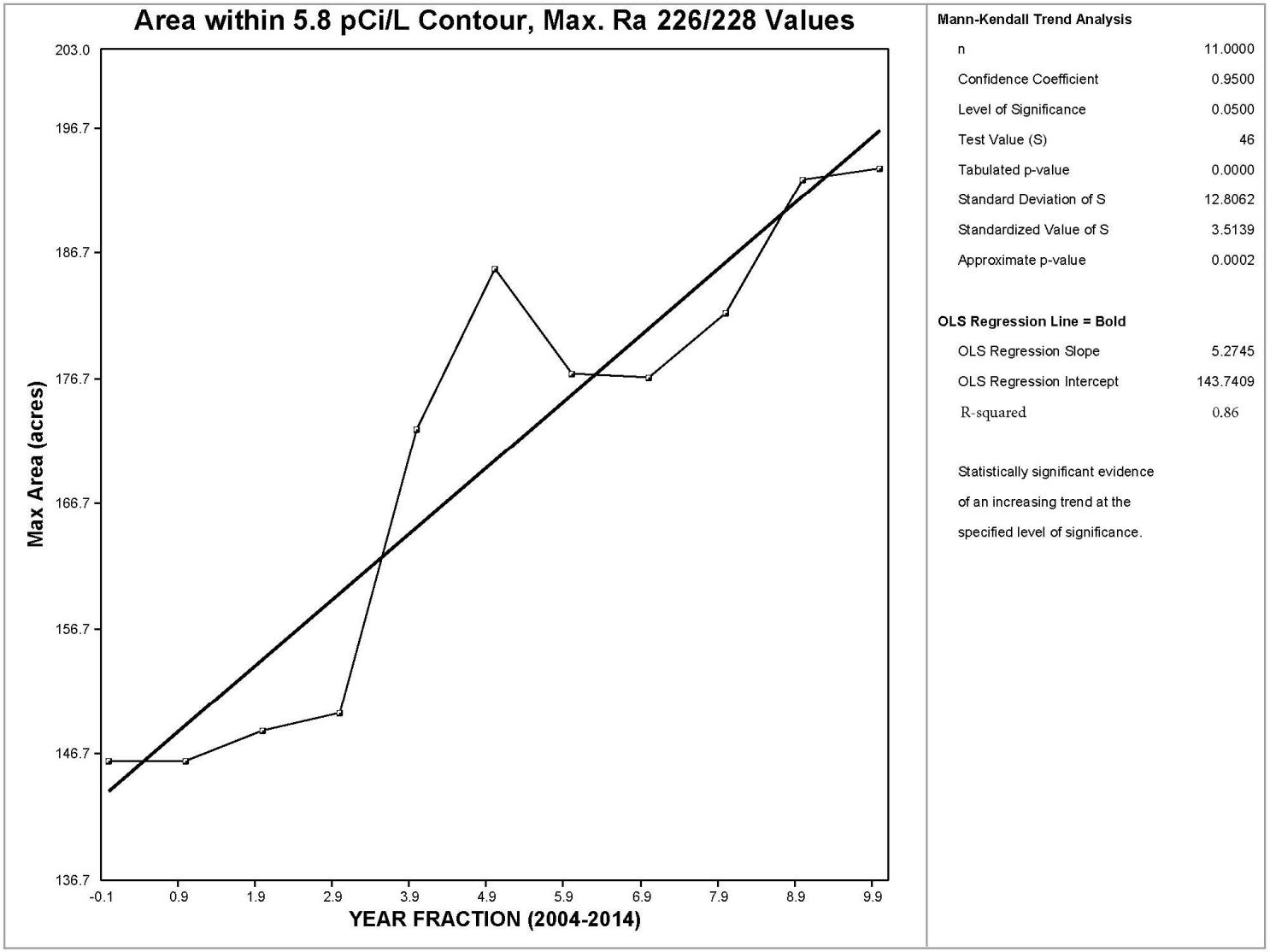

FIGURE 2. Trend analysis of total area enclosed by the 5.8 pCi/L contour derived from year-maximum combined radium concentrations.

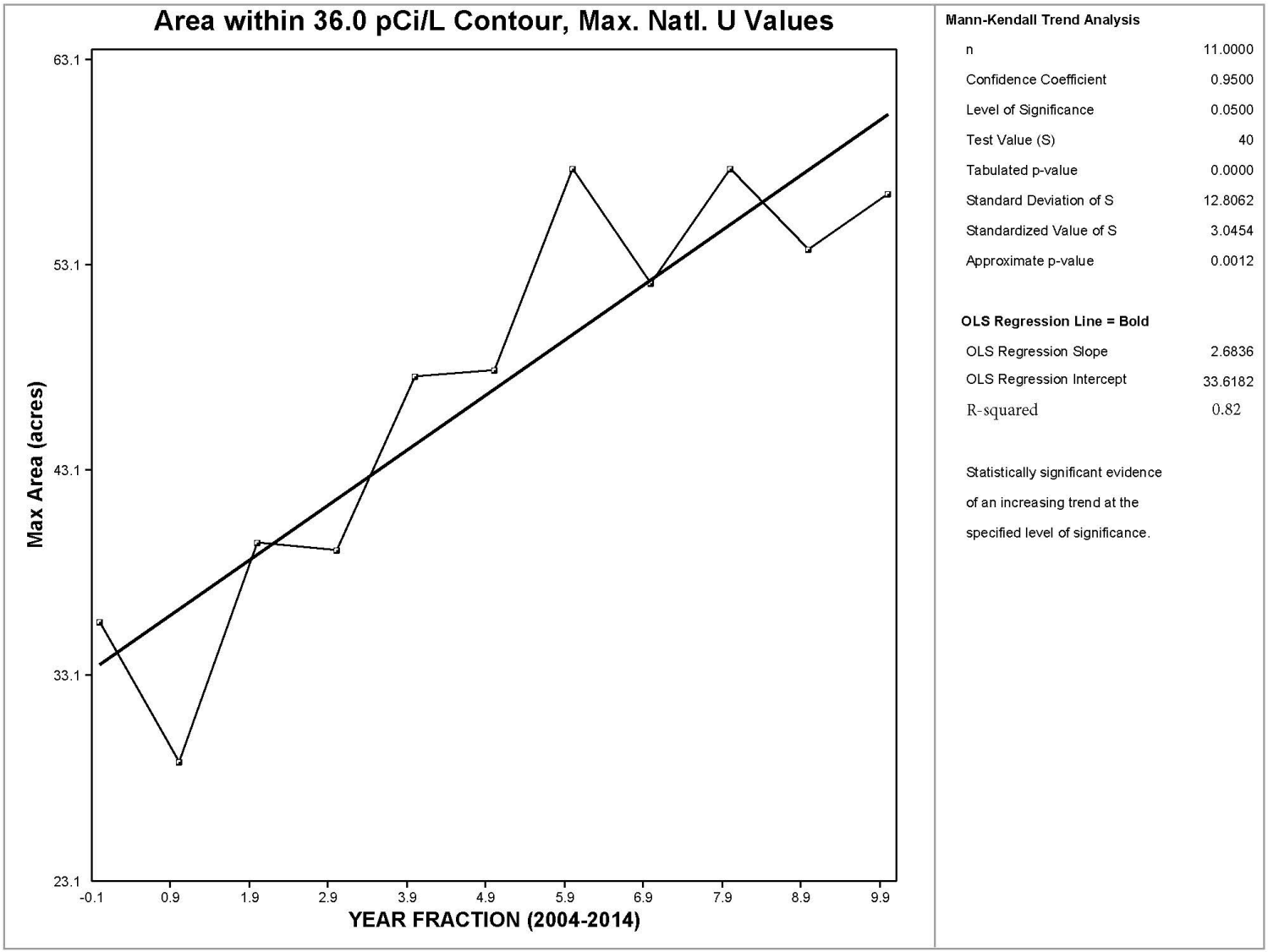

FIGURE 3. Trend analysis of total area enclosed by the 36 pCi/L contour derived from year-maximum natural uranium concentrations.

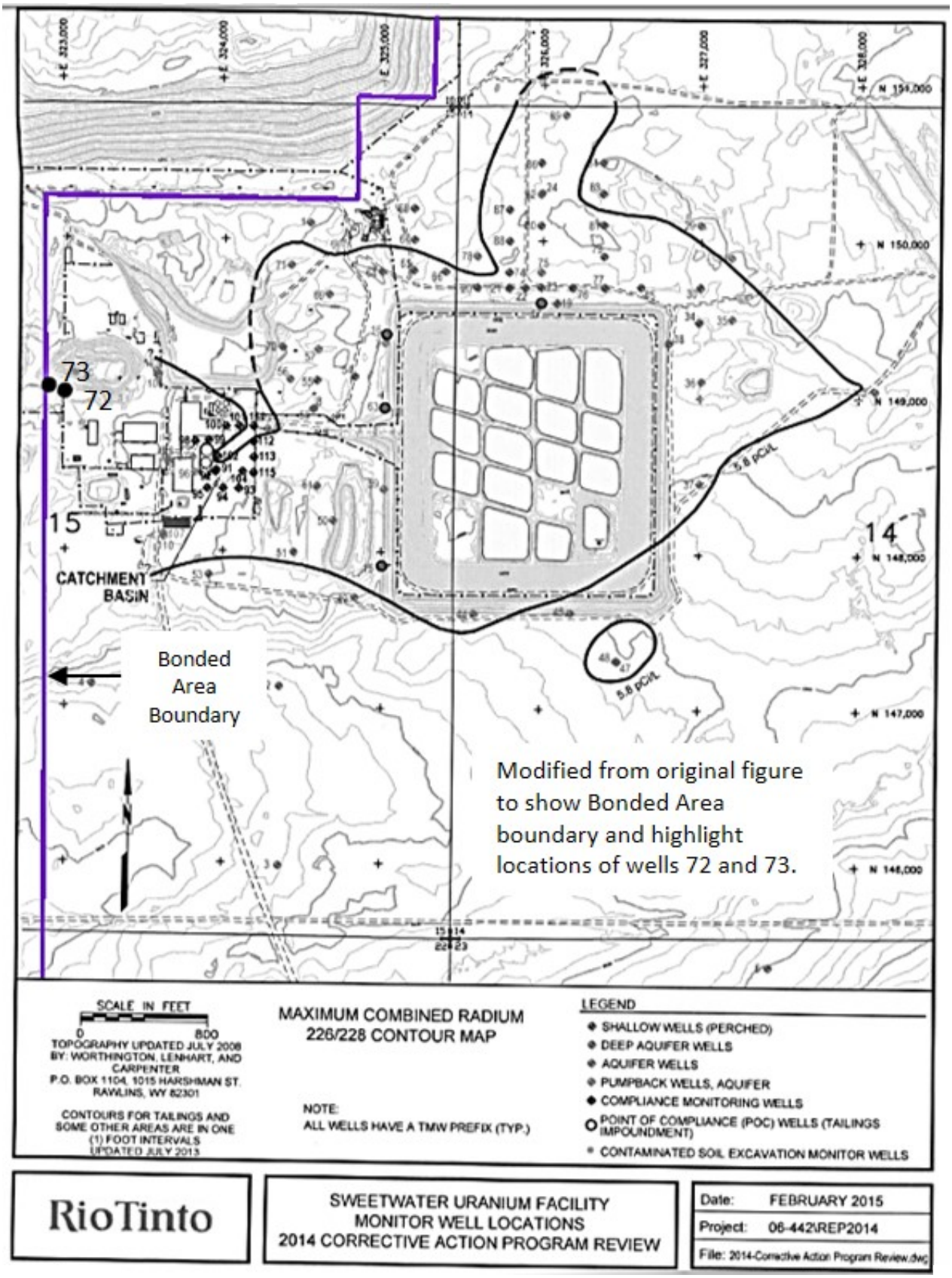

FIGURE 4. Maximum combined radium 5.8 pCi/L-contour map for 2014.

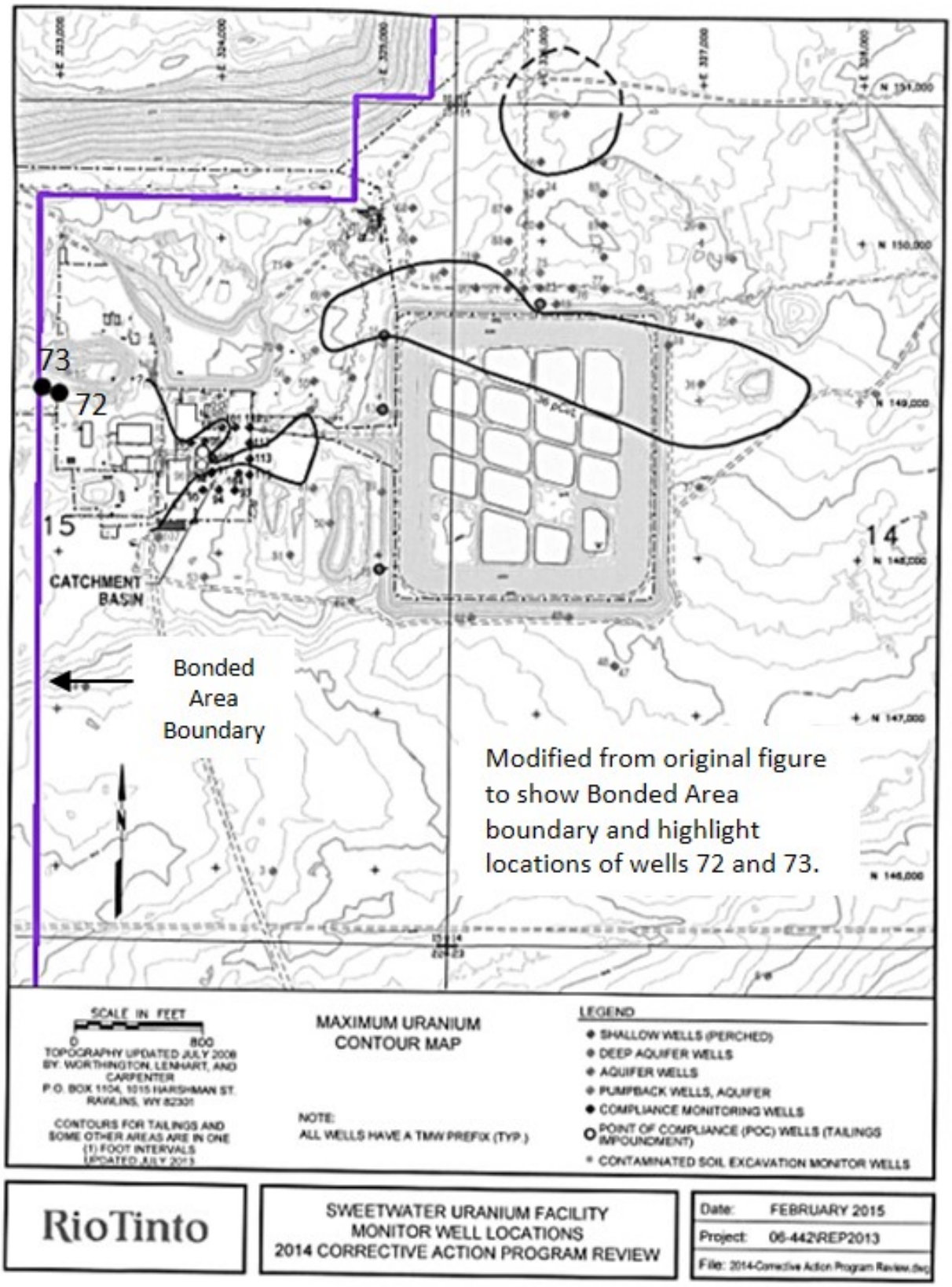

FIGURE 5. Maximum natural uranium 36 pCi/L-contour map for 2014.

