SRB Technologies (Canada) Inc.

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2021 Annual Compliance and Performance Report

Reporting Period:	January 1 – December 31, 2021
Licence Number:	NSPFOL-13.00/2022
Licence Condition:	4.2

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SRB Technologies (Canada) Inc.

2021 Annual Compliance and Performance Report

Submission date: March 31, 2022

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Executive Summary

SRB Technologies (Canada) Incorporated (SRBT) is pleased to provide this compliance and performance report to the Canadian Nuclear Safety Commission (CNSC) as part of our licensed activities.

Our facility continues to process tritium safely, responsibly and efficiently, and we are proud of the level of performance and improvements achieved during 2021. No nuclear safety-related events or significant safety-related issues occurred, and the safety of workers, the public and the environment was maintained at all times.

In 2021, SRBT processed 29,392,257 GBq of tritium into self-luminous light sources and safety devices; in comparison, in 2020, a total of 27,887,498 GBq of tritium was processed.

The ratio of the amount of tritium released to atmosphere versus the amount of tritium processed during the year remained very low (0.10%). This ratio met our annual internal target of 0.11%, and represents only a slight increase in the ratio achieved in 2020 (0.09%).

Tritium oxide releases to atmosphere decreased in 2021 in comparison to the year previous, with 8,387 GBq of oxide being released (vs. 9,755 GBq in 2020).

The total amount of tritium (elemental + oxide) released to the environment through the gaseous effluent pathway increased slightly (28,729 GBq) compared with the previous year (25,186 GBq).

The average weekly rate of gaseous tritium releases met our target for 2021; on the average, 553 GBq of tritium was released weekly, versus our target of 625 GBq per week.

No staff member exceeded 1 mSv for the year – a value that represents the dose limit to the public. A collective dose of 2.35 person·mSv was accrued by staff. As well, no action levels were exceeded with respect to radiation doses. This is a testament to the continued diligence of our workers in maintaining radiation exposures as low as reasonably achievable.

The conservatively-calculated dose to the most-exposed member of the public remains far less than 1% of the prescribed annual limit of 1 mSv, as derived from direct sampling and monitoring of the local environment. Groundwater tritium concentrations continue to respond favorably to modified and optimized processing practices.

In 2021, CNSC staff performed four inspections at the facility; all identified compliance and improvement items have either been addressed, or are in the process of being addressed by our team.

Throughout the year, SRBT provided CNSC staff revisions of several key documents associated with our licensing basis, including our Radiation Safety Program, Public Information Program, programs within our Environmental Management System, and several others.

A successful full-scale Emergency Exercise was conducted in October, in partnership with the City of Pembroke, the Pembroke Fire Department, and local paramedics. CNSC staff were on hand to observe and inspect the exercise, and several opportunities for improvement have been identified which will add to our preparedness for emergency situations.

Our Financial Guarantee for future decommissioning remains fully funded. The Financial Guarantee does not rely on insurance, letters of credit or third-party resources in order to ensure funding availability for future decommissioning of the facility; the funds are held in escrow for access via a Financial Agreement with the Commission.

In summary, 2021 represents a highly successful and safe year of operation for SRBT. Continual improvements in compliance and safety is an ongoing mission, and we will always strive to reduce our operational impact on the environment, and to optimize safety and the effective doses to our workers and the public.

In June, SRBT applied for the renewal of our nuclear substance processing facility operating licence, for a period of fifteen years. A public hearing where this application will be considered by the Commission is scheduled to take place in April 2022.

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Acronyms and Abbreviations

ACR	Annual Compliance Report / Annual Compliance and Performance Report
AOPFN	Algonquins of Pikwakanagan First Nation
Bq	Becquerel • MBq → megabecquerel • GBq → gigabecquerel • TBq → terabecquerel
BSI	British Standards Institute
CLC	Canada Labour Code
CLW	Clearance Level Waste
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
COVID-19	Coronavirus Disease (2019)
CSA	Canadian Standards Association
CSM	Conceptual Site Model
CVC	Compliance Verification Criteria
DS	Downspout
ECR	Engineering Change Request
EffMP	Effluent Monitoring Program
EMP	Environmental Monitoring Program
EMS	Environmental Management System
ERA	Environmental Risk Assessment
FASC	Facility Access Security Clearance
FG	Financial Guarantee
FHA	Fire Hazard Assessment

Acronyms and Abbreviations

GMP / GWMP	Groundwater Monitoring Program
GTLS	Gaseous Tritium Light Source
HT	Elemental Tritium
HTO	Tritium Oxide
IAEA	International Atomic Energy Agency
IATA	International Air Transportation Agency
ISO	International Organization for Standardization
IT	Information Technology
LCH	Licence Conditions Handbook
LLW	Low-Level Waste
LSC	Liquid Scintillation Counting
LTI	Lost Time Incident
MDA	Minimum Detectable Activity
MW	Monitoring Well
NCR	Non-Conformance Report
NEW	Nuclear Energy Worker
NIST	National Institute of Standards and Technology
NSCA	Nuclear Safety and Control Act
NSPFOL	Nuclear Substance Processing Facility Operating Licence
OBT	Organically Bound Tritium
OFI	Opportunity for Improvement
OLC	Operating Limits and Conditions
PAS	Passive Air Sampler
PDP	Preliminary Decommissioning Plan

Acronyms and Abbreviations

PFD	Pembroke Fire Department
PIP	Public Information Program
PLC	Professional Loss Control
PUTT	Pyrophoric Uranium Tritium Trap
QA	Quality Assurance
QC	Quality Control
RDU	Remote Display Unit
REGDOC	Regulatory Document
RPD	Relative Percent Difference
RW	Residential Well
SAR	Safety Analysis Report
SAT	Systematic Approach to Training
SCA	Safety and Control Area
SN	Serial Number
SRBT	SRB Technologies (Canada) Incorporated
Sv	Sievert • mSv → millisievert • µSv → microsievert
T2	Molecular Tritium Gas
TDG	Transportation of Dangerous Goods
TNA	Training Needs Analysis
UL	Underwriters Laboratories
VLLW	Very Low-Level Waste
WMP	Waste Management Program
WSIB	Workplace Safety and Insurance Board

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1. Introduction

1.1 General Introduction

For the period of January 1 – December 31, 2021, SRB Technologies (Canada) Inc. (SRBT) operated a tritium processing facility in Pembroke, Ontario, under Canadian Nuclear Safety Commission (CNSC) Nuclear Substance Processing Facility Operating Licence NSPFOL-13.00/2022[1].

The facility was operated in compliance with the regulatory requirements of the Nuclear Safety and Control Act (NSCA), our operating licence, and all other applicable federal, provincial and municipal regulations throughout the review period. As well, no new CNSC-licensed activities were implemented since the previous compliance monitoring report.

Compliance was ensured by the continued implementation of our Management System and associated programs and procedures, coupled with a high level of independent internal and external oversight through audit and inspection activities.

During this period, there were no exceedances of environmental or radiation protection action levels, nor licence / regulatory limits associated with our operating licence. Two events occurred during the year which were deemed to meet criteria for reporting to CNSC staff, neither of which impacted nuclear safety.

The SRBT operating licence includes conditions that require SRBT to prepare and submit an annual compliance report (ACR). This requirement is currently defined as part of the compliance verification criteria (CVC) in the Licence Conditions Handbook (LCH)[2] relating to condition 4.2 of NSPFOL-13.00/2022, which states:

> *The licensee shall submit an annual compliance report by March 31 of each year, covering the operation for the 12-month period from January 1 to December 31 of the previous year that includes at a minimum:*
>
> *a) Operational review including equipment and facility performance and changes, significant events/highlights that occurred during the year.*
> *b) Information on production including verification that limits specified in the licence was complied with.*
> *c) Modifications including changes in organization, administration and/or procedures that may affect licensed activities.*
> *d) Health physics information including operating staff radiation exposures including distributions, maxima and collective doses; review of action level or regulatory exceedance(s), if any, historical trending where appropriate.*

e) Environmental and radiological compliance including results from environmental and radiological monitoring, assessment of compliance with licence limits, historical trending where appropriate, and quality assurance/quality control results for the monitoring.
f) Facility effluents including gaseous and liquid effluent releases of nuclear substances from the facility, including unplanned releases of radioactive materials and any releases of hazardous substances.
g) Waste management including types, volumes and activities of solid wastes produced, and the handling and storage or disposal of those wastes.
h) Updates regarding activities pertaining to safety, fire protection, security, quality assurance, emergency preparedness, research and development, waste management, tritium mitigation and training (as applicable).
i) Compliance with other federal and/or provincial Regulations.
j) A summary of non-radiological health and safety activities, including information on minor incidents and lost time incidents.
k) A summary of stakeholder engagement activities, public opinion and information products, as committed to in the Public Information Program.
l) Forecast for coming year(s).

The purpose of this report is to provide the required information in order to meet the requirements of conditions 4.2 of Licence NSPFOL-13.00/2022, and the CVC in the associated LCH.

The information is reported in a format which meets the requirements of CNSC Regulatory Document 3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills,* SRBT's Regulatory Reporting Program, and in consideration of regulatory feedback and comments regarding previous ACRs submitted in the past.

Where possible, information is presented in the most appropriate section / safety and control area (SCA), in such a way as to avoid duplication in other sections.

1.2 Facility Operation – Compliance Highlights and Significant Events

SRBT conducted its licenced activities safely and compliantly throughout 2021.

1.2.1 Tritium Processing

In 2021, SRBT conducted 3,968 tritium processing operations (light source filling), with a total of 29,392,257 GBq of tritium being processed into gaseous tritium light sources (GTLS).

Please refer to section 1.4, ‘Production or Utilization’ for additional details on tritium processing in 2021.

1.2.2 Distribution of Self-luminous Safety Products

In 2021, 811 shipments of our self-luminous safety products were made to customers in 28 different countries, including Canada.

Please refer to section 4.8, ‘SCA – Packaging and Transport of Nuclear Substances’ for additional details on the distribution of our products in 2021.

1.2.3 Acceptance of Expired Products

In 2021, a total of 24,510 expired (or otherwise removed from service) self-luminous safety ‘EXIT’ type signs were accepted by SRBT from Canadian and American sources, representing a total activity of 3,767.75 TBq of tritium. In 2020, 34,081 signs were processed representing 5,360.02 TBq of tritium.

These signs were disassembled safely and the light sources removed. A very small number of these signs were evaluated as having light sources that could be reused in other self-luminous devices. Lights that could not be repurposed were packaged and shipped to a licenced radioactive waste management service provider.

As well, an additional 302.18 TBq of tritium was accepted from international origins (i.e. other than Canada and the United States) in the form of expired tritium illuminated devices, such as aircraft signs, dials, gauges and other smaller equipment. These were also processed for shipment to a licenced waste management facility.

Please refer to section 4.5, ‘SCA – Waste Management’ and section 4.8, ‘SCA – Packaging and Transport of Nuclear Substances’ for additional details on the acceptance of expired self-luminous safety signs in 2021.

1.2.4 External Oversight

During the year, there were a total of thirteen major inspections or audits conducted by stakeholders and external parties on our operations.

CNSC staff conducted compliance inspections on four occasions in 2021. In August, CNSC staff conducted a major five-day Management System inspection and an inspection focused on our Dosimetry Service Licence. In October, an inspection was conducted focused on the 2021 Emergency Exercise. In November, an inspection was conducted focused on Fire Protection.

BSI Management Systems, on behalf of the International Organization for Standardization (ISO), conducted a major audit of SRBT operations in September 2021.

BSI concluded that SRBT continues to effectively manage our operations in a fashion that ensures the elements of the scope of our certification with ISO 9001 are effectively addressed, and confirmed our certification to the 2015 version of ISO 9001.

One major customer of SRBT products conducted an independent audit of our operations in November 2021, while Underwriters Laboratories (UL) completed four quarterly audits as planned.

Additional details on the above noted external oversight of SRBT operations can be found in section 2.1, ‘SCA – Management System’.

Two focused facility inspections were conducted relating to fire protection. Both the Pembroke Fire Department (PFD) and Professional Loss Control (PLC) inspected the facility. As well, an independent third-party audit of SRBT’s Fire Protection Program was conducted.

Details on fire protection-related inspections and audits can be found in section 4.4, ‘SCA – Emergency Management and Fire Protection’.

Many of the external audits and inspections were performed remotely, or as a hybrid on-site / remote activity, in response to the continued risks associated with the COVID-19 pandemic.

1.2.5 Internal Oversight

Twelve internal compliance audits were conducted through the year, focused on all aspects of our operations and our organization. A total of 8 non-conformance reports and 24 opportunities for improvement were identified as a result of these activities, all of which have been addressed (or are in the process of being addressed) by the responsible managers.

Additional details on internal oversight of SRBT operations can be found in section 2.1, ‘SCA – Management System’.

1.2.6 Reported Events

SRBT experienced two events that met the regulatory criteria for unplanned event reporting in 2021. Event reporting is governed by the SRBT Regulatory Reporting Program.

On February 19, a fire alarm occurred at the facility at approximately 0745h. A malfunction of the compressor generated a small quantity of smoke just prior to the unit automatically shutting down.

The PFD responded to the event within minutes of the alarm, noted no further hazard, and gave the all clear after assessing the facility.

The compressor malfunction was likely due to a very brief power fluctuation on the municipal grid just prior to the false alarm. A momentary ‘brownout’ caused a voltage drop on the motor under load conditions, likely leading to the generation of smoke from overheating as the motor recovered under load, and eventually an automatic safety trip on the compressor.

There was no hazard to workers, the facility or the environment. CNSC staff accepted SRBT’s final report[3] on this event on March 16[4].

On August 16, a hand-held oxy-acetylene torch malfunctioned during operation, causing a brief excess flame which was detected immediately by staff, as well as by the facility fire protection systems, resulting in the fire alarm sounding.

Staff shut of the gas to the torch, eliminating the hazard. PFD fire fighters arrived shortly thereafter, and the all-clear was given after checking the area and equipment.

There was no hazard to workers, the facility or the environment. CNSC staff accepted SRBT’s final report[5] on this event on September 20[6].

1.2.7 Operational Challenges

SRBT continued to experience challenges introduced by the onset of the COVID-19 pandemic.

Restrictions on visitor access to the facility continued to be enforced throughout the year, and staff continued to be updated on changing expectations on not attending work if they experienced symptoms of COVID-19, in particular with the onset of the Omicron variant.

'Work-from-home' strategies were implemented during the year at various points for all administrative employees who could feasibly do so without negatively impacting safety.

Work schedules remain adjusted in order to promote augmented physical distancing of staff. Importantly, a very high rate of vaccination uptake has been recorded among SRBT employees, well exceeding the rate of the general population.

Despite these challenges, no nuclear safety-related events or significant safety-related issues occurred, and the safety of workers, the public and the environment was maintained at all times.

1.2.8 Summary of Significant Modifications

No significant modifications were implemented in the facility which pertain to our licensed activities in 2021, and there were no changes to the self-luminous safety light production capacity of the facility.

All minor and non-safety significant modifications to structures, systems and components were conducted in accordance with our change control processes.

Please refer to section 3.2, 'SCA – Physical Design', for more information regarding notable facility modifications carried out in 2021.

1.2.9 Summary of Organizational Structure and Key Personnel

At the conclusion of 2021, SRBT employs 39 employees and managers.

Two structural changes to the organization were implemented in 2021, neither of which has any significant safety-related impact:

- The position of Design Engineer was eliminated, as it was assessed as no longer required. All responsibilities of this position were reallocated to the Project Engineer, the IT Specialist and the Graphic Design Specialist.
- The position of Production Control Assistant was eliminated as it was assessed as no longer required. All responsibilities of this position were reallocated to the Production Control Manager and the Inventory Control Assistant.

Please refer to section 2.1, ‘SCA – Management System’ for details regarding SRBT’s organizational structure in 2021.

1.3 Summary of Compliance with Licence and OLCs

Throughout 2021, SRBT complied with the conditions of our operating licence, and possessed, transferred, used, processed, managed and stored all nuclear substances related to the operation of the facility in compliance with regulatory requirements.

Specifically:

- All required programs have been implemented and maintained,
- The CNSC was notified as required of changes to the programs, processes and documents referenced in the management system / licensing basis,
- All required records have been established and maintained pursuant to the operating licence, the Nuclear Safety and Control Act and its regulations,
- All pertinent notifications were made, and written reports filed, within prescribed periods,
- An accepted decommissioning strategy continues to be maintained for future use,
- An accepted financial guarantee continues to be maintained for future decommissioning.
- Cost recovery fees were paid on time and in full, and
- Limits on releases of tritium to the atmosphere and sewer, and radiation dose limits to the public and SRBT nuclear energy workers were not exceeded.