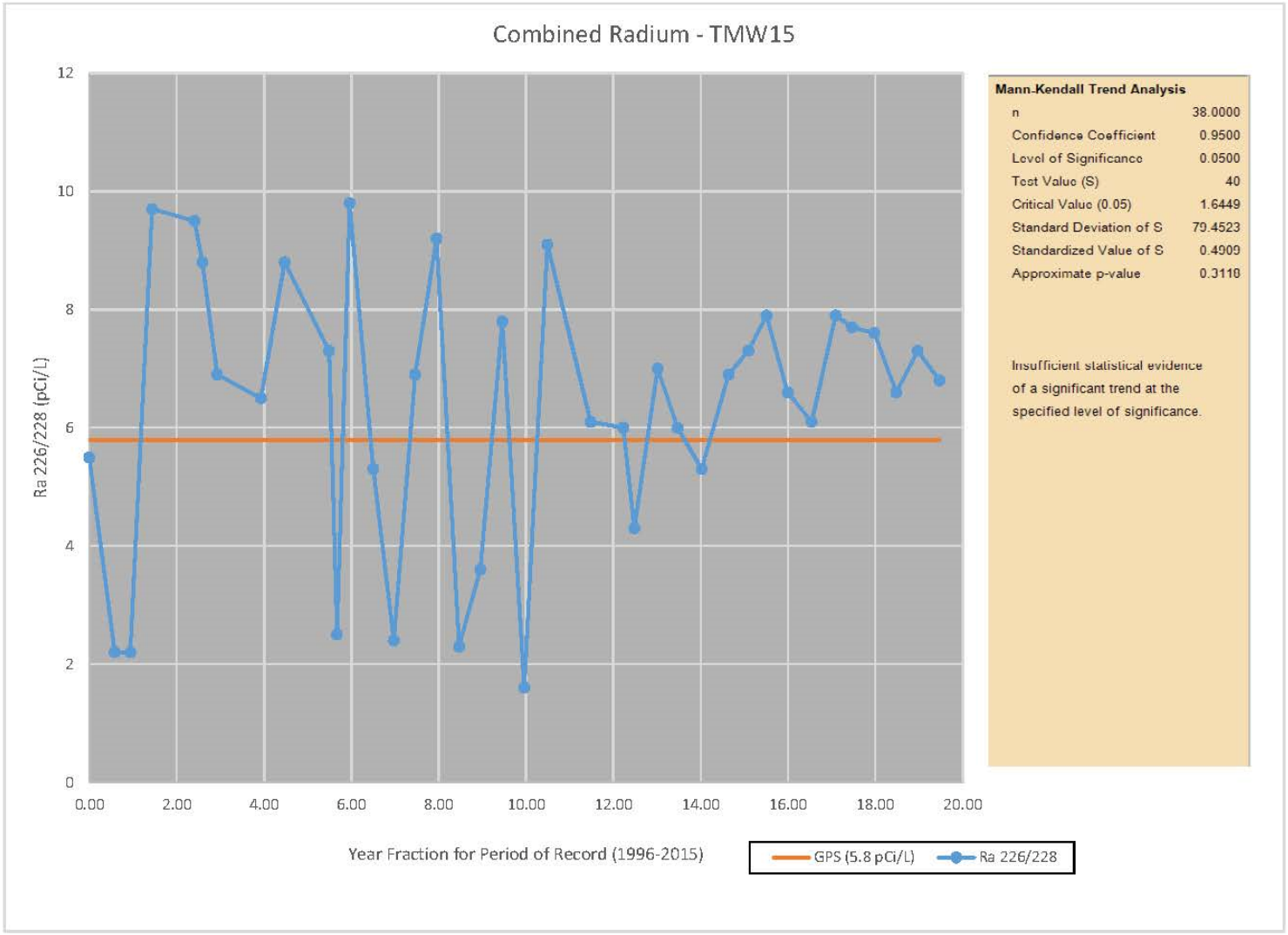

FIGURE 6. Time series of combined radium concentrations in monitoring well TMW15.

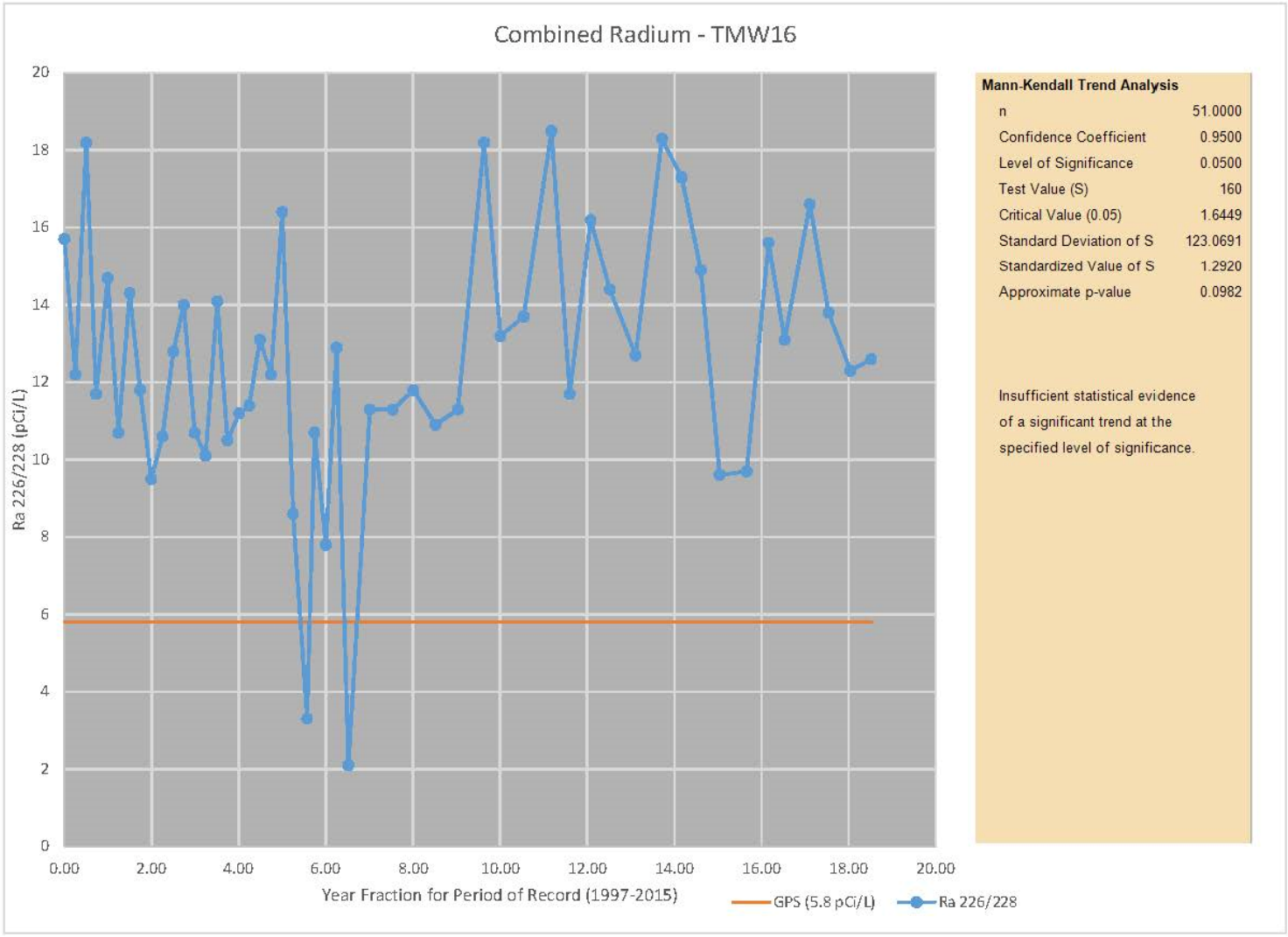

FIGURE 7. Time series of combined radium concentrations in monitoring well TMW16.

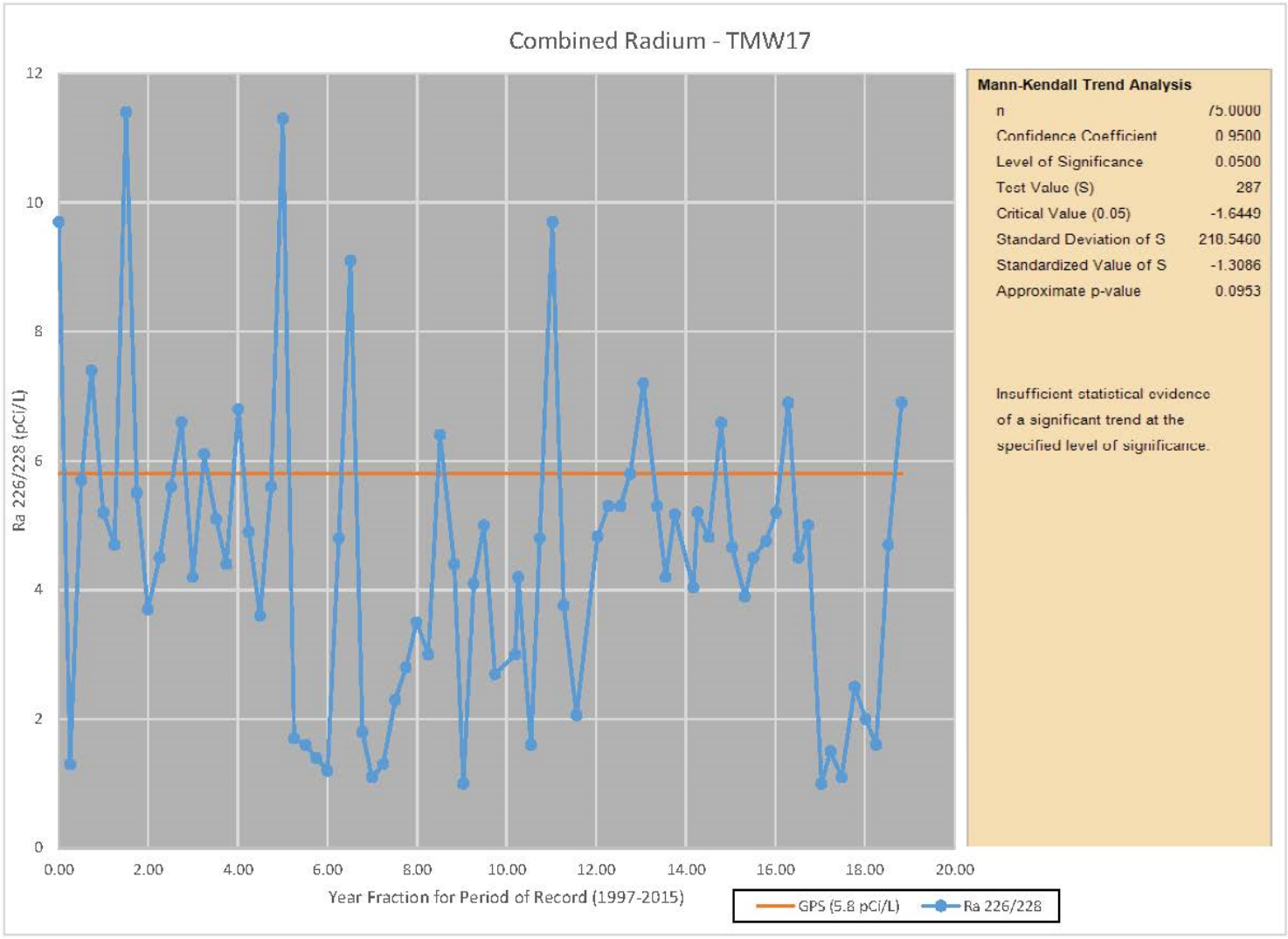

FIGURE 8. Time series of combined radium concentrations in monitoring well TMW17.

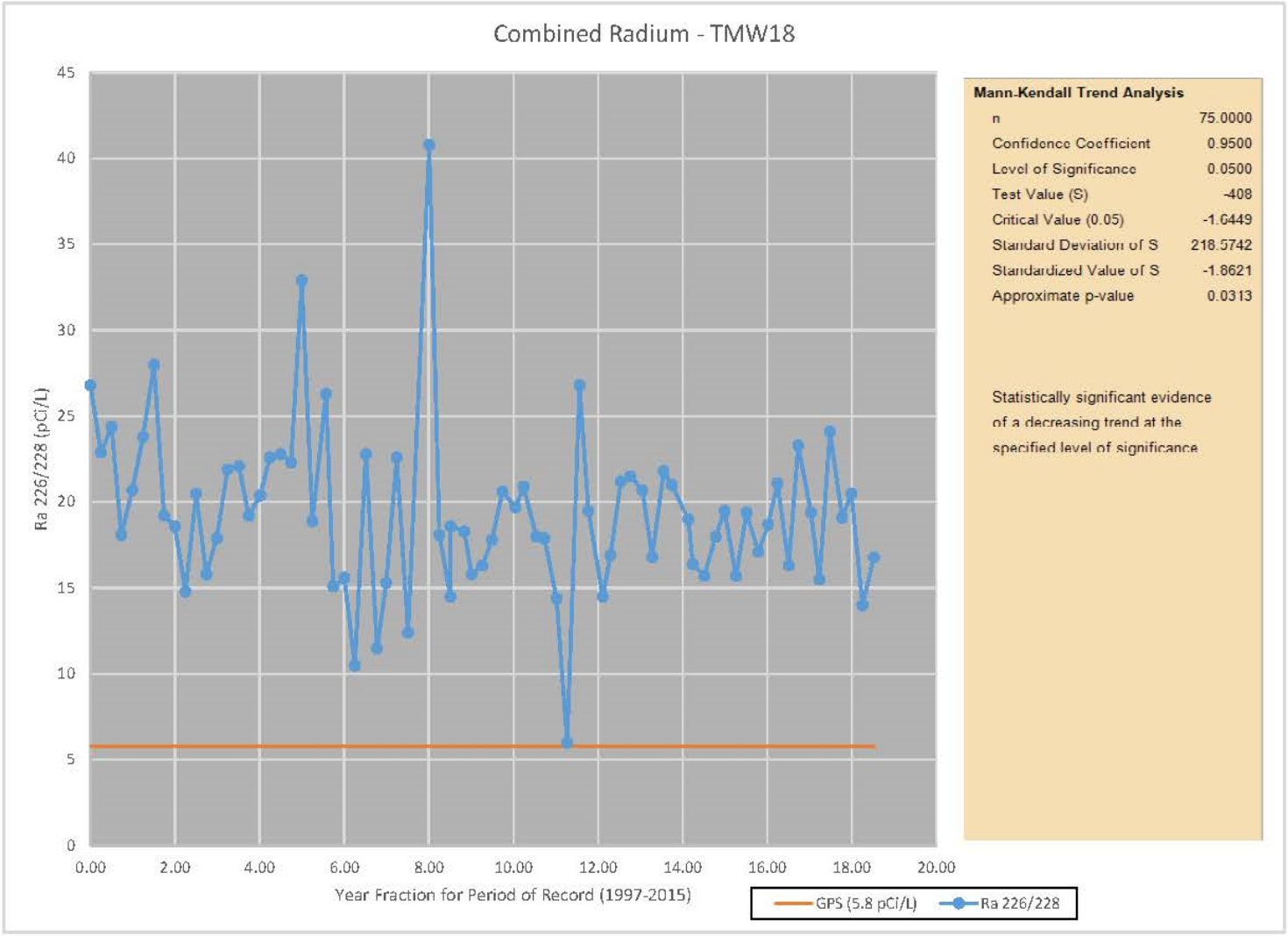

FIGURE 9. Time series of combined radium concentrations in monitoring well TMW18.

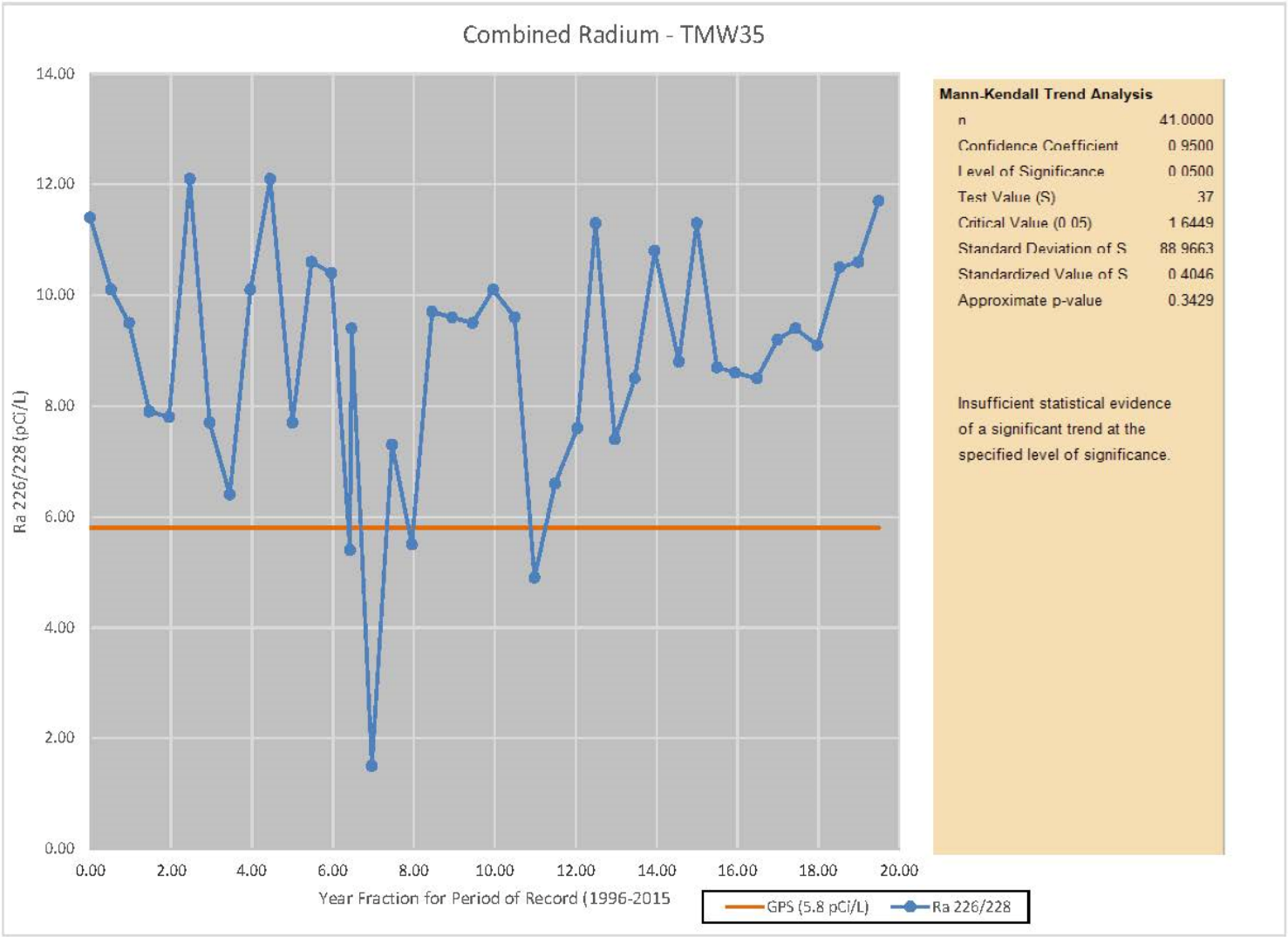

FIGURE 10. Time series of combined radium concentrations in monitoring well TMW35.