SRBT also remained in compliance with requirements of all other federal and provincial regulations as pertaining to the operation of the facility, including the Canada Labour Code and associated regulations, as well as provincial regulations with respect to the management of hazardous materials and waste.

The following summary report is provided respecting SRBT compliance with the Operating Limits and Conditions (OLC) established within our Safety Analysis Report (SAR) throughout the course of 2021.

Each applicable OLC is repeated below, with a statement of compliance.

1.3.1 Tritium Possession Limit

SRBT is authorized by licence to possess up to 6,000 TBq of tritium in any form.

SRBT possessed less than 6,000 TBq of tritium at all times during 2021.

Please refer to section 2.3, ‘SCA – Operating Performance’ for more details.

1.3.2 Tritium Processing – Permitted Hours of Operation

Tritium processing operations consist of filling and sealing of gaseous tritium light sources (GTLS) on processing rigs, laser cutting of GTLS, or bulk splitting operations. Tritium processing operations are restricted to 0700h – 1900h, seven days a week, unless specifically approved by senior management.

All tritium processing operations were conducted between the hours of 0700h and 1900h during 2021. No processing occurred outside of this time period.

1.3.3 Tritium Processing – Precipitation

Tritium processing shall not occur during measurable periods of precipitation, as detected by the precipitation detection system or equivalent.

Tritium processing operations were only conducted during periods where measurable precipitation was not occurring during 2021.

Processing operations were ceased and equipment placed into a safe state when precipitation events occurred during operating hours.

1.3.4 Tritium Releases to Atmosphere – Tritium Oxide

SRBT shall not release in excess of 6.72E+13 Bq of tritium oxide to atmosphere in any year.

The total amount of tritium oxide (HTO) released to atmosphere in 2021 was equal to 8.39E+12 Bq (8,387 GBq), representing 12.5% of this licenced limit.

Please refer to section 4.3 ‘SCA – Environmental Protection’ for more details.

1.3.5 Tritium Releases to Atmosphere – Tritium Oxide + Elemental

SRBT shall not release in excess of 4.48E+14 Bq of total tritium as tritium oxide and tritium gas to atmosphere in any year.

The total amount of combined HTO and elemental tritium (HT) released to atmosphere in 2021 was equal to 2.87E+13 Bq (28,729 GBq), representing 6.4% of this licenced limit.

Please refer to section 4.3 ‘SCA – Environmental Protection’ for more details.

1.3.6 Minimum Differential Pressure Measurements for Tritium Processing

Tritium processing operations shall not occur unless the following differential pressures are achieved, as measured by the gauges on each of the active ventilation system stacks:

- Rig Stack: 0.27 inches of water column
- Bulk Stack: 0.38 inches of water column

These measurements correspond to an average effective stack height of 27.8 metres, assuming a wind speed of 2.2 m/s.

At no time did tritium processing occur during 2021 when the noted differential pressures were not being achieved, as measured daily prior to operations commencing.

1.3.7 Tritium Releases to Sewer – Water-soluble Tritium

SRBT shall not release in excess of 2.00E+11 Bq of water-soluble tritium to the municipal sewer system in any year.

The total amount of water-soluble tritium released to the municipal sewer in 2021 was equal to 3.07E+09 Bq, representing 1.54% of this licenced limit.

Please refer to section 4.3 ‘SCA – Environmental Protection’ for more details.

1.3.8 PUTT Filling Cycles

Any pyrophoric uranium tritium trap (PUTT) base is limited to 30 complete bulk splitter filling cycles, after which it is no longer permitted to be used for further tritium processing.

All tritium processing in 2021 was conducted using PUTTs that had been cycled 30 times or less on the bulk splitter.

1.3.9 PUTT / Bulk Container Tritium Loading Limit

PUTTs are limited to less than 111,000 GBq of tritium loading at any time.

Bulk containers are limited as follows:

- SRBT shall request no more than 925,000 GBq per bulk container when submitting a purchase order to an approved supplier of tritium gas.
- No bulk container shall exceed 1,000,000 GBq of tritium loading at any time.

In 2021, no PUTT was loaded with more than 111,000 GBq of tritium.

No bulk container was used in the facility in excess of the 1,000,000 GBq loading limit.

1.3.10 Bulk Container Heating Limit

Bulk tritium containers are limited to a heating temperature of approximately 550°C, as measured by the thermocouple placed between the heating band and the container surface.

Brief and small exceedances of this value are tolerable so long as they are not sustained, and the temperature is returned below this value as soon as possible.

Bulk tritium container heating operations were conducted in compliance with this limit throughout 2021.

1.3.11 On-site Depleted Uranium Inventory

The on-site physical inventory of depleted uranium (virgin, in use and decommissioned bases) is limited to 10 kg.

The on-site inventory of depleted uranium did not exceed 10 kg in 2021.

Please refer to section 2.3, ‘SCA – Operating Performance’ for more details on inventory controls of DU in 2021.

1.3.12 Exceedances of Facility Action Levels

There were no exceedances of radiation protection or environmental protection action levels in 2021.

1.4 Production or Utilization

1.4.1 Tritium Processing

In 2021, at total of 29,392,257 GBq of tritium was processed. This represents an increase of about 5.4% from the 2020 value of 27,887,498 GBq.

The following table is presented to illustrate the five-year history of tritium processing at SRBT.

TABLE 1: TRITIUM PROCESSED – FIVE-YEAR TREND

YEAR	2017	2018	2019	2020	2021
TRITIUM PROCESSED (GBq)	32,968,695	31,251,329	30,327,048	27,887,498	29,392,257

1.4.2 Tritium Possession

SRBT is restricted by licence to possess no more than 6,000 TBq of tritium in any form at the facility at any time.

Throughout 2021 this possession limit was not exceeded. The maximum tritium activity possessed at any time during 2021 was 5,065.56 TBq, in May. The monthly average inventory of tritium in the facility was 3,641.44 TBq.

At all times, unsealed source material was stored on tritium traps or in the handling volumes of tritium processing equipment.

The monthly data of tritium activity on site during calendar year 2021 can be found in **Appendix A** of this report.

1.5 Changes in Management System Documentation

In 2021, SRBT revised several key program-level management system documents associated with our licensing basis, following the change control provisions of our Licence Conditions Handbook.

Examples of revised programs and procedures include:

- Radiation Safety Program
- Health and Safety Policy
- Hazard Prevention Program
- Environmental Management System
- Environmental Monitoring Program
- Effluent Monitoring Program
- Groundwater Monitoring Program
- Fire Protection Program
- Fire Safety Plan
- Facility Security Program
- Waste Management Program
- Public Information Program

In line with our mission and policy of continual improvement, process and procedural revisions continued to be a managerial focus throughout the year.

In total, 79 Engineering Change Requests were generated to control the revision and review of programs, procedures or forms in 2021.

Specific details on the changes in documentation can be found in section 2.1, ‘SCA – Management System’.

2. Management SCAs

2.1 SCA – Management System

Throughout 2021, the SRBT Management System was effectively and thoroughly implemented, ensuring that our nuclear substance processing facility operations continued to meet the requirements detailed in our LCH, including key elements such as organization and responsibilities, capability of personnel, use of experience, work planning and control, process and change control, independent verification, non-conformance and corrective action.

A total of 45 non-conformance reports (NCR) and 87 opportunities for improvement (OFI) were raised in different areas of the company operations.

As of the end of 2021, 28 out of the 45 NCRs raised in 2021 had been addressed, reviewed for effectiveness and closed. The remaining 11 NCRs are still in progress due to the fact that they were raised in the later part of the year, or due to relative longer timeframes for the actions that are to be taken to resolve the issues identified.

For OFIs, 59 out of the 87 raised in 2021 have been addressed, reviewed for effectiveness and closed. The remaining 28 OFIs were either raised later in the year, and/or were assigned target completion due dates that have not yet been reached, and will be reviewed as per normal processes as they are addressed.

SRBT affirms that corrective actions and opportunities for improvement have been effective at resolving problems and promoting the concept of continual improvement within our management system in 2021.

Organizational Management Reviews were conducted in early 2021 by all program owners and responsible managers, including benchmarking and self-assessment activities. These reviews were focused on the 2020 calendar year. Reports were submitted to the Executive Assistant in preparation for the annual Management Review.

Between March 23rd to March 31st, the annual Management Review was conducted by way of a series of one-on-one meetings between key members of the Executive Committee and each of the individual program owners and responsible managers. Smaller meetings were held in order to ensure compliance with facility COVID-19 protocols limiting the number of people gathering together.

The results of the benchmarking and self-assessment activities performed for the previous calendar year were reviewed and discussed, and areas where improvements could be made in the various company safety programs were highlighted.

The management system was found to be effective at meeting the current requirements of the NSCA, associated regulations and the conditions of the operating licence, as well as ISO 9001:2015, and customer requirements.

The 2021 Organizational Management Reviews are scheduled to take place in early 2022, followed by Senior Management meetings to discuss the outputs of the reviews with responsible managers, and the identification of any opportunities for improvements, actions required to mitigate risks, and compliance or performance issues.

2.1.1 Staffing and Organization

At the beginning of 2021, SRBT total staff complement stood at 38 employees.

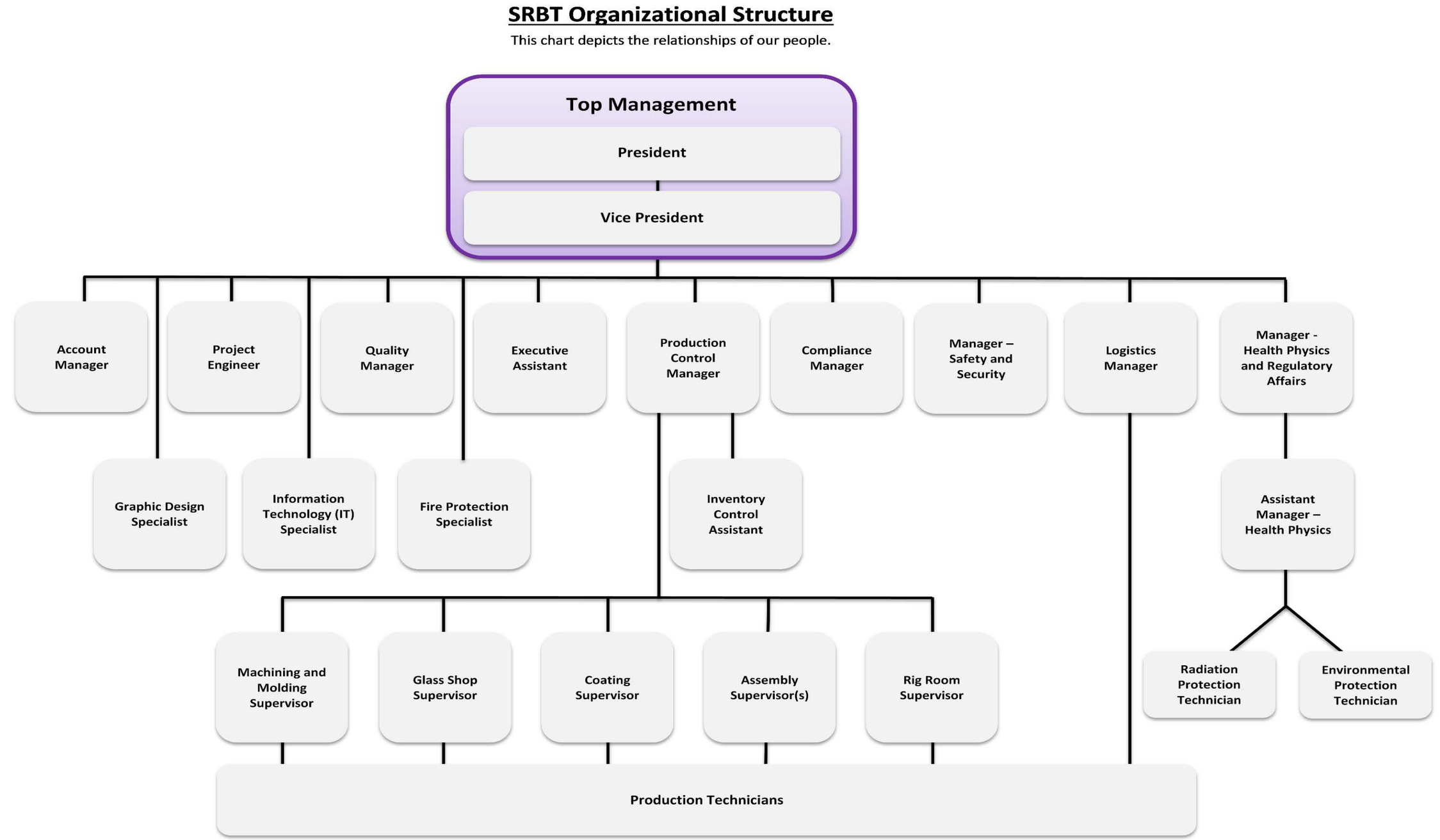
Three new employees were hired during the year, and one employee returned to work after a period of parental leave.

Three employees left the employ of the company in 2021, one of which was hired as a summer student.

As of the end of 2021, the total working staff complement stands at 39 employees.

The organizational chart in Figure 1 represents the structure of the company, as of the end of 2021, that ensures SRBT meets the Nuclear Safety and Control Act, regulations and conditions of our operating licence.

FIGURE 1: ORGANIZATIONAL CHART



As of the end of 2021, a total of 39 employees worked at the company, including 17 administrative employees and 22 production / technician-level employees.

Administrative employees include the two members of Top Management:

- President has the overall responsibility for the facility and ensures that all licensing requirements are met.
- Vice President assumes the full duties of the President in his absence or otherwise assists the President's in his duties.

At the conclusion of 2021, the administrative employees also include ten individuals at the Organizational Management level:

- Quality Manager is mainly responsible for ensuring the quality of products, the satisfaction of customers, and adherence to the requirements of the Underwriters Laboratories (UL). They also provide input ensuring that our management system meets the requirements of the ISO 9001 standard.
- Logistics Manager is mainly responsible for the shipment, receipt and inventory control of radioactive materials, as well as import and export activities.
- Executive Assistant is mainly responsible for providing administrative support to the President, and for ensuring meeting minutes are recorded.
- Production Control Manager is mainly responsible for all company purchasing and production planning activities, as well as processing sales orders, maintaining the order book and the distribution of work packages.
- Project Engineer is mainly responsible for developing and maintaining product specifications and manufacturing procedures, product research and development, and oversight of the change control process.
- Account Managers (2) are mainly responsible for all company accounting activities.
- Manager – Safety and Security is mainly responsible for ensuring staff health and safety and ensuring compliance with the health and safety provisions of the Canada Labour Code, Canada Occupational Health and Safety Regulations, and support for the Security Program.

- Compliance Manager is mainly responsible for performing independent internal audits and further ensuring facility compliance with external and internal requirements.
- Manager of Health Physics and Regulatory Affairs is mainly responsible for oversight of all company Health Physics activities, as well as communicating with CNSC staff on regulatory matters.

Five employees provide program oversight and/or directly assist individuals at the management support level,

- Graphic Design Specialist is responsible for coordinating changes to the company website, and for the design and development of public information products and sales literature.
- IT Specialist manages and maintains the facility computer network and provides a wide range of technical and engineering support.
- Fire Protection Specialist ensures that facility fire safety procedures are implemented, and for coordinating with the PFD for drills, inspection and training. This individual is also responsible for the day-to-day management of maintenance activities in the facility.
- Inventory Control Assistant oversees the receipt of all materials, including quality evaluation where applicable, and for general stores and materials.
- Assistant Manager – Health Physics is responsible for the day-to-day implementation of company Health Physics-related programs and processes, including coordinating the activities of technician-level resources assigned to the department.

At the technician level, within the Health Physics department, two individuals are assigned:

- Radiation Protection Technician performs duties relating primarily to radiation protection.
- Environmental Protection Technician is primarily responsible for performing duties relating to environmental protection and monitoring.

Twenty production-focused employees include six Production Supervisors:

- Glass Shop Supervisor is responsible for all the activities within the Glass Shop Department.
- Coating Supervisor is responsible for all the activities within the Coating Department.
- Rig Room Supervisor is responsible for all the activities within the Rig Room Department.
- Assembly Supervisors (2) are responsible for all the activities within the Assembly Department.
- Machining and Molding Supervisor is responsible for all the activities within the Machining and Molding Department.

These supervisors oversee the work of fourteen Production Technicians,

- Production Technicians who are responsible for performing production activities to company procedures.

2.1.2 Committees

In 2021, committees have continued to be instrumental in the development and refinement of company programs and procedures, identifying new safety initiatives and ensuring continuing effective communication at all organizational levels.

Committees use meeting results as an opportunity for improvement and make recommendations accordingly. In 2021, a total of 99 committee meetings took place at the company compared to 77 in 2020, and 82 in 2019.