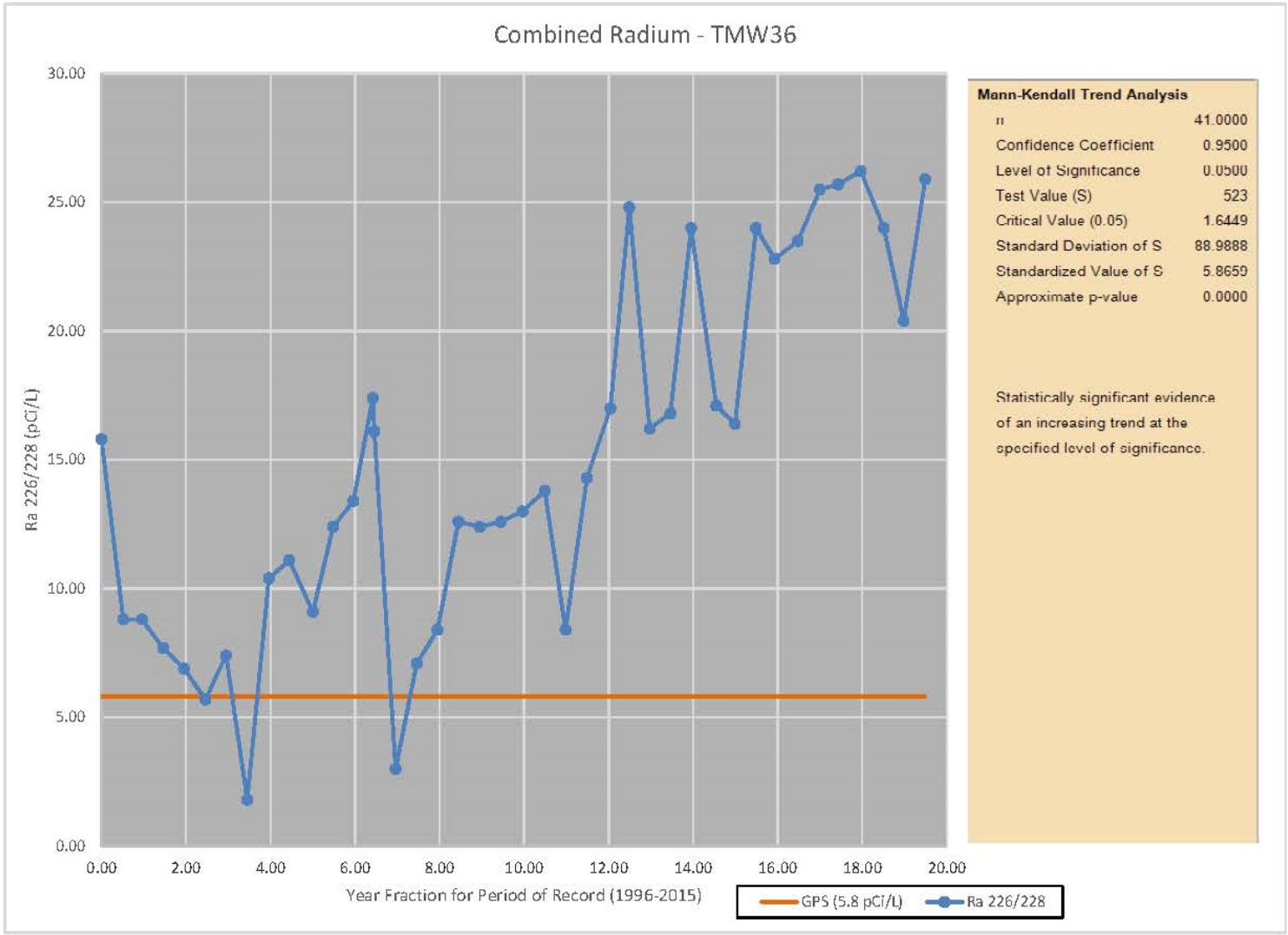

FIGURE 11. Time series of combined radium concentrations in monitoring well TMW36.

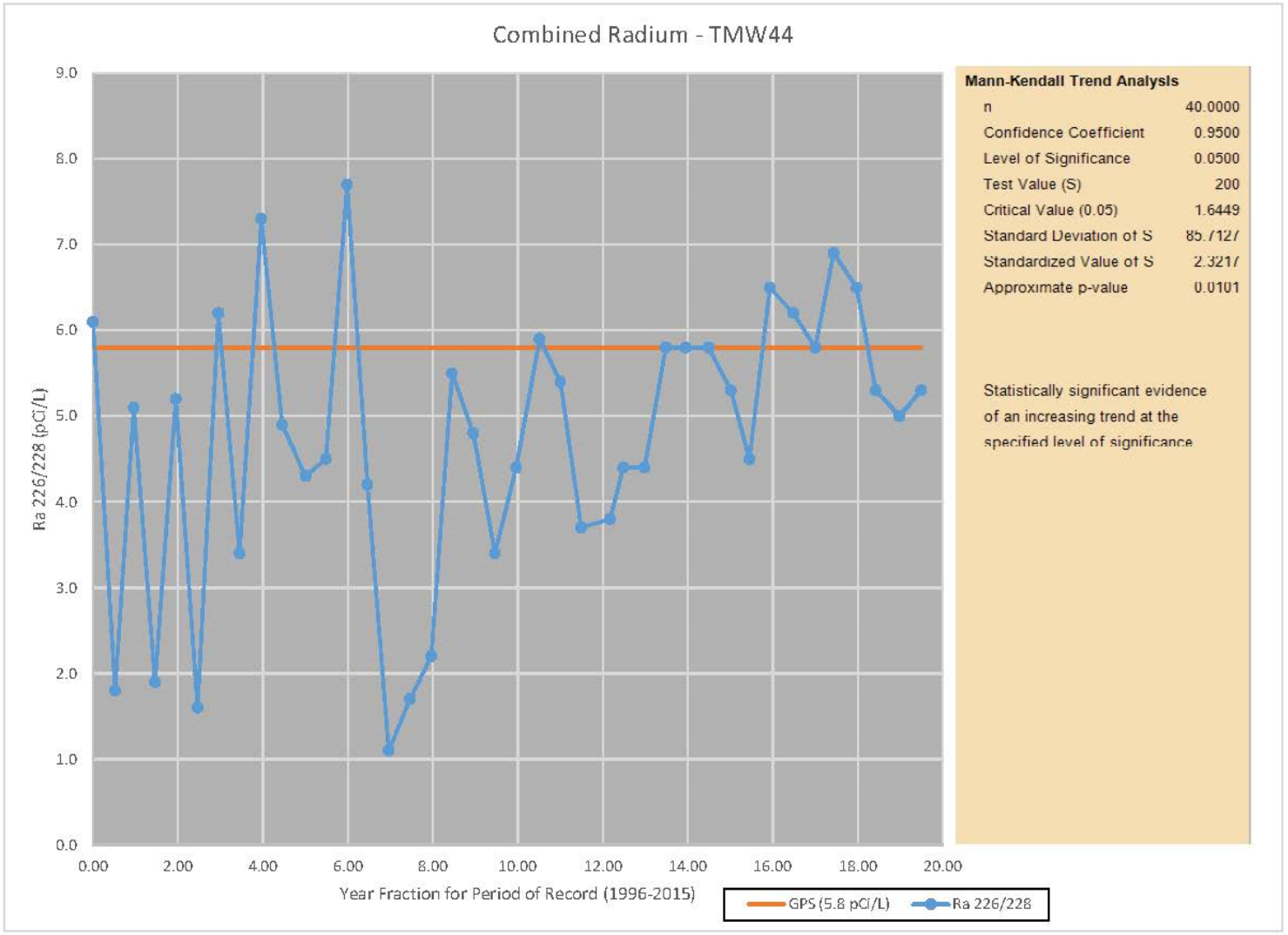

FIGURE 12. Time series of combined radium concentrations in monitoring well TMW44.

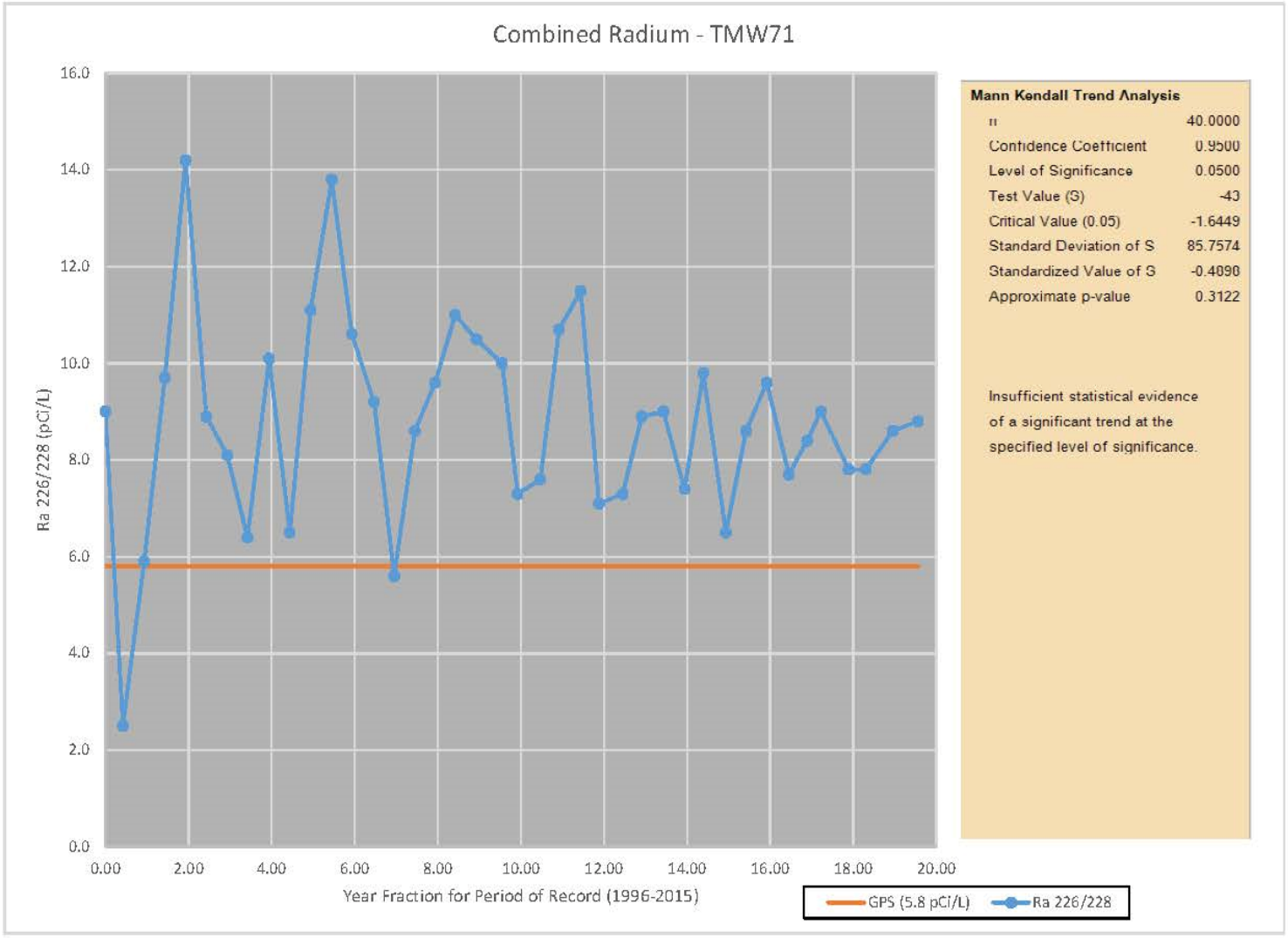

FIGURE 13. Time series of combined radium concentrations in monitoring well TMW71.

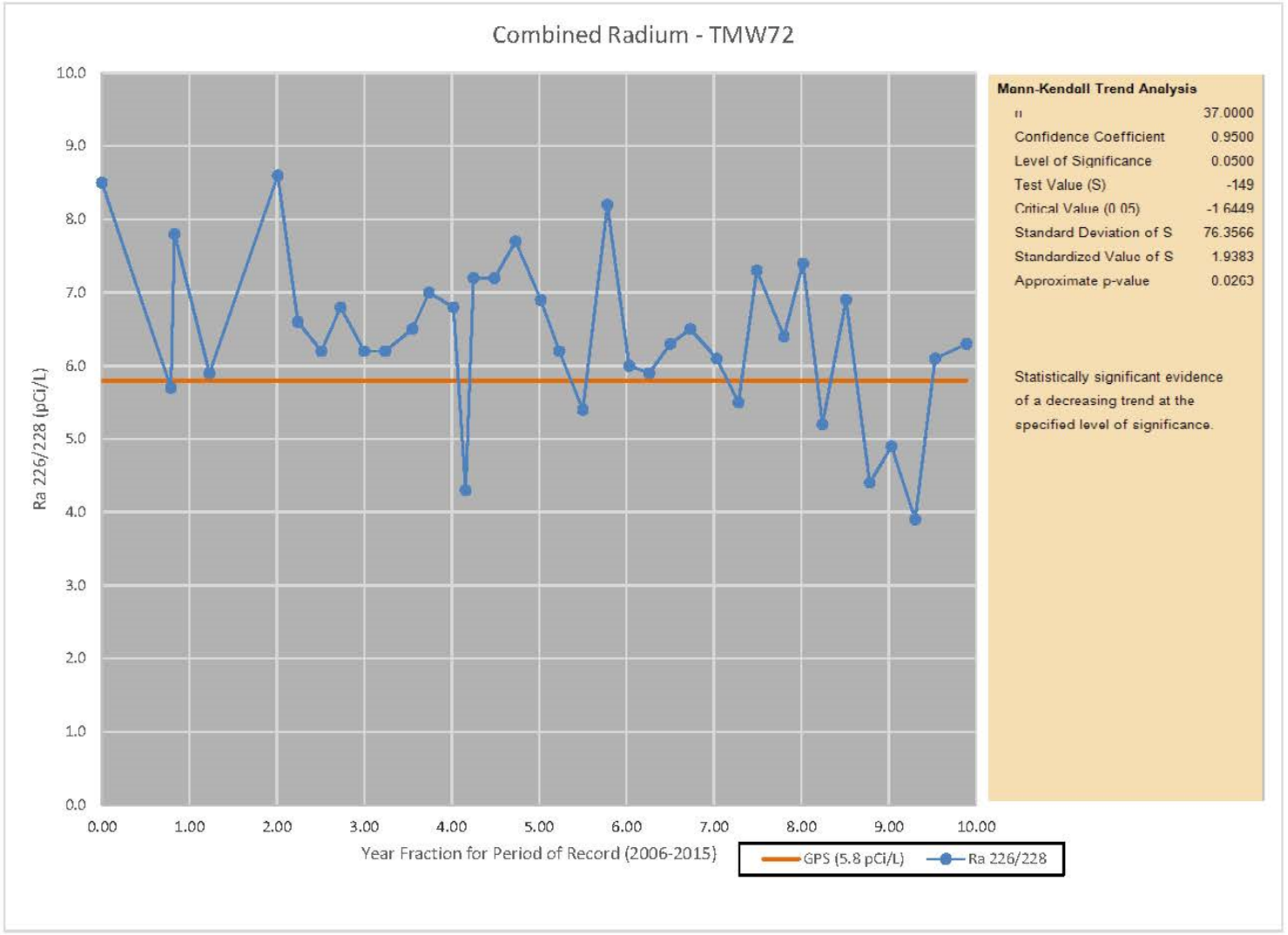

FIGURE 14. Time series of combined radium concentrations in monitoring well TMW72.