TABLE 2: COMMITTEE MEETINGS

COMMITTEE	NUMBER OF MEETINGS
PRODUCTION COMMITTEE	45
WORKPLACE HEALTH AND SAFETY COMMITTEE	14
OTHER COMMITTEE / STAFF MEETINGS	13
HEALTH PHYSICS COMMITTEE	5
MAINTENANCE COMMITTEE	4
MITIGATION COMMITTEE	4
TRAINING COMMITTEE	4
EXECUTIVE COMMITTEE	3
WASTE MANAGEMENT COMMITTEE	2
PUBLIC INFORMATION COMMITTEE	2
FIRE PROTECTION COMMITTEE	2
SAFETY CULTURE COMMITTEE	1
TOTAL	**99**

Committee meetings continue to be a key force to improve all aspects of our operations, and safety in general.

2.1.3 Review of Quality Assurance and Management System Effectiveness

The SRBT management system is subject to both focused periodic reviews, as well as continuous review and improvement.

Based upon the following factors, and the information presented in this report, it is concluded that the SRBT management system has been effective throughout the year:

- A very low frequency of lost-time injuries or incidents occurring in 2021,
- All workplace injuries were relatively minor in nature,
- Highest worker dose for 2021 is less than 1% of the regulatory limit,
- Maximum calculated public dose remains less than 1% of the regulatory limit for persons who are not nuclear energy workers,
- Continued low ratio of tritium released vs. processed,
- Gaseous tritium oxide releases were 12.5% of authorized limits, while combined oxide and elemental tritium releases were 6.4% of authorized limits,
- Tritium releases via liquid effluent were less than 2% of authorized limits,
- All conditions of our facility operating licence met throughout the year,
- Very few open CNSC compliance actions as of the end of 2021, all of which were from recent inspection activities,
- Continued improvement of several key programs and processes, and
- Continuous registered certification to the latest revision of the ISO 9001 standard.

2.1.4 Audit Summary – Internal

The goal of SRBT's internal auditing process is to ensure that all licensed activities and company safety programs and procedures are being adhered to.

Internal audits are often specifically focused on the safety and control areas established by the CNSC.

The Compliance Manager implemented an audit schedule for 2021 that touched on several aspects of our operations.

A total of twelve internal audits were completed, focused in the following areas of our operations:

- Management System
- Safety Analysis
- Personnel Training
- Security
- Radiation Safety and Dosimetry Services
- Quality Department
- Effluent Monitoring Program
- Environmental Monitoring Program
- Waste Management
- Shipping and Inventory Control
- Health and Safety
- Production Departments

Thirteen audits had been approved for the 2021 schedule; an internal audit of the Finance Department was rescheduled to 2022. The rescheduling of this audit has no impact on nuclear safety.

Internal audits resulted in 8 non-conformances (NCR) and 24 opportunities for improvement (OFI) being identified in 2021. Actions have been established and tracked in each case in order to drive compliance and continuous improvement.

2.1.5 Audit Summary – External

During the year, there were a total of thirteen major inspections or audits conducted by stakeholders and external parties on our operations.

2.1.5.1 CNSC Inspections (4)

CNSC staff conducted compliance inspections on four occasions in 2021, three of which were focused on aspects of the SRBT nuclear processing facility operating licence.

In August, CNSC staff conducted a major compliance inspection focused on the Management Systems SCA (SRBT-2021-01). The inspection was conducted remotely over the course of five days, and included extensive record review and interviews with key members of the SRBT organization.

As a result of the inspection, only a single notice of non-compliance of low safety significance was raised, alongside five recommendations[7]. SRBT committed to an action plan to address all findings[8], and CNSC staff accepted this plan and closed the inspection file on January 24, 2022[9].

In October, CNSC staff conducted a compliance inspection (SRBT-2021-02) focused on Emergency Preparedness. This inspection assessed the planning, conduct and post-exercise processes surrounding SRBT's full-scale Emergency Exercise, conducted on October 26, 2021.

The inspection was conducted in a hybrid fashion, with both in-person and remote attendance by members of the CNSC inspection team.

The inspection team found SRBT to be in compliance with the inspection criteria, with no notices of non-compliances being identified over the course of the three-day inspection activity[10]. Nine recommendations were raised by CNSC staff, and SRBT has raised Opportunities for Improvement to address each of these recommendations[11].

In November, CNSC staff conducted an inspection focused on Fire Protection. The inspection was conducted in a hybrid fashion, with both in-person and remote attendance by members of the CNSC inspection team.

The inspection included a comprehensive facility walk-down, as well as compliance verification of the implementation of SRBT's Fire Protection Program and associated procedures. SRBT expects the final inspection report to be shared in early 2022.

A fourth inspection was conducted in August, focused on compliance verification of our Dosimetry Services Licence 11341-3-28.

Although this inspection is outside of the scope of this report, for completeness, two enforcement actions of low significance were issued[12], which were both addressed[13] after SRBT updated an internal procedure and associated form. CNSC staff closed the inspection file on December 6[14].

2.1.5.2 ISO Certification Audits (1)

On behalf of the International Organization for Standardization (ISO), BSI Management Systems conducted an audit of SRBT operations related to the quality management system on September 10, 16 and 17, 2021, as part of the maintenance of SRBT's ISO 9001 certification.

This audit also included an extension of the scope to include the injection molding activities into the scope of the certification.

The audit was successful in obtaining re-certification, including the extended scope, and resulted in two opportunities for improvement identified. The audit was conducted partially on-site, for the extended scope activities, and remotely, due to the continued challenges of the COVID-19 pandemic.

2.1.5.3 Customer-Led Audits (1)

In November 2021, an external audit was executed by a major customer of our commercial safety signs. The audit was a product-focused quality audit of our facility.

No findings were identified through this audit, which was conducted remotely due to the continued challenges of the COVID-19 pandemic.

2.1.5.4 Underwriters Laboratories (4)

Underwriters Laboratories (UL) provides safety-related certification, validation, testing, inspection, auditing, advising and training services to a wide range of clients, including manufacturers.

UL performs quarterly visits of our facility. These visits are unannounced and are to ensure compliance that the products we produce which are listed with UL are manufactured using the materials, procedures and testing parameters required under the specific UL listing.

In 2021, UL performed inspections on March 9, May 14, September 1 and November 3 with no variation notices being raised through the year.

All four inspections were conducted remotely due to the continued challenges of the COVID-19 pandemic.

2.1.5.5 Fire Protection Inspections (3)

Three focused facility inspections / audits were conducted relating to fire protection.

The PFD inspected the facility in December, with no violations being identified.

PLC conducted a N393-13 compliant site condition inspection in May. The inspection report showed no new non-conformances and concluded the findings from previous inspections had been rectified.

PLC also performed an audit of SRBT's Fire Protection Program, with the final audit report being tabled in December. This report was submitted to CNSC staff for their information and review[15].

Details on these inspections can be found in section 4.4, 'SCA – Emergency Management and Fire Protection'.

2.1.5.6 SRBT Audits of Suppliers, Manufacturers or Service Providers

In 2021, SRBT did not perform an audit of any supplier, manufacturer or service provider. Due to the ongoing COVID-19 pandemic, no external audits of suppliers were planned or scheduled.

2.1.6 Benchmarking and Self-assessments

In 2021, individuals responsible for specific programs and procedures at SRBT regularly looked at process problems, corrective actions as well as trending and used this information to benchmark elsewhere in or out of the organization in order to improve the effectiveness of these programs and procedures and to help define where improvements could be made.

Benchmarking against other similar CNSC licensees is encouraged. Documents describing the performance of similar CNSC licensees are made available for review, including:

- Commission Member Documents
- Proceedings, Including Reasons for Decision
- Documents from other licensees, including annual compliance reports

Self-assessments are also performed by Organizational Managers to identify, correct and prevent problems that hinder the achievement of the company's vision, mission, goals, values and policy and to assess the adequacy and effectiveness of the Quality Management System.

Self-assessments were performed by review of:

- Analysis and trending of performance data against historical data
- Input from stakeholders (public, contractors, regulators, etc.)
- Workplace inspections or observations
- Routine communications with staff to determine whether expectations are understood
- Training and coaching results
- Corrective and preventive actions raised throughout the organization
- Internal audit results

Both Benchmarking and Self-assessment reports formed key inputs into the annual Management Review meetings conducted between March 23-31.

The scope of these meetings was to fully and critically review our operations for calendar year 2020, to develop actions to address identified issues and risks, and to take advantage of opportunities for improvement.

The 2021 Management Review cycle is scheduled to be completed in the first half of 2022.

2.1.7 Programs and Procedures

2.1.7.1 Programs and Major Licensing Documents

In 2021, several key management system programs, procedures or plans were revised in line with SRBT's mission of continuous improvement.

CNSC staff accepted the latest update to SRBT's **Fire Hazard Assessment** on February 16[16]. This document had been submitted for regulatory review in December 2020.

On January 29, SRBT submitted revised versions of two LCH-listed procedures that had been implemented[17]. **SHP-001, Packing and Shipping – General Requirements**, and **RSO-029, Nuclear Substances Inventory Management** were accepted as revised on February 25[18].

CNSC staff provided comments on SRBT's **Environmental Risk Assessment** (ERA) report on March 12[19], after completing their review of the report as submitted by SRBT on December 23, 2020.

SRBT addressed all comments and incorporated changes into a new revision of the report. Revision B of the SRBT ERA was submitted to CNSC staff on April 12 for review and acceptance[20], which was received on April 22[21].

On May 5, SRBT submitted a revised **Health and Safety Policy** document to CNSC staff[22], who reviewed and accepted the revision on May 26[23].

On June 30, SRBT applied to the CNSC Secretariat (now the CNSC Registrar) for the renewal of nuclear substance processing facility operating licence NSPFOL-13.00/2022, for a period of fifteen years[24].

As a component part of this application, several SRBT safety program documents were revised in order to reflect the most accurate information on our organization and our safety programs and processes.

In all cases, programs were revised to correct minor errors and inaccuracies, and to incorporate updated administrative information.

For program documentation relating to the area of Environmental Protection, the recommendations and outputs of the recently completed ERA process were also incorporated into each individual program at this time. As well, the frequency of sampling for certain environmental media were optimized.

The following updated programs were submitted to CNSC staff for review and acceptance concurrently with the application for renewal[25]:

- **Quality Manual**
- **Radiation Safety Program**
- **Hazard Prevention Program**
- **Environmental Management System**
- **Environmental Protection Program**
- **Groundwater Protection Program**
- **Environmental Monitoring Program**
- **Effluent Monitoring Program**
- **Groundwater Monitoring Program**
- **Fire Protection Program**
- **Waste Management Program**

CNSC staff accepted these revised program documents on August 25[26].

On September 15, SRBT submitted a revised **Public Information Program** to CNSC staff for review and acceptance[27], and inclusion as a component part of our application for renewal of NSPFOL-13.00/2022.

This program was revised in order to align it with the requirements of CNSC Regulatory Document (REGDOC)-3.2.1, *Public Information and Disclosure.* CNSC staff accepted this program on October 29[28].

On September 28, SRBT submitted a revised **Facility Security Program** document to CNSC staff[29].

The revised program was accepted by CNSC staff on October 12[30], noting that the program meets CNSC requirements outlined in REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material, Version 2.1,* as well as Part 2 of the *Nuclear Security Regulations*.

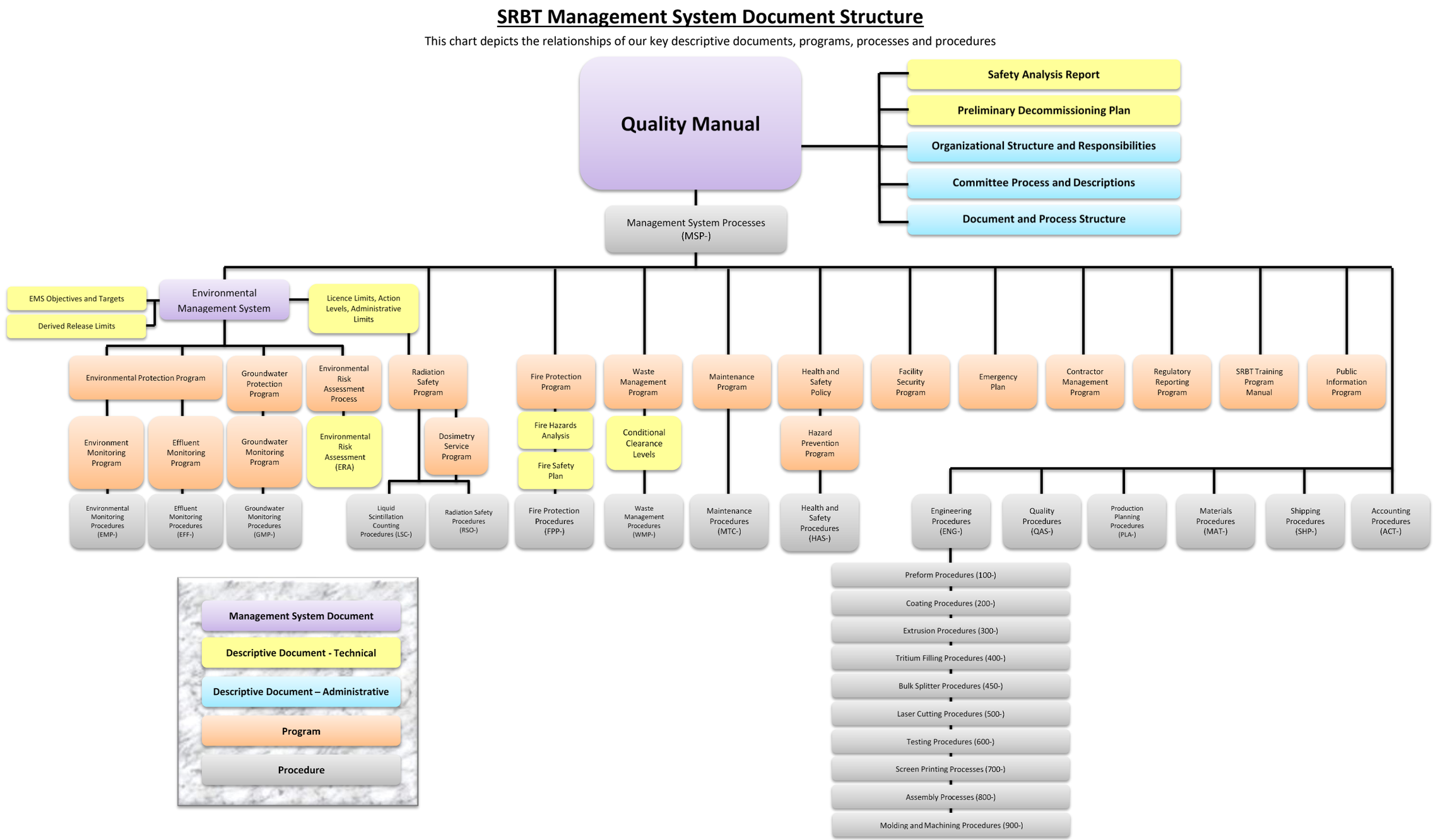
On November 8, SRBT submitted a revised report describing **Derived Release Limits** (DRL) for the operation of the facility[31]. The previous review and revision of this analysis had been completed in 2017.

The revised DRL report was accepted by CNSC staff on December 14[32], and is expected to be incorporated as part of the basis for any renewed licence in 2022. Additional details on the revised DRL can be found in section 4.3 of this report.

2.1.7.2 SRBT Management System Document Hierarchy

Figure 2 illustrates the Management System document hierarchy in place as of the end of 2021.

FIGURE 2: MANAGEMENT SYSTEM DOCUMENTS



2.1.7.3 Management System Changes

In 2021, a total of 79 Engineering Change requests (ECR) were filed relating to procedural or program changes in the SRBT management system (compared to 100 in 2020, 105 in 2019, and 60 in 2018).

The breakdown of ECRs filed was as follows:

TABLE 3: PROCEDURAL ECR SUMMARY

PROGRAM / AREA	NUMBER OF ECRs
ENVIRONMENTAL MONITORING AND PROTECTION	19
CONVENTIONAL HEALTH AND SAFETY	12
RADIATION SAFETY	11
ENGINEERING	8
QUALITY	7
MANAGEMENT SYSTEM	6
LIQUID SCINTILLATION COUNTING LAB	6
EFFLUENT MONITORING	3
FIRE PROTECTION	2
SHIPPING AND RECEIVING	2
WASTE MANAGEMENT	1
SECURITY	1
TRAINING	1
TOTAL	**79**

Note that where appropriate, one ECR may encompass more than one procedural improvement.