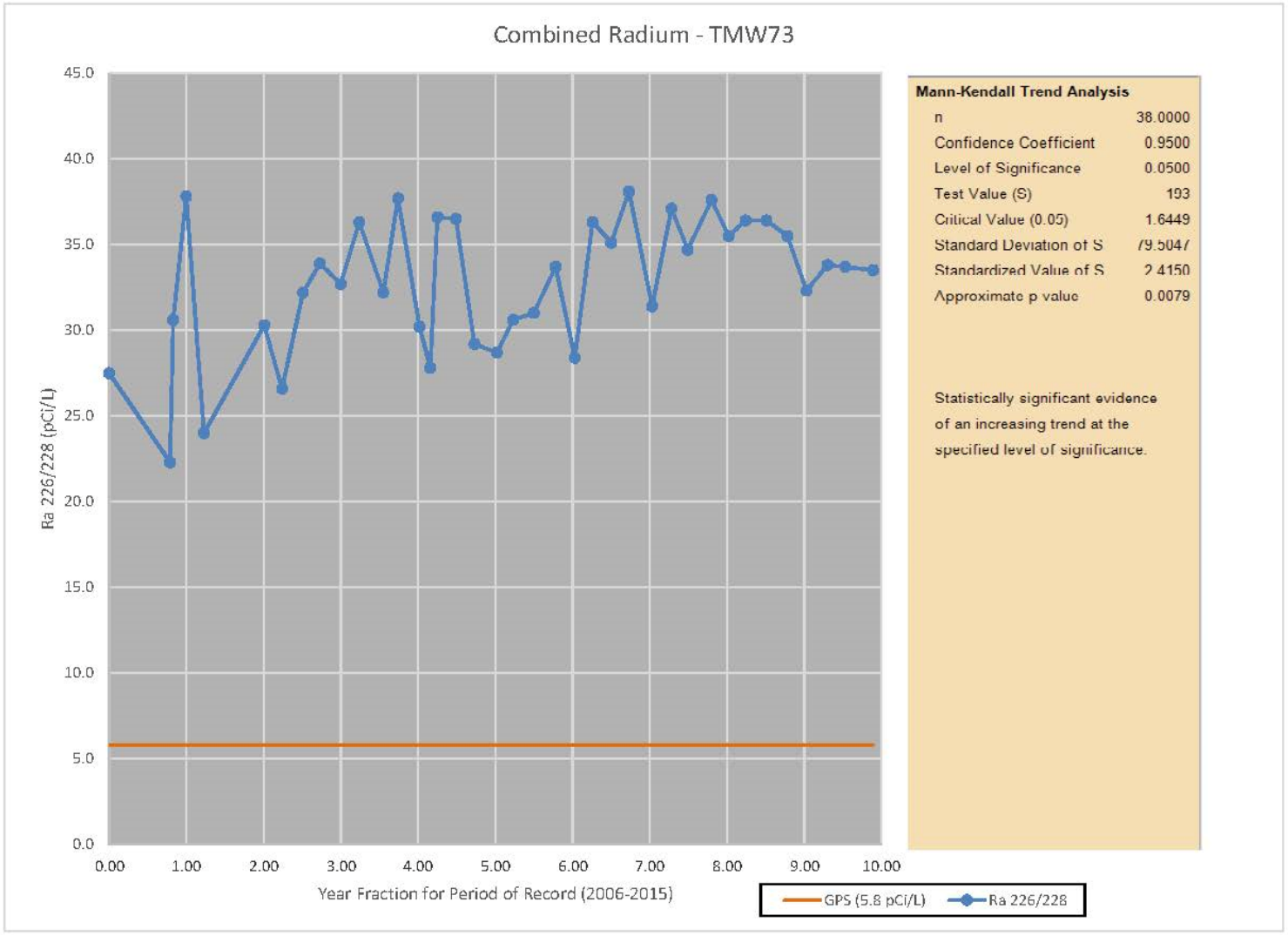

FIGURE 15. Time series of combined radium concentrations in monitoring well TMW73.

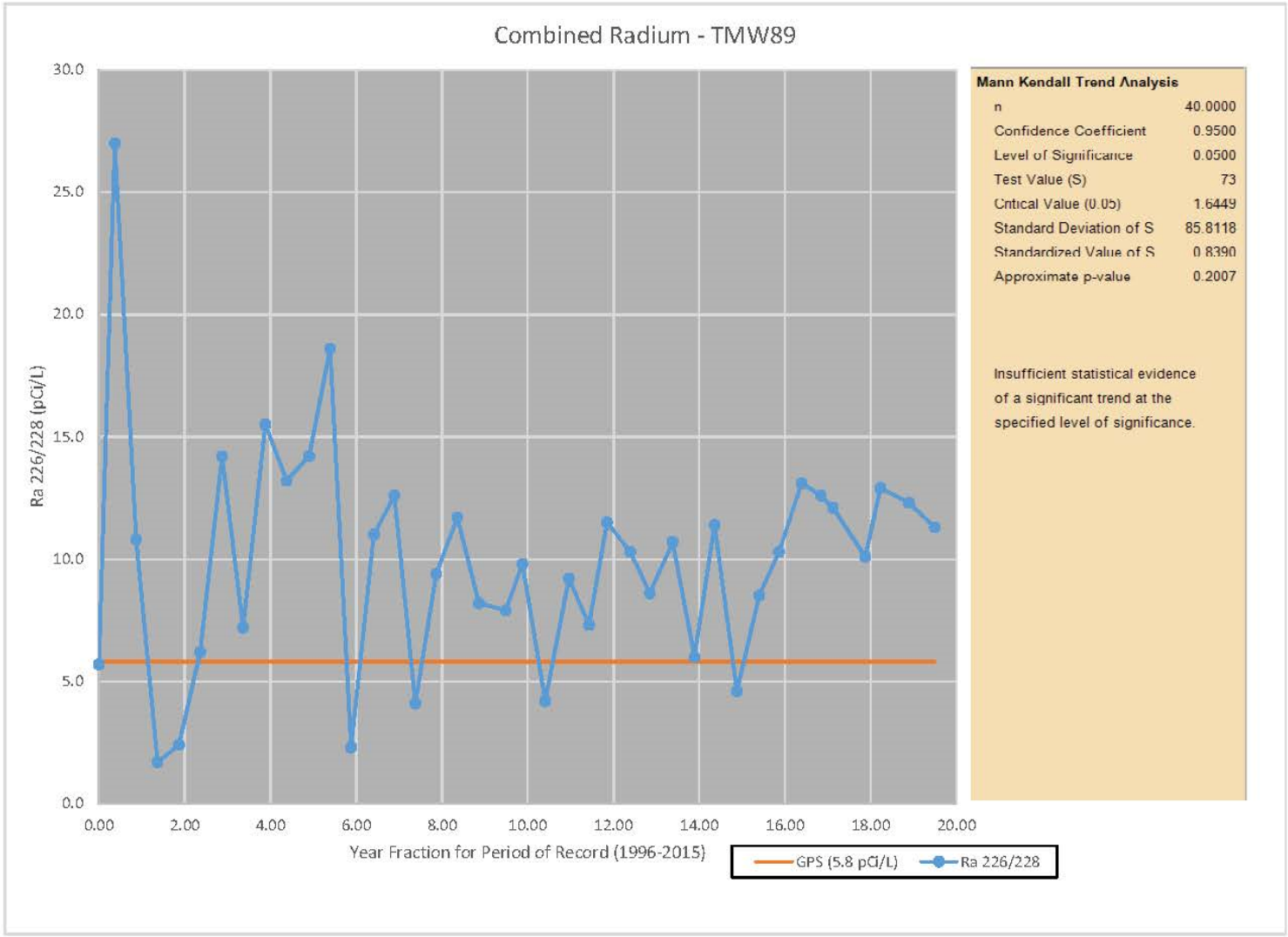

FIGURE 16. Time series of combined radium concentrations in monitoring well TMW89.

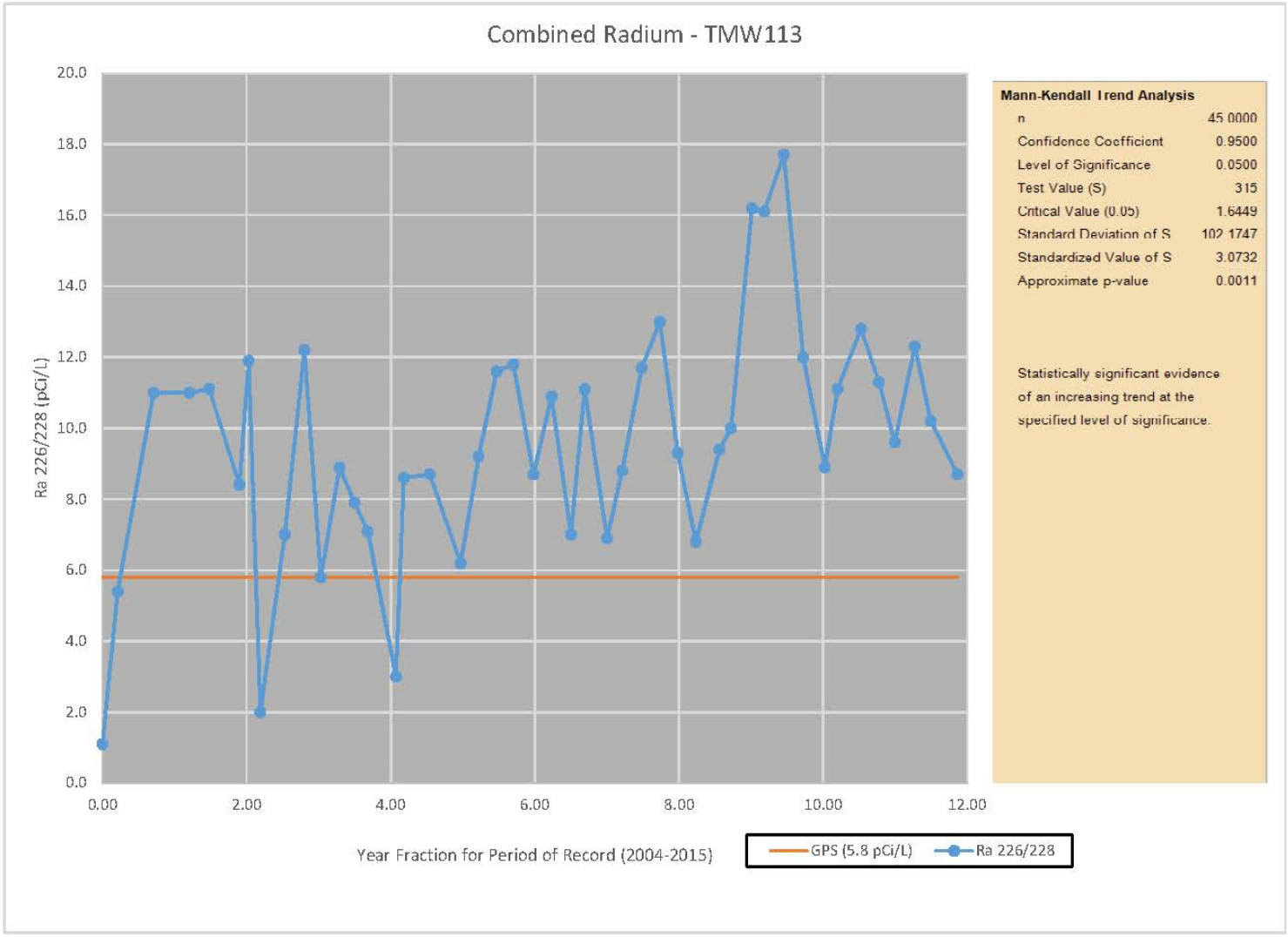

FIGURE 17. Time series of combined radium concentrations in monitoring well TMW113.

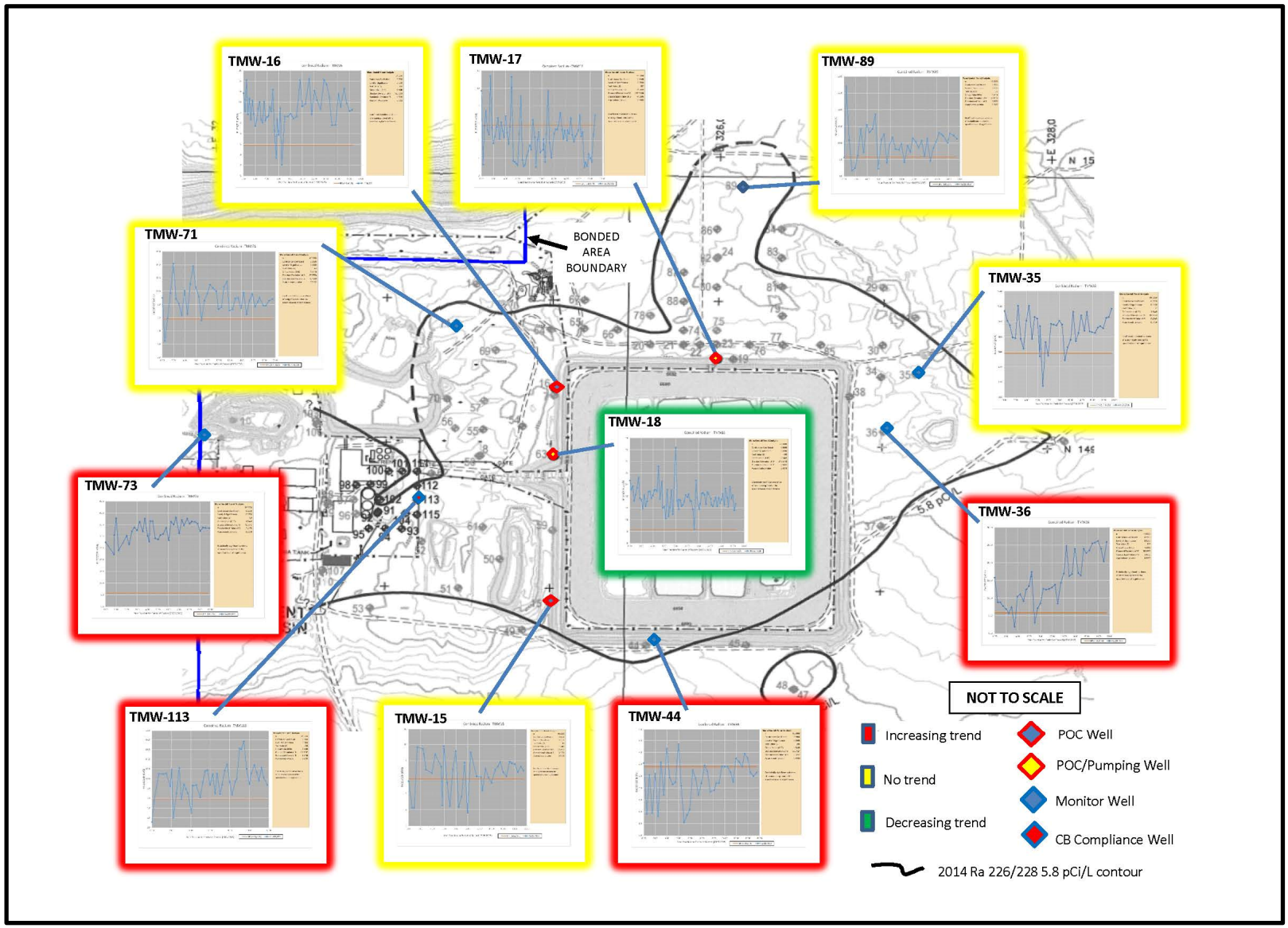

FIGURE 18. Synoptic view of Mann-Kendall trend analysis results for combined radium concentrations.

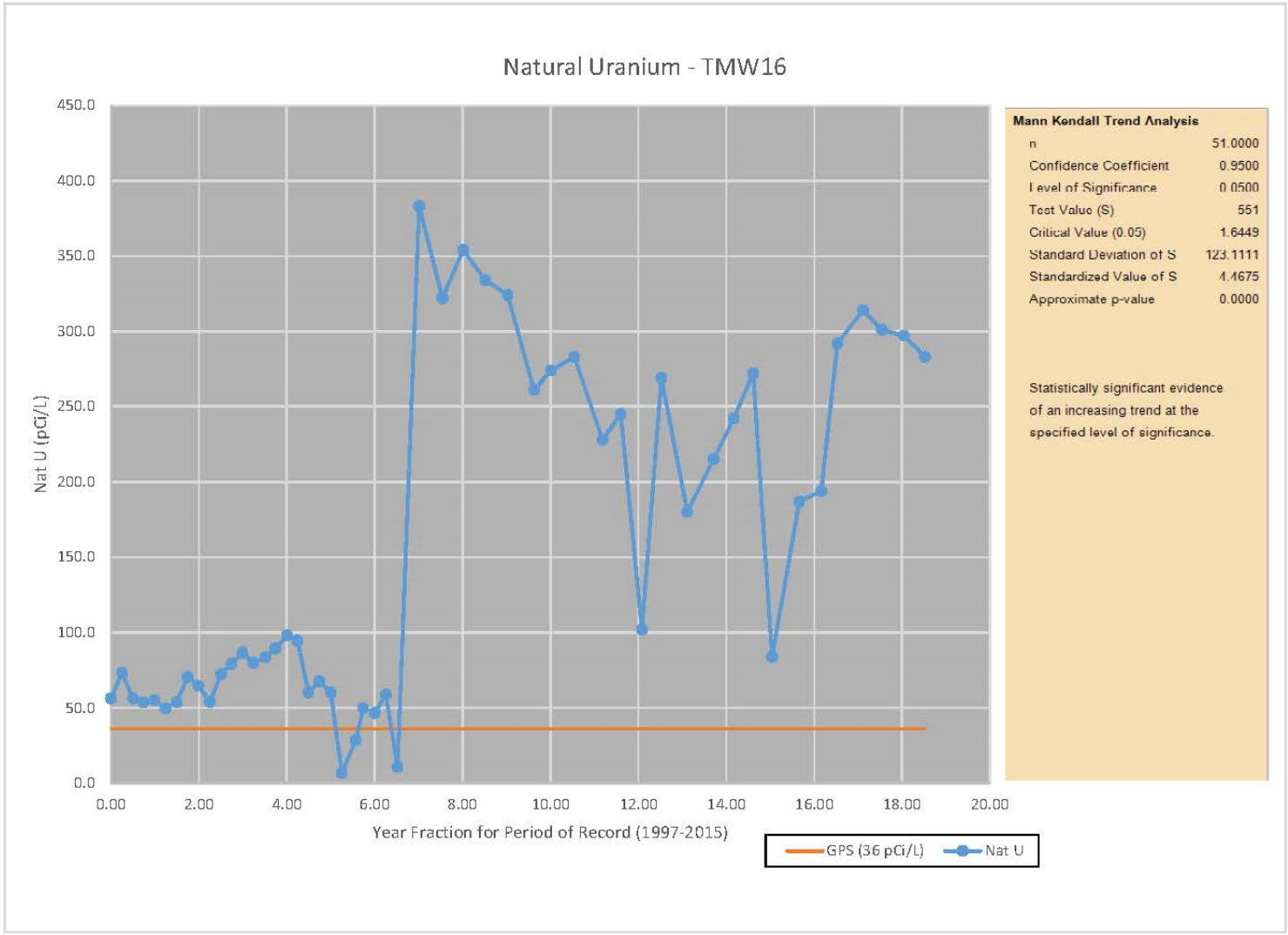

FIGURE 19. Time series of natural uranium concentrations in monitoring well TMW16.

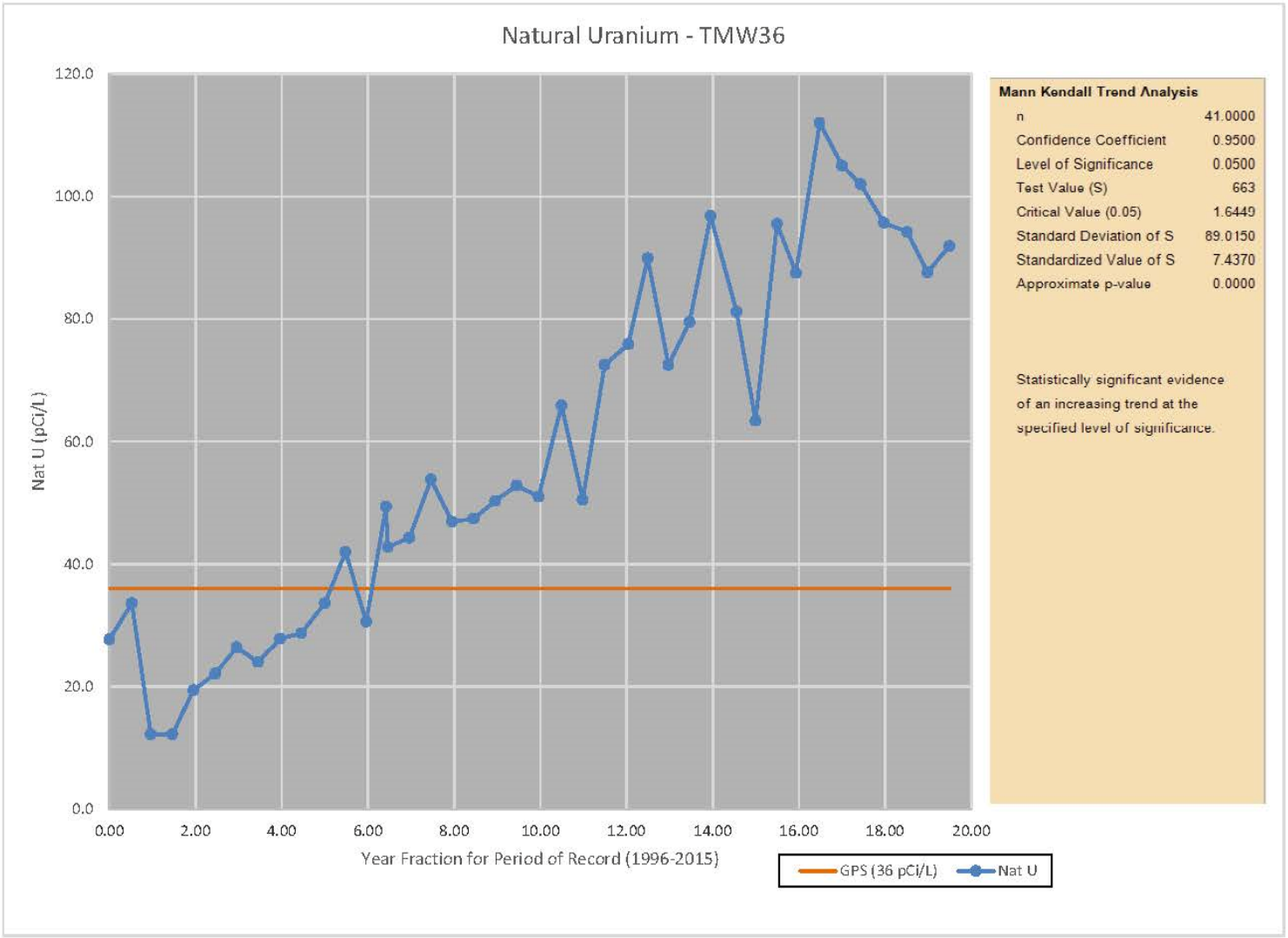

FIGURE 20. Time series of natural uranium concentrations in monitoring well TMW36.

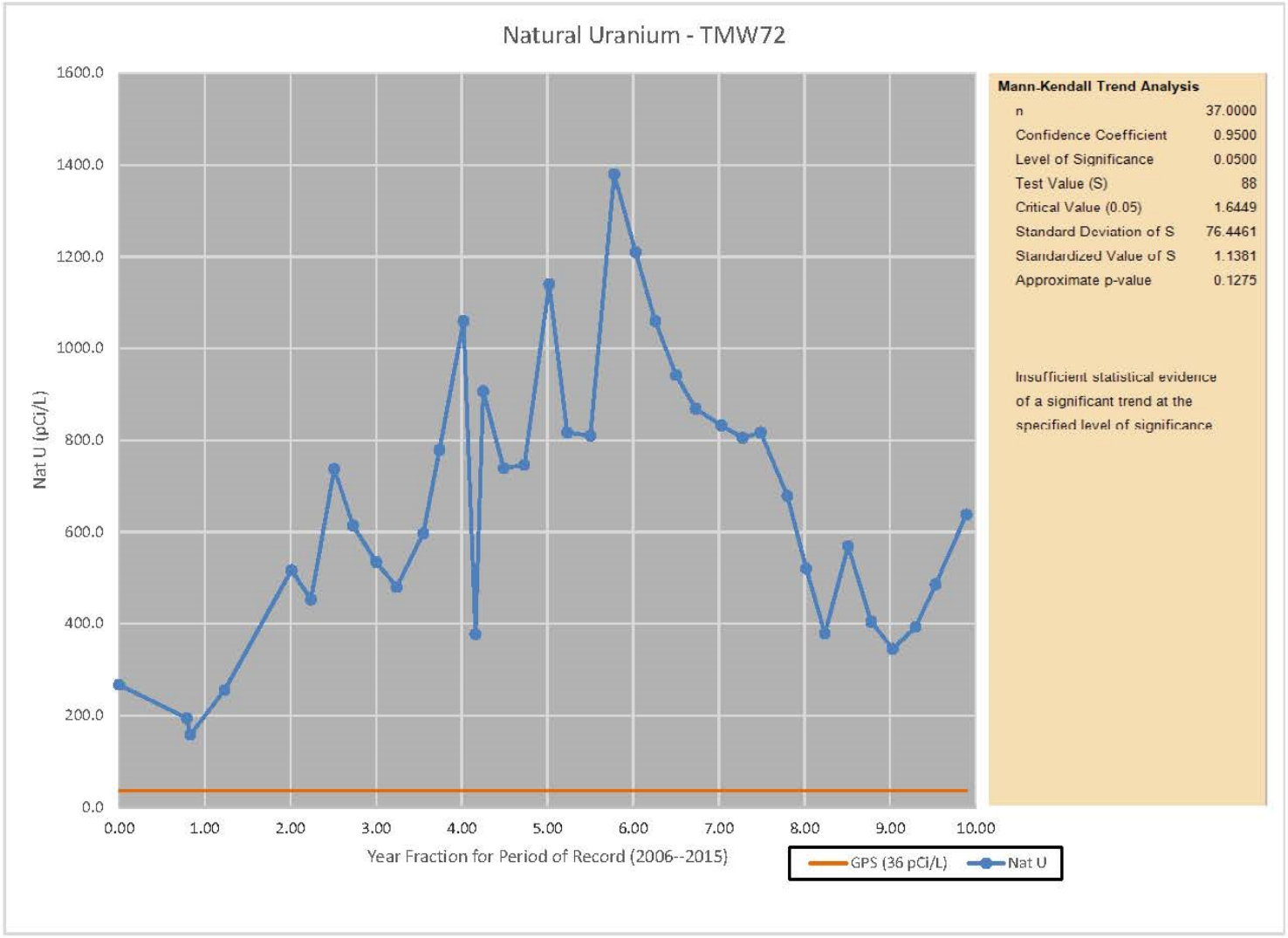

FIGURE 21. Time series of natural uranium concentrations in monitoring well TMW72.

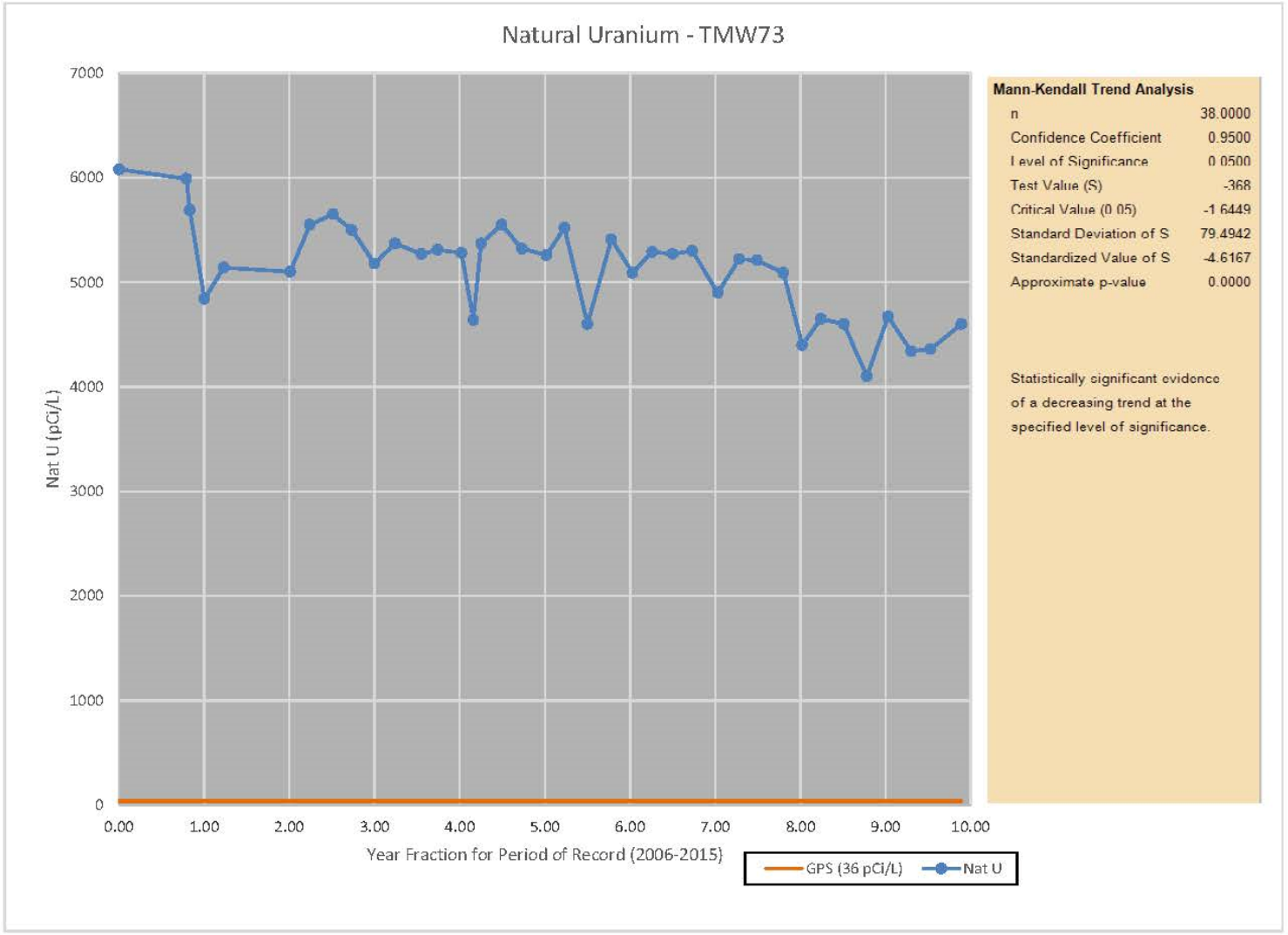

FIGURE 22. Time series of natural uranium concentrations in monitoring well TMW73.

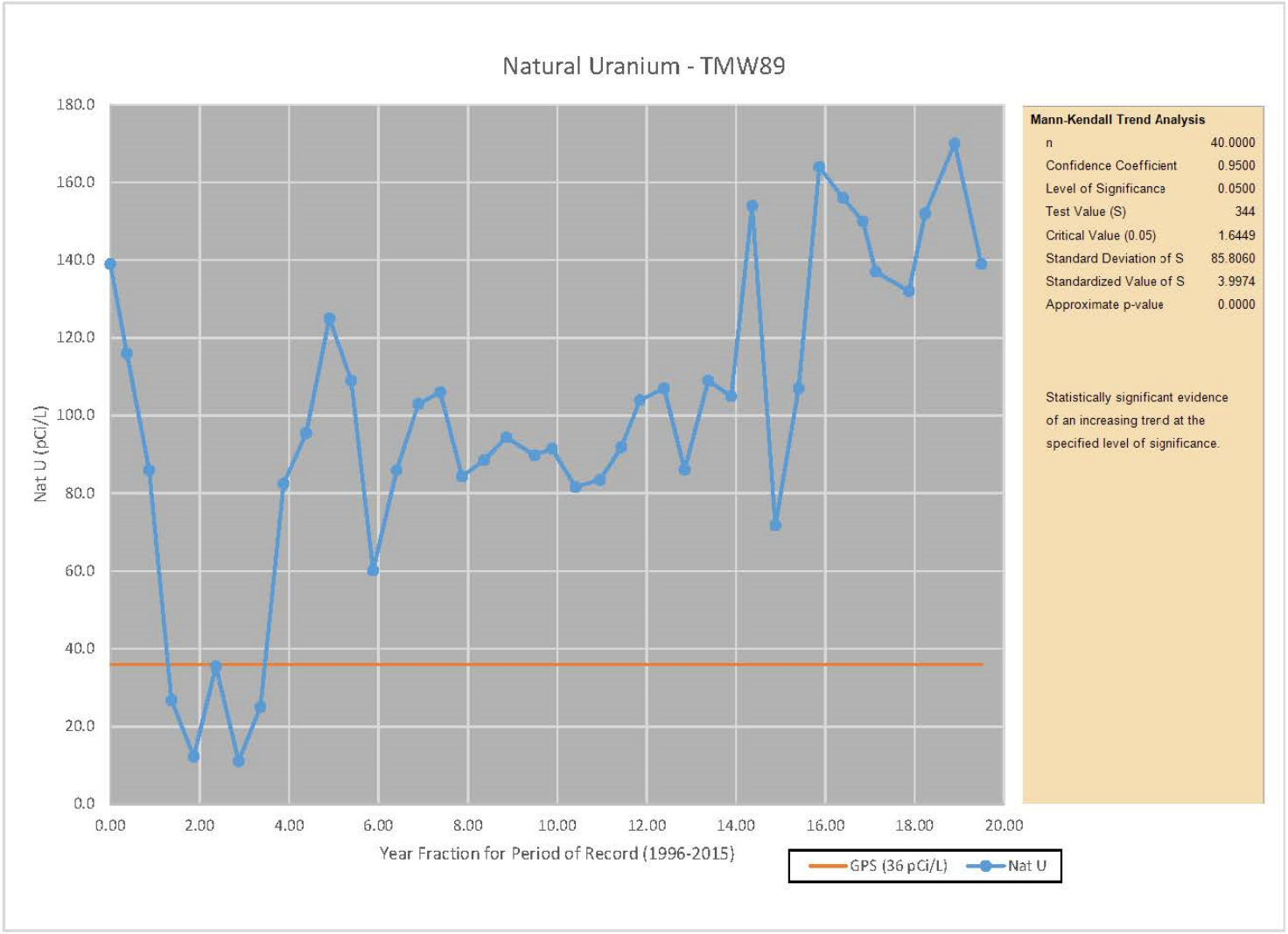

FIGURE 23. Time series of natural uranium concentrations in monitoring well TMW89.