Procedural or programmatic changes were implemented for a variety of purposes. Many improvements have been incorporated as a result of the continuing, expanded oversight provided by SRBT's internal audit processes, as well as a dedicated managerial focus on improvement initiatives in each area.

2.2 SCA – Human Performance Management

Throughout the course of 2021, SRBT ensured the programs that manage human performance were implemented effectively, and the interfaces between these programs and other aspects of our management system were maintained and executed. At all times a sufficient number of qualified workers were available to carry out licenced activities in a safe manner, and in accordance with regulatory requirements and SRBT safety programs.

In 2021, SRBT employed a total of 39 staff members including one seasonal employee and one employee who returned from parental leave. Three new employees were hired in 2021, while three employees left the company, one of which was employed as a summer student.

At the end of 2021 the average experience of our workforce stands just over 13 years, with an average age of just over 43 years old.

The Health Physics Team possesses a combined 85 years of work experience with the company, while production supervisors average just over 22 years of experience with SRBT.

Careful consideration continues to be taken when appointing new staff to ensure continued nuclear safety. The activities of five work areas (marked in yellow in Table 4) do not involve tasks that affect nuclear safety.

TABLE 4: NUCLEAR SAFETY TASKS PERFORMED PER WORK AREA

WORK AREA	AVERAGE EXPERIENCE (IN YEARS)	RESPONSIBLE FOR PROGRAMS AND PROCEDURES THAT AFFECT NUCLEAR SAFETY	PROCESS TRITIUM	HANDLE SEALED TRITIUM SOURCES
ADMINISTRATION	**17.75**	✓	-	-
GLASS SHOP	**15.25**	-	-	-
MACHINING AND MOLDING	**12.77**	-	-	-
ASSEMBLY	**10.27**	-	-	✓
RIG ROOM	**9.83**	-	✓	✓
COATING	**9.54**	-	-	-
SHIPPING	**8.61**	-	-	-

Generally, employees hired as Production Technicians are first appointed to one of these four work areas. These positions do not in any way impact the company's ability to ensure that the requirements of the Nuclear Safety and Control Act, Regulations and conditions of the licence[1] and LCH[2] are met.

The Rig Room is the work area where tritium gas is processed into GTLS. The average work experience of the staff within this department is just under 10 years. The Supervisor in this department has over 30 years of experience and performs or oversees all activities that involve tritium processing or handling of tritium sources.

The Assembly Department is where tritium sources are handled by staff for assembly into products or for packaging. The tritium is contained in the source at this stage and the possibility of tritium exposure is low. The Supervisor in this department has over 30 years of experience, and performs or oversees all activities of other staff members.

As a result of COVID-19 restrictions, Senior Management instituted a night shift in order to reduce the amount of staff at the facility which includes the appointment of a second Supervisor in the Assembly Department who has over 22 years of experience.

During an Executive Committee meeting date December 11, 2020, Senior Management noted that in 2021, the Executive Assistant will no longer be on the Health Physics Team since the Radiation Protection Technician and the Environmental Protection Technician are now fully trained in their areas.

With the organizational changes implemented to the Health Physics Team back in 2019, the need for the Executive Assistant to continue to act as a member of this committee has diminished.

The overall performance of the human performance program implemented by SRBT was satisfactory throughout 2021, and several improvements made will serve to continually increase its effectiveness.

As a result of the CNSC Management Systems inspection, SRBT Senior Management have now incorporated a more formal assessment of both training and performance as part of annual performance review completion for all staff, including supervisors and managers.

2.2.1 Training

2.2.1.1 Annual All-Staff Training Session

Traditionally, once per calendar year, SRBT shuts down all manufacturing operations in order to conduct an all-day, all-staff training session.

The agenda for this training typically incorporates a wide variety of aspects of our operations. The majority of the day is dedicated to a refresher course in radiation protection, specifically oriented at the unique type of hazard present at SRBT.

This training was conducted in two separate groups of trainees over the course of consecutive days in December, and was focused on information with respect to anticipated health effects from radiation exposure, tritium, proper handling of tritium throughout the facility, and equipment for personal radiation protection purposes. All trainees successfully challenged the associated written test for this training.

As well, training segments focused on Conventional Health and Safety, Fire Safety and Emergency Preparedness, Supervisory Awareness Program, and the SRBT Management System were also conducted with all staff.

Finally, a survey on Safety Culture was administered to all staff by the Safety Culture Committee, the results of which will help to continue to maintain and improve a healthy safety culture at the facility.

Based on course evaluation data, the annual all-staff training session provides an excellent opportunity for workers to refresh their training and knowledge on several of the safety-related aspects of working at SRBT.

2.2.1.2 Fire Extinguisher Training

Fire extinguisher training is typically conducted annually for all SRBT employees; however, as a consequence of the COVID-19 pandemic, training had not been conducted in 2020.

This training resumed in 2021 for all SRBT employees. The PFD provided this training in December.

2.2.1.3 Fire Protection Specialist Training

The Fire Protection Specialist continues to serve as a volunteer firefighter for a local fire department, and receives fire protection training from this department.

2.2.1.4 TDG Training

Transportation of Dangerous Goods (TDG) training for Shipping department staff is scheduled every two years. The training is conducted by an outside agency with expertise in the transport of dangerous goods.

A session was conducted on February 18, 2021. Six employees successfully underwent this training at that time, and were TDG-certified. In line with the schedule of this training, the next TDG training session is scheduled to be held in February 2023.

2.2.1.5 Health and Safety Training

Due to the COVID-19 pandemic, all training conferences that were normally attended yearly were again cancelled in 2021.

The following training did take place:

- Forklift licence training was conducted; 6 employees have valid forklift licences
- First Aid/CPR training was conducted; 11 employees have valid first aid certificates

2.2.2 Systematic Approach to Training Program

SRBT continues to implement a systematic approach to training (SAT) as part of our overall training program, and the Training Committee actively ensures that the processes described in the SRBT Training Program Manual are managed effectively and improved on an ongoing basis.

Four meetings of the Training Committee were held in 2021, with the annual program evaluation being held in February, the annual SAT-analysis review taking place in April, and the annual review of the qualification of SAT-based trainers being conducted in November.

There were eight instances where new or modified activities or equipment were brought to the Training Committee for a categorization decision during the year. Seven of these were determined to be eligible for management as Category 1 training activities (non-SAT based), and were assigned to the responsible manager to ensure that training is performed as needed.

One categorized activity was assigned as Category 2; the safe use, care and maintenance of hand-held oxy-acetylene torches was determined to meet the criteria to be trained as a SAT-based element under already developed training program SAT-OP-01, *Tritium Processing – Filling and Sealing Light Sources.*

Qualification management processes continue to ensure that SAT-qualified staff members maintain their skills through frequency of performance requirements, and that the qualification of SAT-based trainers continues to be evaluated periodically.

A total of eleven individual workers (spanning all organizational levels) are either fully qualified in their area of responsibility, or are in the process of qualification, in at least one of the eight SAT-based activities developed and implemented.

The following table compiles information on the number of qualified workers assigned tasks that are trained in accordance with a SAT-based method at the end of 2021.

TABLE 5: WORKER QUALIFICATION IN SAT-BASED ACTIVITIES

SAT WORK ACTIVITY	FULLY QUALIFIED WORKERS	WORKERS PROGRESSING TOWARD FULL QUALIFICATION
SAT-HP-01: ADVANCED HEALTH PHYSICS INSTRUMENTATION	2	0
SAT-HP-02: LIQUID EFFLUENT MANAGEMENT AND CONTROL	4	0
SAT-HP-03: WEEKLY STACK MONITORING	4	0
SAT-HP-04: BIOASSAY AND DOSIMETRY	3	1
SAT-OP-01: TRITIUM PROCESSING – FILLING AND SEALING LIGHT SOURCES	5	2
SAT-OP-02: BULK SPLITTER OPERATIONS	4	2
SAT-OP-03: HANDLING PUTTS	4	2
SAT-SHP-01: IMPORT AND EXPORT PROCESSES	4	0

No SAT-based training exams were administered in 2021.

Refresher training modules were provided on several occasions, including the first iteration of annual refresher training for certain infrequently performed work tasks that score high on the difficulty and importance scale for specific activities.

The training needs analysis (TNA) process was implemented on eleven occasions in response to procedural / program changes, new or modified facility equipment, or the occurrence of a reportable event.

The frequent use of this documented TNA process has been very helpful at ensuring a level of appropriate training is provided to SRBT staff when required, and in reducing human performance-related issues.