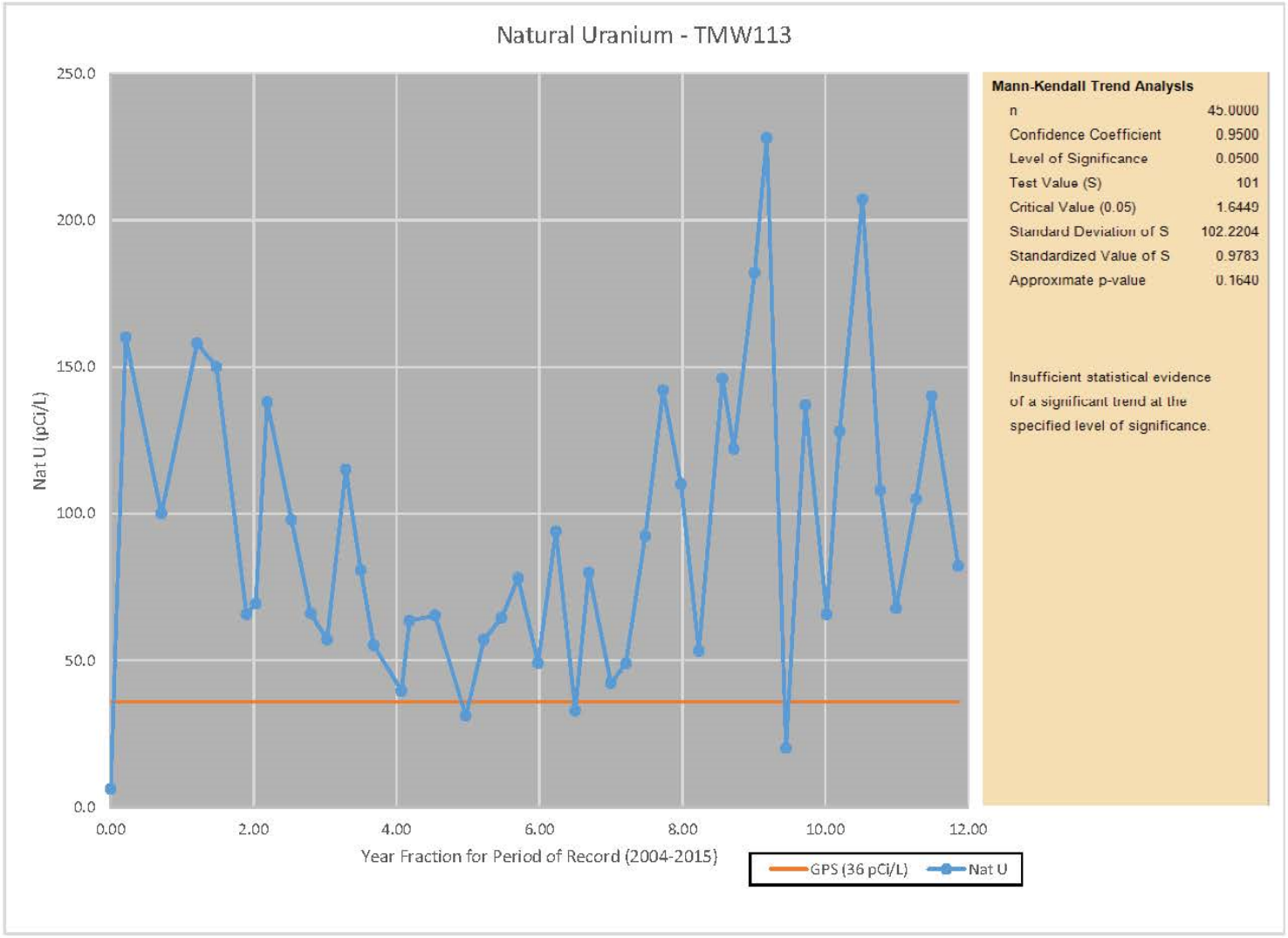

FIGURE 24. Time series of natural uranium concentrations in monitoring well TMW113.

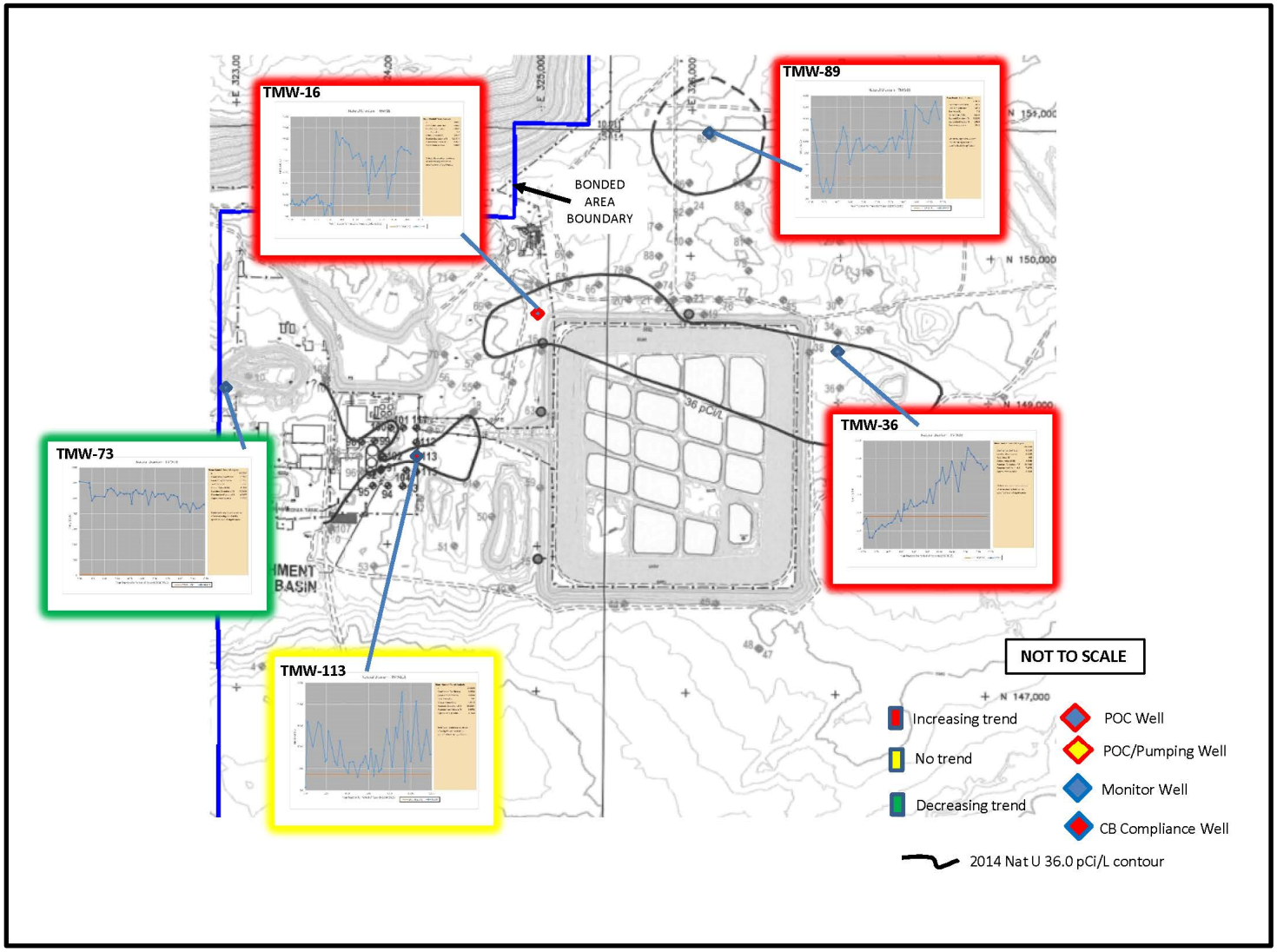

FIGURE 25. Synoptic view of Mann-Kendall trend analysis results for natural uranium concentrations.

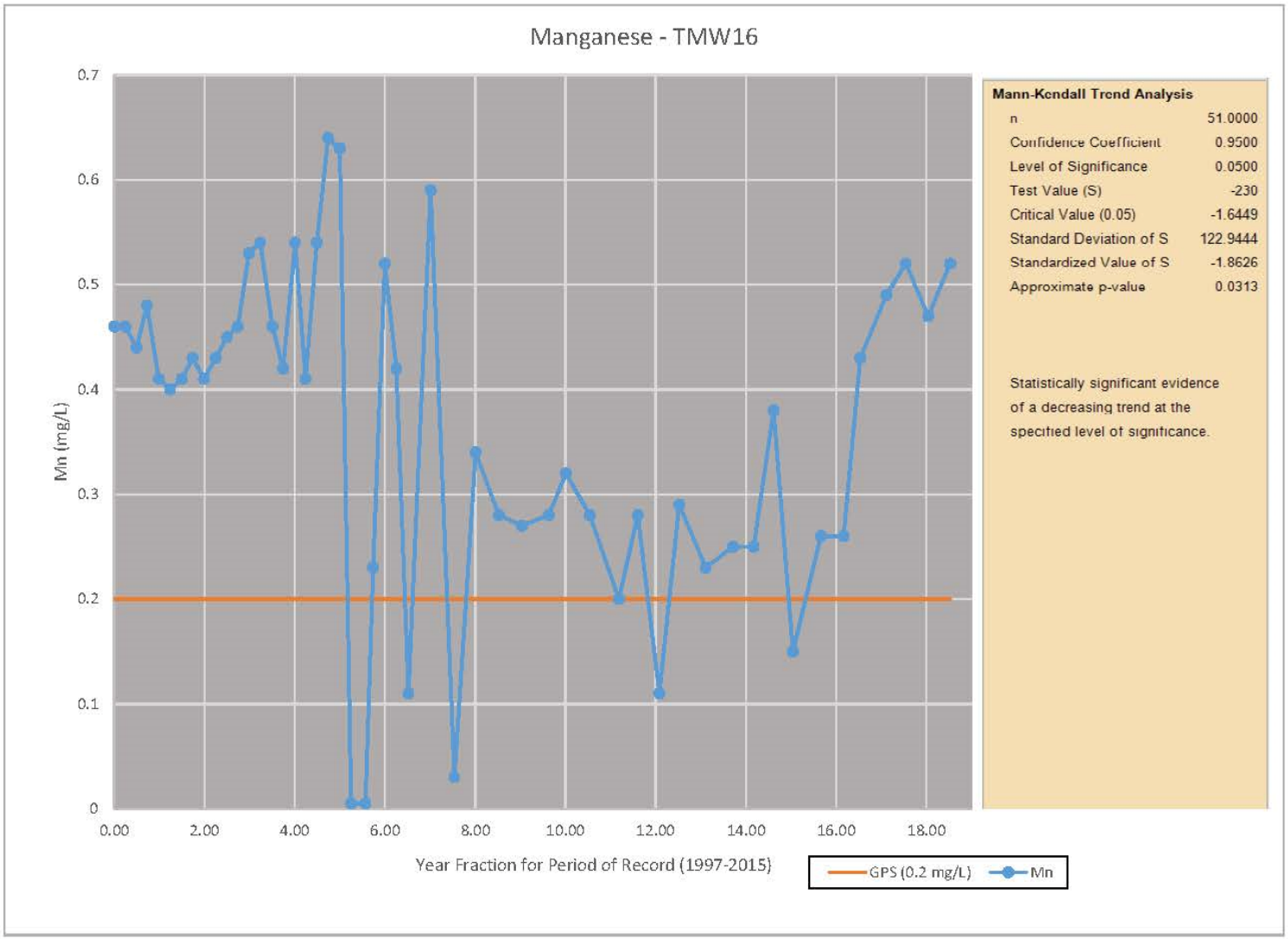

FIGURE 26. Time series of manganese concentrations in monitoring well TMW16.

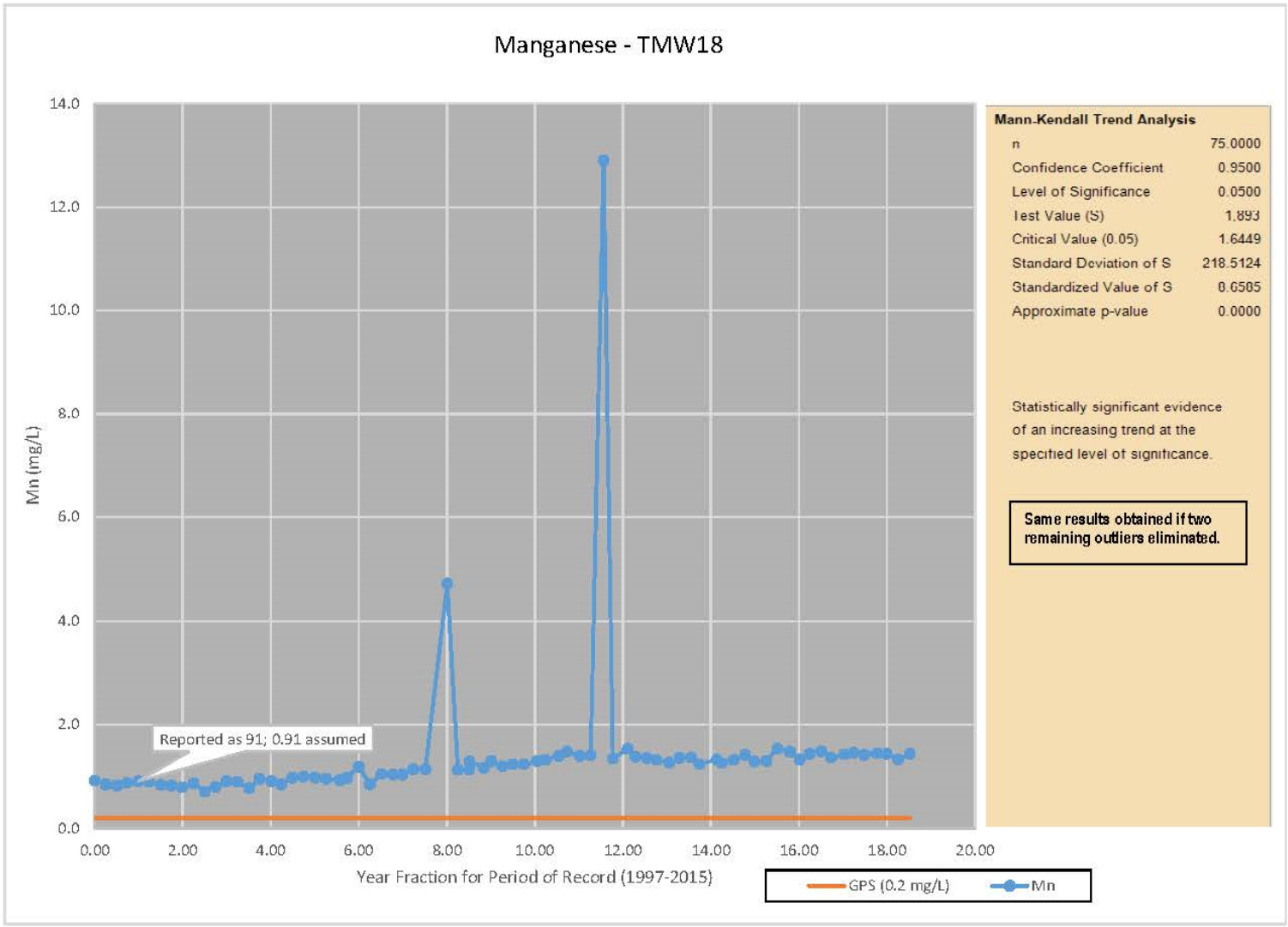

FIGURE 27. Time series of manganese concentrations in monitoring well TMW18.

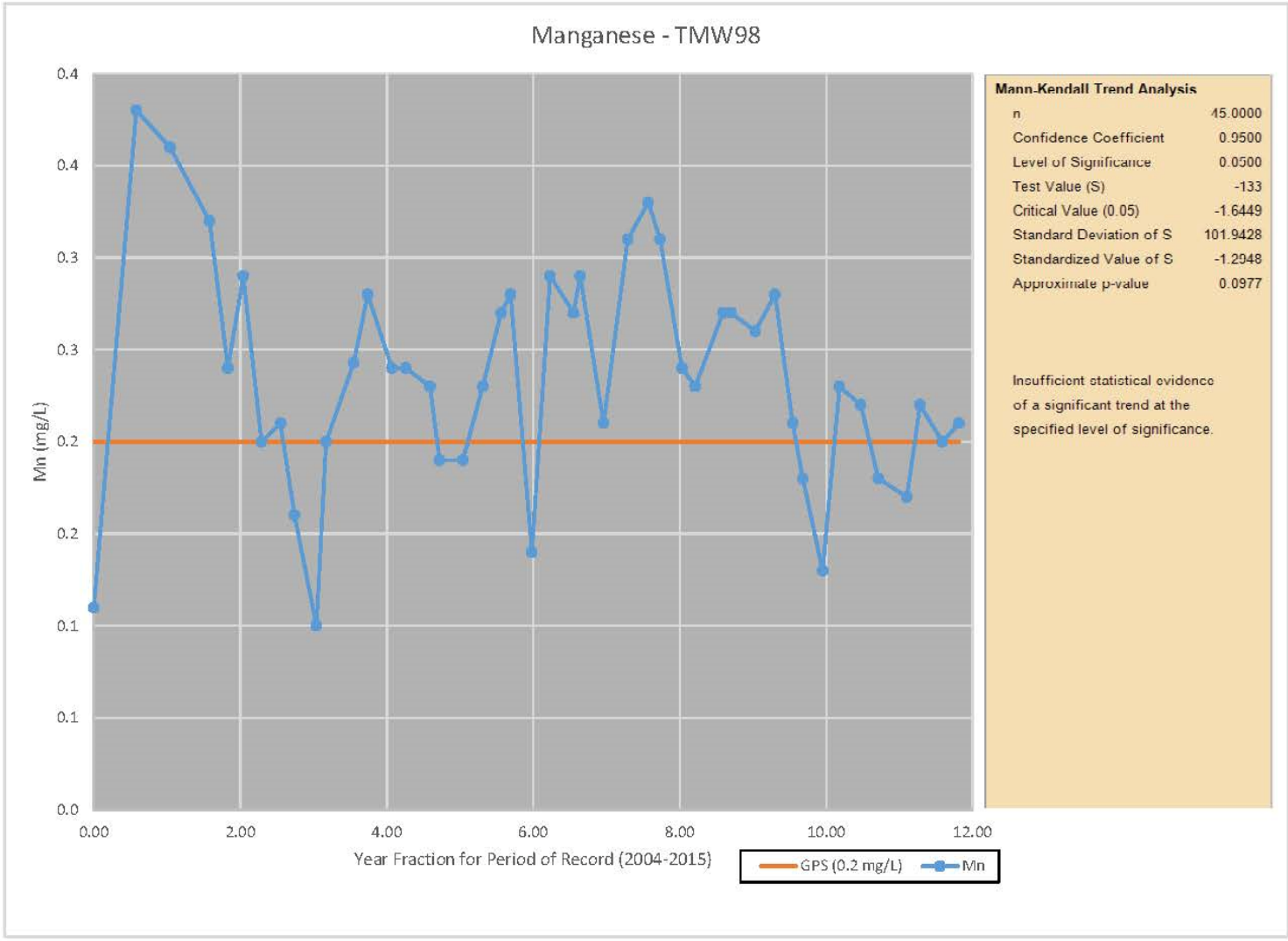

FIGURE 28. Time series of manganese concentrations in monitoring well TMW98

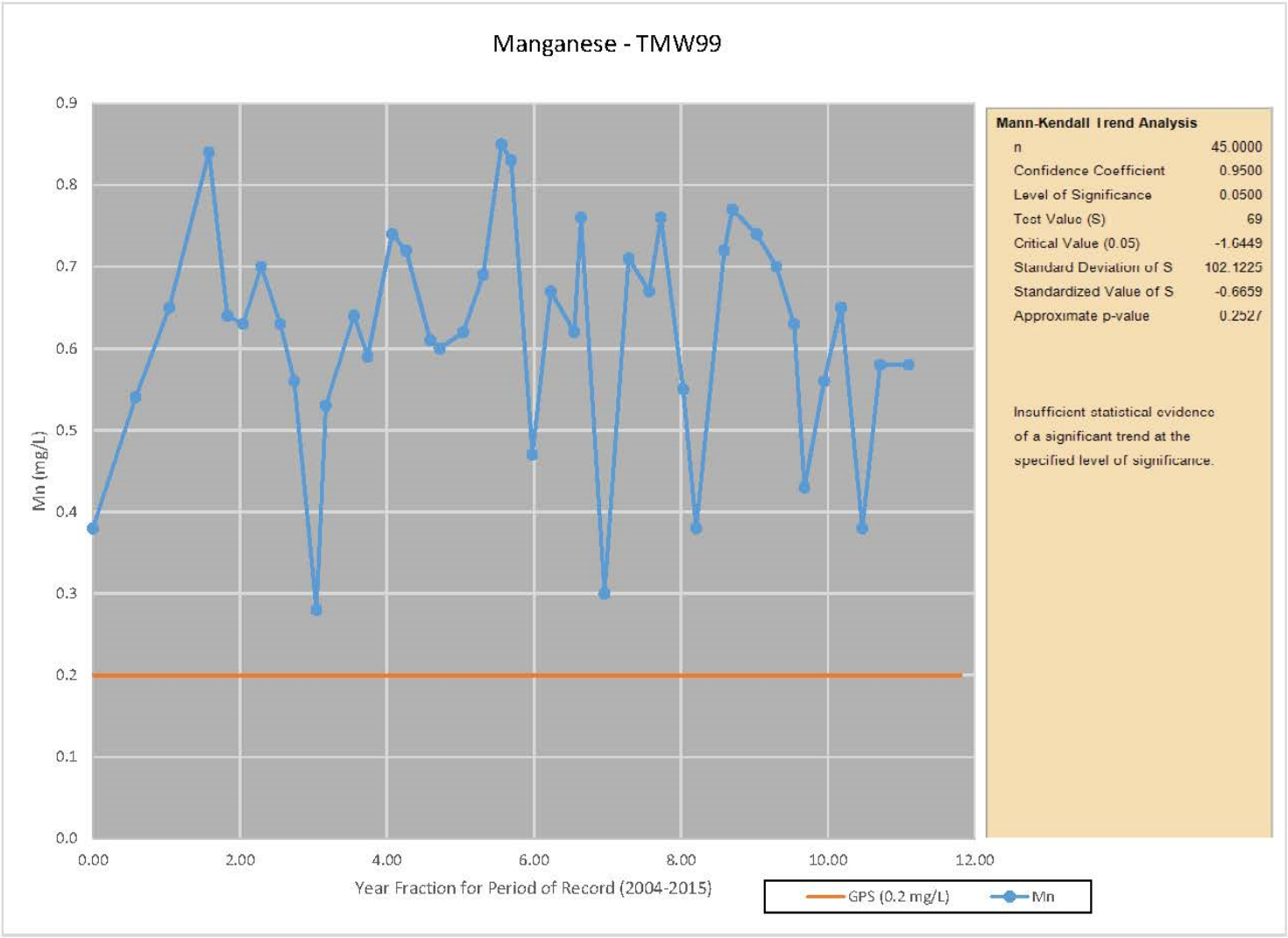

FIGURE 29. Time series of manganese concentrations in monitoring well TMW99.

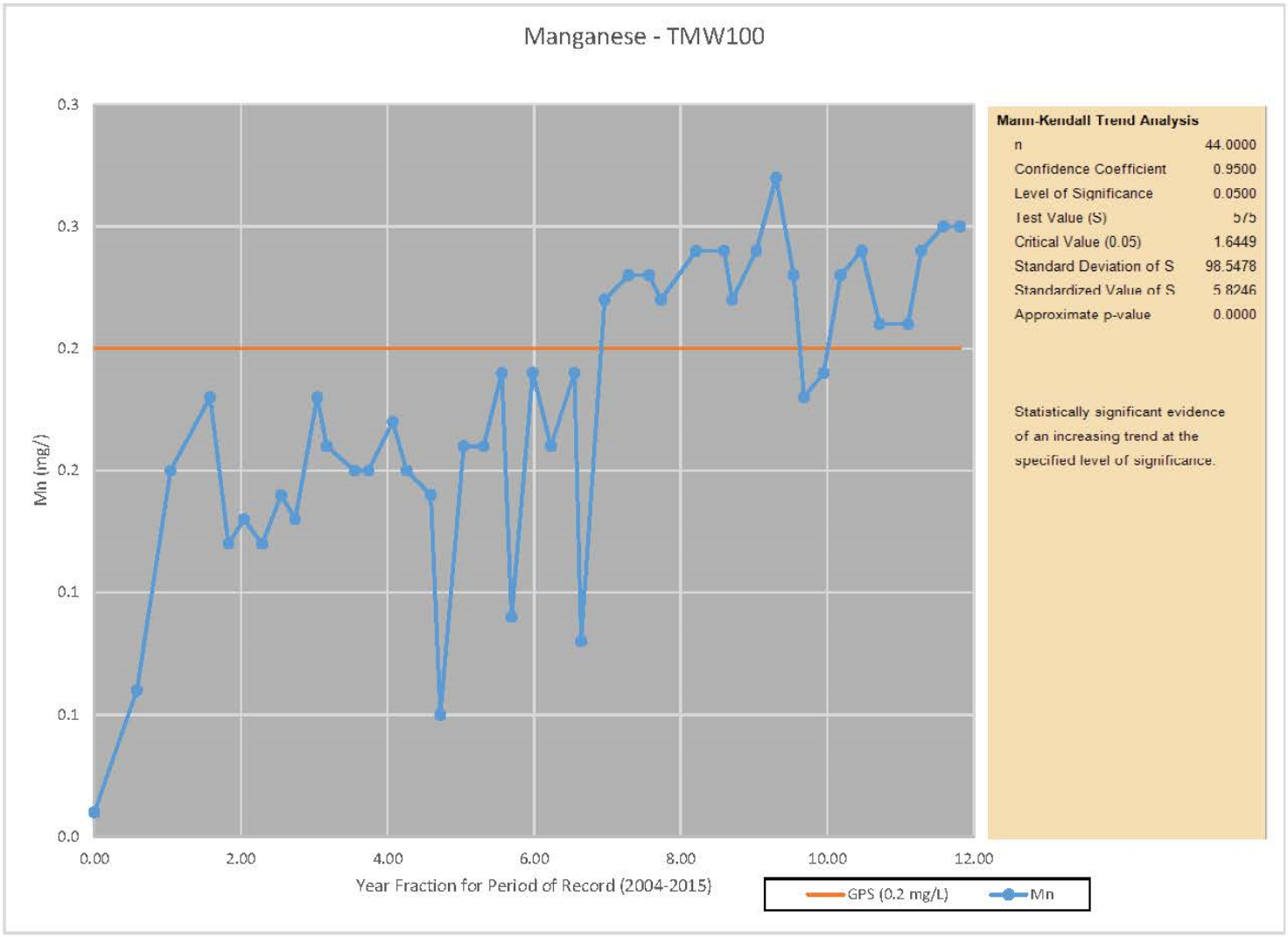

FIGURE 30. Time series of manganese concentrations in monitoring well TMW100.

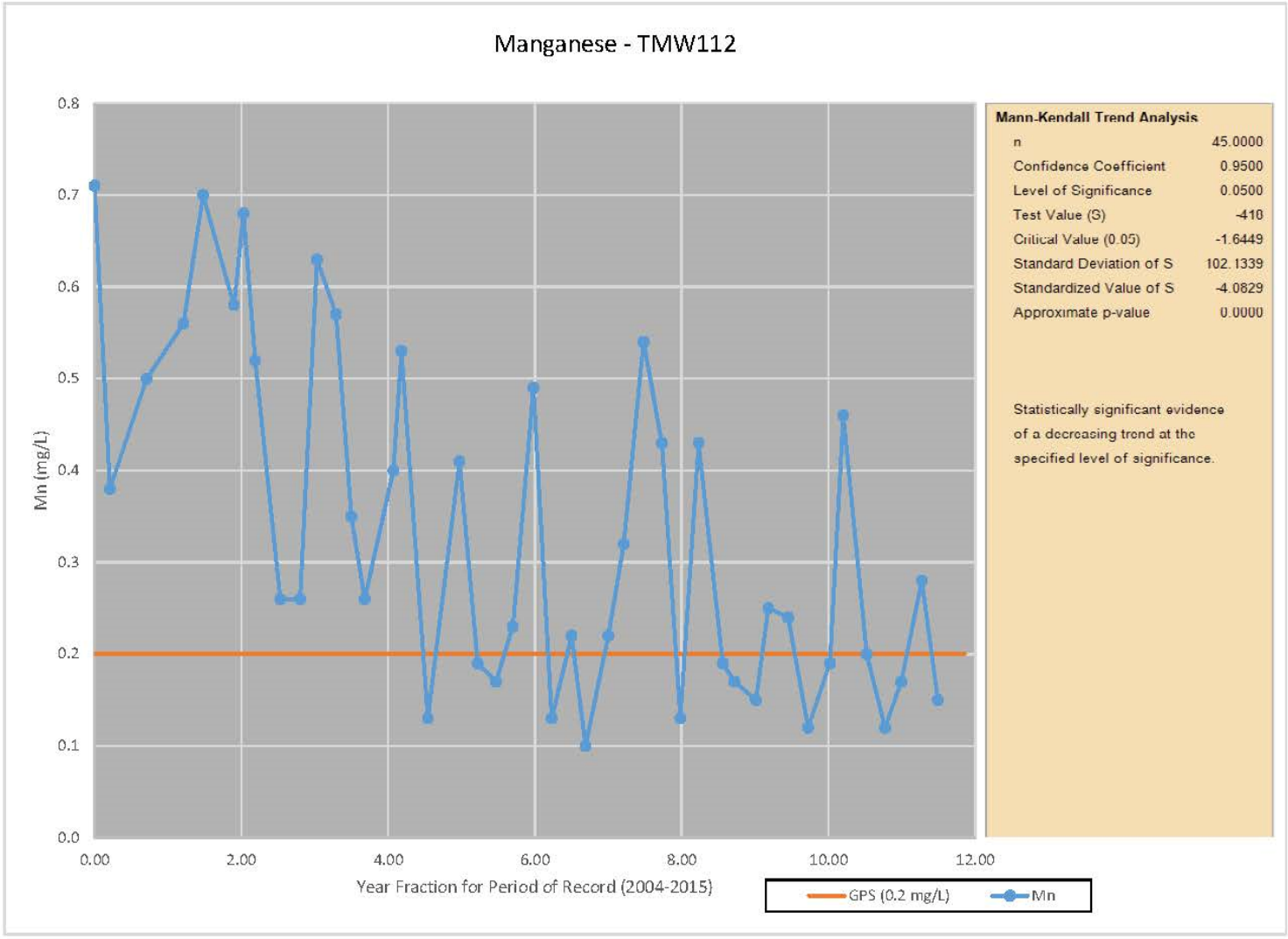

FIGURE 30. Time series of manganese concentrations in monitoring well TMW112.

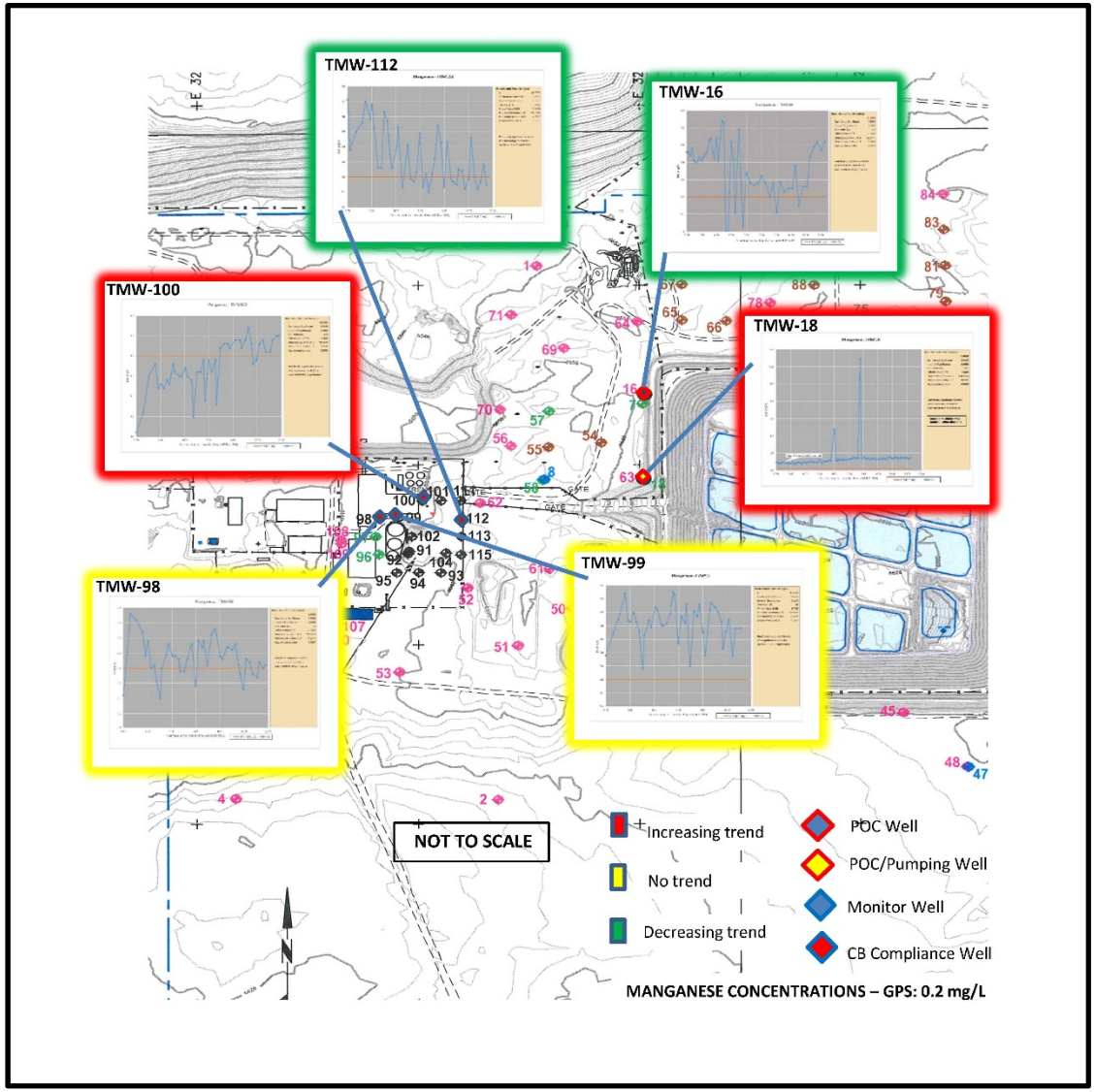

FIGURE 31. Synoptic view of Mann-Kendall trend analysis results for manganese concentrations.

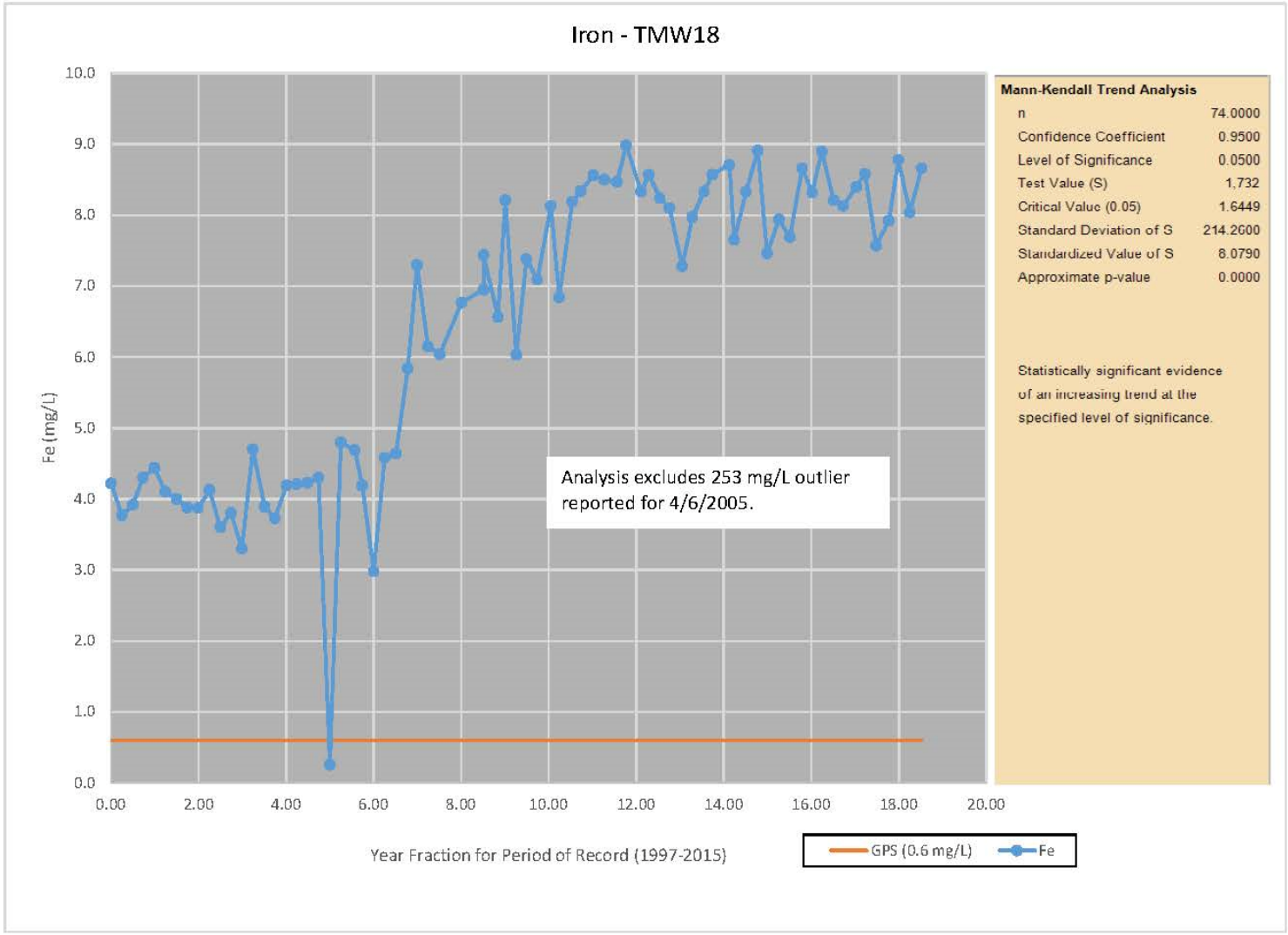

FIGURE 33. Time series of iron concentrations in monitoring well TMW18.

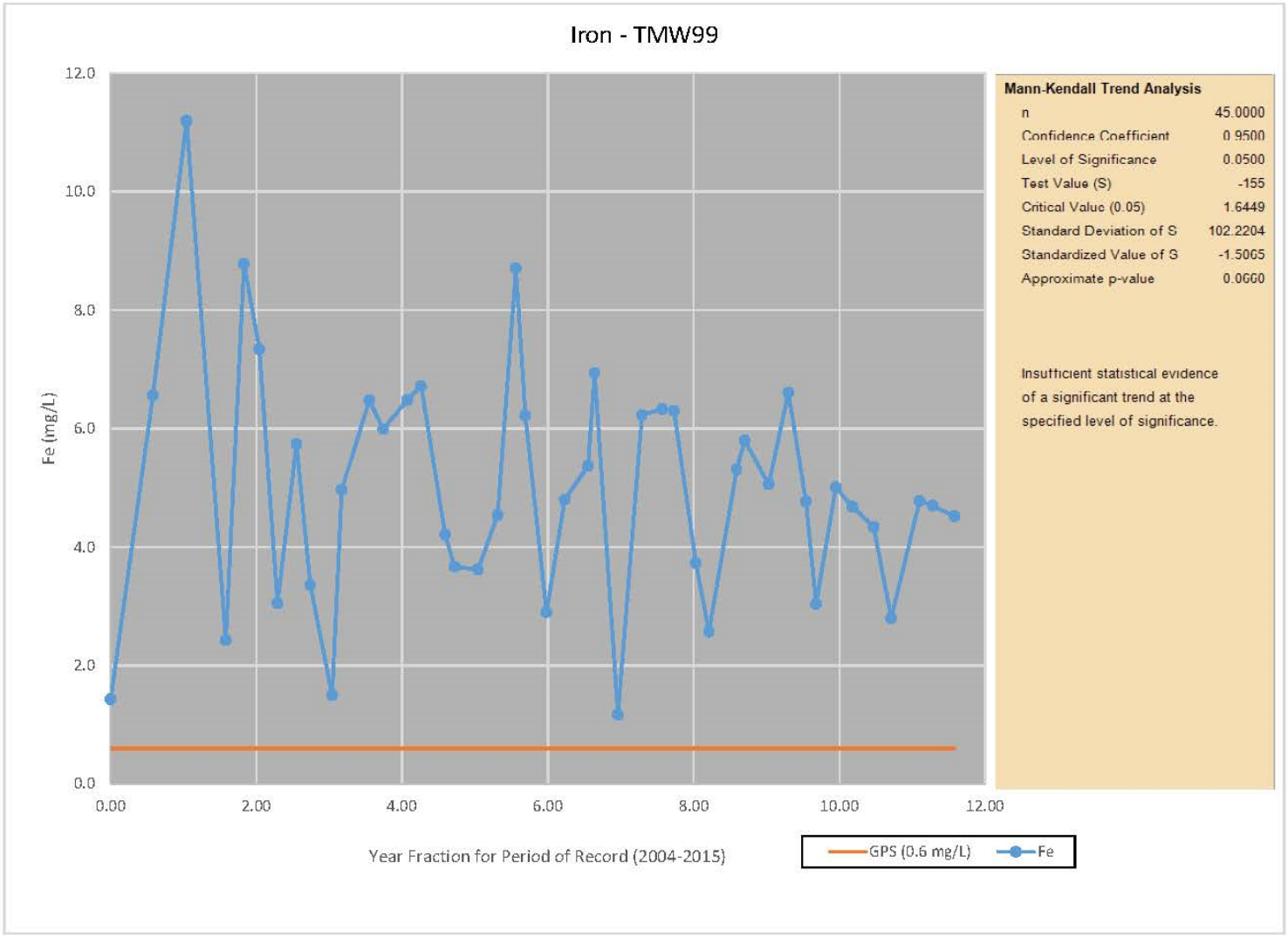

FIGURE 34. Time series of iron concentrations in monitoring well TMW99.

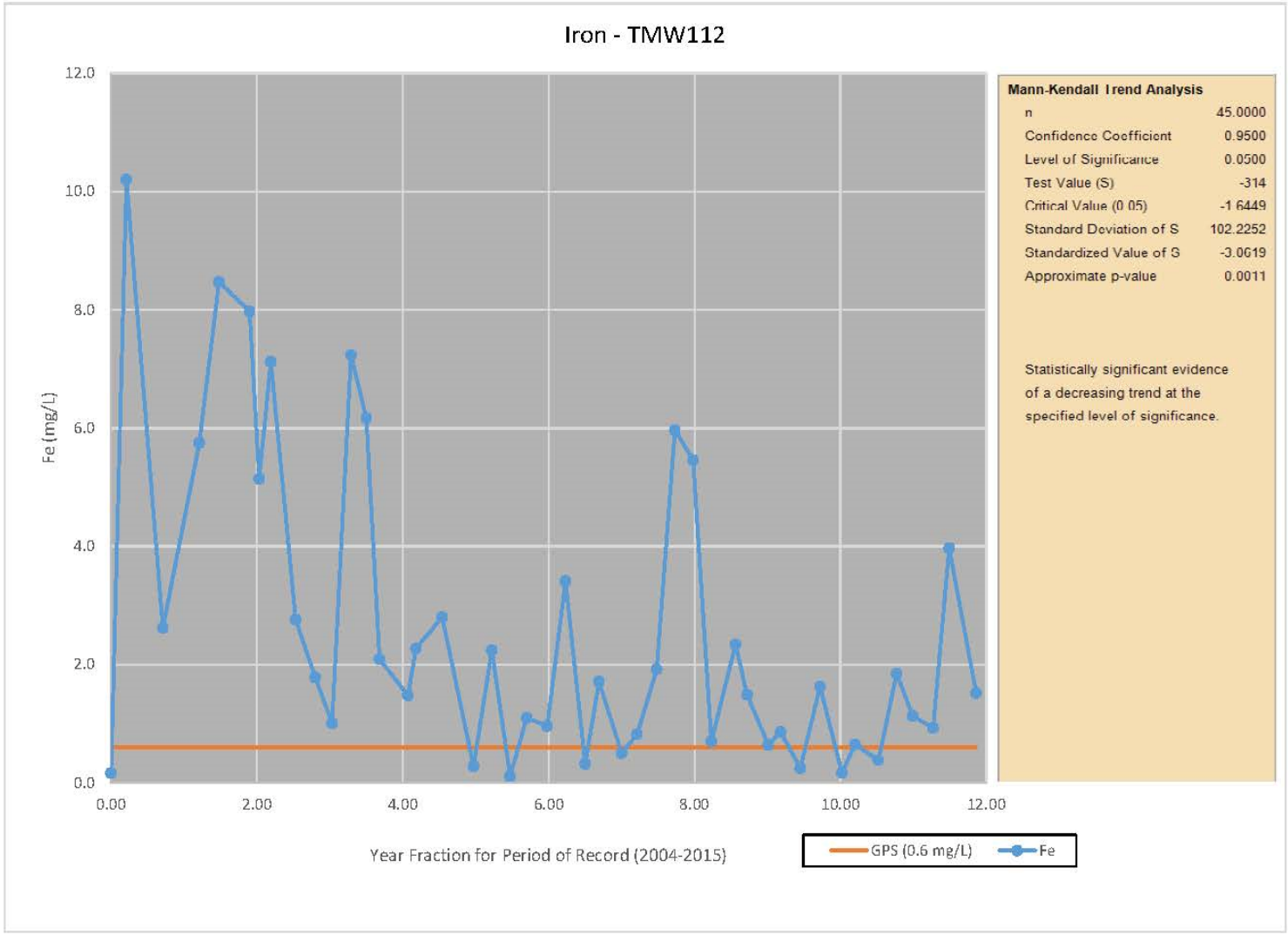

FIGURE 35. Time series of iron concentrations in monitoring well TMW112.

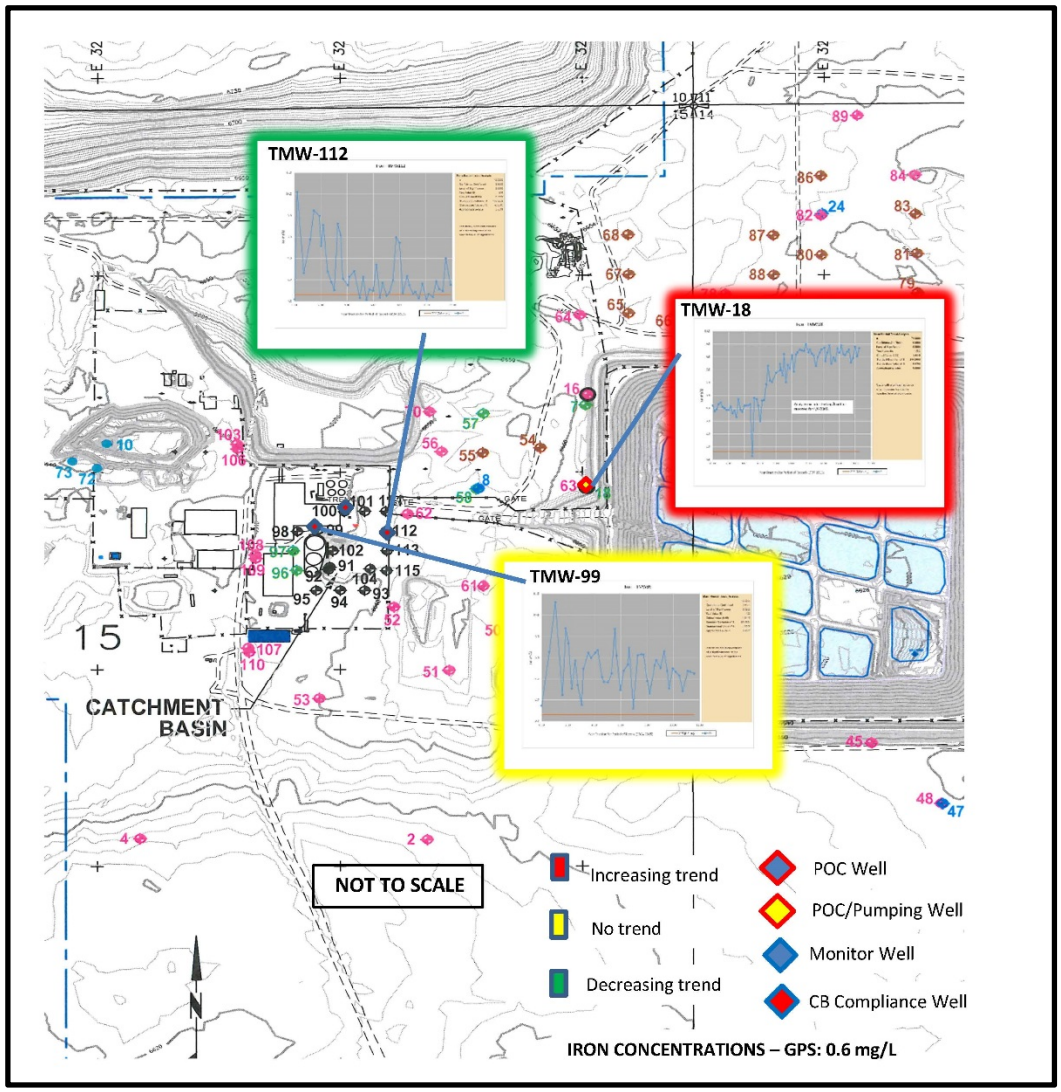

FIGURE 36. Synoptic view of Mann-Kendall trend analysis results for iron concentration