2.3 SCA – Operating Performance

SRBT has continued to operate the facility safely and in compliance with our operating licence throughout 2021.

Our programs and processes have continued to evolve to meet or exceed regulatory requirements and expectations, with safety as an overriding priority in all aspects of our licensed activities.

A summary of compliance with operational limits and conditions can be found under section 1.3 of this report, while a summary of annual production / utilization data can be found in section 1.4 of this report.

A description of the internal and external audits conducted relating to licensed activities can be found under sections 2.1.4 and 2.1.5 of this report.

2.3.1 Ratio of Tritium Released to Processed

In 2021 our team continued to strive to minimize the amount of tritium released to the environment for every unit of tritium processed – we refer to this as the 'released to processed' ratio. This ratio is an excellent indicator of the overall effectiveness of our emission reduction initiatives.

The following table illustrates how this ratio has trended over the past five years.

TABLE 6: TRITIUM RELEASED TO PROCESSED RATIO FIVE-YEAR TREND (2017-2021)

DESCRIPTION	2017	2018	2019	2020	2021
TOTAL TRITIUM RELEASED TO ATMOSPHERE (GBq/YEAR)	24,822	33,180	31,769	25,186	28,729
TRITIUM PROCESSED (GBq/YEAR)	32,968,695	31,251,329	30,327,048	27,887,498	29,392,257
RELEASED / PROCESSED (%)	**0.08**	**0.11**	**0.10**	**0.09**	**0.10**
CHANGE IN RATIO INCREASE (+) / REDUCTION (-)	-20%	+38%	-9%	-10%	+10%

The ratio of tritium released to processed has remained very low and relatively stable for several years, which is indicative of continued safe processing operations.

2.3.2 Objectives and Targets

SRBT performance against key objectives and targets for 2021 is tabled below.

TABLE 7: 2021 PERFORMANCE TARGETS

DESCRIPTION	2021 TARGET	2021 PERFORMANCE
MAXIMUM DOSE TO NUCLEAR ENERGY WORKER	≤ 0.60 mSv	0.36 mSv
AVERAGE DOSE TO NUCLEAR ENERGY WORKER	≤ 0.060 mSv	0.056 mSv
CALCULATED DOSE TO MEMBER OF THE PUBLIC	≤ 0.0040 mSv	0.0020 mSv
WEEKLY AVERAGE TRITIUM RELEASES TO ATMOSPHERE	≤ 625 GBq / week	553 GBq
RATIO OF TRITIUM EMISSIONS VS. PROCESSED	≤ 0.11	0.10%
TOTAL TRITIUM EMISSIONS EFFLUENT PATHWAY	≤ 11 GBq	3.07 GBq
ACTION LEVEL EXCEEDANCES ENVIRONMENTAL	≤ 1	0
ACTION LEVEL EXCEEDANCES RADIATION PROTECTION	≤ 1	0
CONTAMINATION CONTROL FACILITY-WIDE PASS RATE	≥ 95%	96.1%
LOST TIME INJURIES	0	0
MINOR INJURIES REPORTABLE TO WSIB	≤ 5	0
MINOR INCIDENTS / FIRST AID INJURIES (NON-REPORTABLE)	≤ 15	7

Targets values are set at the outset of each calendar year by various committees. Data is tracked and trended throughout the year in order to ensure that appropriate measures can be taken where appropriate, in an effort to ensure a high level of safety performance.

Where targets are missed, specific actions are documented and tracked to improve performance where feasible; however, in some cases production considerations can result in effects that were not anticipated when the annual targets were set.

No targets were missed for calendar year 2021.

2.3.3 Reportable Events

SRBT experienced two events that met the regulatory criteria for unplanned event reporting in 2021. Event reporting is governed by the SRBT Regulatory Reporting Program.

On February 19, a fire alarm occurred at the facility at approximately 0745h. A malfunction of the compressor generated a small quantity of smoke just prior to the unit automatically shutting down.

The PFD responded to the event within minutes of the alarm, noted no further hazard, and gave the all clear after assessing the facility.

The compressor malfunction was likely due to a very brief power fluctuation on the municipal grid just prior to the alarm sounding. A momentary ‘brownout’ caused a voltage drop on the motor under load conditions, likely leading to the generation of smoke from overheating as the motor recovered under load, and eventually an automatic safety trip on the compressor.

There was no hazard to workers, the facility or the environment. CNSC staff accepted SRBT’s final report[3] on this event on March 16[4].

On August 16, a hand-held oxy-acetylene torch malfunctioned during operation, causing a brief excess flame which was detected immediately by staff, as well as the facility fire protection systems, resulting in the fire alarm sounding.

Staff shut of the gas to the torch, eliminating the hazard. PFD fire fighters arrived shortly thereafter, and the all-clear was given after checking the area and equipment.

There was no hazard to workers, the facility or the environment. CNSC staff accepted SRBT’s final report[5] on this event on September 20[6].

2.3.4 Inventory Control Measures

2.3.4.1 Tritium

SRBT has continuously possessed, transferred, used, processed, managed and stored all nuclear substances related to the operation of our facility in compliance with the requirements of our licence.

A number of inventory control measures are in place to ensure that tritium on site does not exceed the possession limit prescribed by our operating licence.

The maximum amount of tritium possessed by SRBT at any one time during 2021 was 5,065.56 TBq, which represents 84.4% of the facility possession limit. The average monthly inventory on site was 3,641.44 TBq.

Tritium on site is found in:

- Bulk containers and tritium traps,
- New light sources,
- The exit signs for our facility,
- New product that contain light sources,
- Work in progress,
- Waste,
- Expired light sources taken out of product,
- Products that contain expired light sources, and
- Non-conforming product

Refer to **Appendix A** for additional details on tritium inventory in 2021.

2.3.4.2 Depleted Uranium

SRBT possessed a reported 9.368 kg of depleted uranium in metallic form at the beginning of 2021. During the year, no transfers of this material in or out of the facility were made.

This material is used in tritium 'traps' as storage media for tritium gas on our processing equipment, a well-understood and widely-used strategy for manipulating and storing tritium in its gaseous, elemental state.

By using depleted uranium in this fashion, we can ensure that the quantity of gaseous tritium being used during any given processing operation is restricted. This helps to ensure that the consequences of any unplanned event are minimized with respect to radiation and environmental protection, by ensuring that any release of tritium is limited.

The inventory of material changed once in 2021; as a result of the annual detailed mass assessment in July, the total inventory was adjusted upward by 229 grams, representing a 2.4% discrepancy over the previously measured mass. This discrepancy is attributed to inherent uncertainties in the methodology for assessment of mass of the material, and is likely a correction for a similar, but opposite discrepancy observed in 2020 (-155 grams).

At the conclusion of 2021, the mass of depleted uranium on site is 9.597 kg. A limit of 10 kg of this material in inventory is applied as part of the operating limits and conditions in the SAR.

The breakdown of this inventory at the conclusion of 2021 is as follows:

TABLE 8: DEPLETED URANIUM INVENTORY BREAKDOWN AT THE END OF 2021

QTY	DESCRIPTION	DEPLETED URANIUM IN EACH (GRAMS)	TOTAL DEPLETED URANIUM (GRAMS)
1	LOOSE FORM – CONTAINER 1	N/A	1,380
1	LOOSE FORM – CONTAINER 2	N/A	4,975
9	ACTIVE P.U.T.T.	30 +/- 5 grams	290
34	NON-ACTIVE P.U.T.T.	30 +/- 5 grams	1,032
6	AMERSHAM CONTAINERS	320	1,920
		TOTAL	**9,597**

2.3.5 Liquid Scintillation Quality Assurance and Control

2.3.5.1 Routine Performance Testing

As a component of SRBT's Dosimetry Services Licence, Routine Performance Testing is performed on both liquid scintillation counters on a quarterly basis, as required by CNSC REGDOC-2.7.2, *Dosimetry, Volume II, Technical and Management System Requirements for Dosimetry Services*.

These quality assurance tests are performed to demonstrate that liquid scintillation counting assays in support of the dosimetry service are operated in a predictable and consistent way.

This testing was carried out every 3 months as required throughout 2021 on each of the two 'TriCarb 2910' units, with no failures reported.

2.3.5.2 Weekly LSC Performance Check

SRBT quality assurance requirements for liquid scintillation counting include weekly instrument performance checks using National Institute of Standards and Technology (NIST) traceable standards of a blank, H-3 and C-14 standards.

All tests have been performed on both TriCarb 2910 Liquid Scintillation Counting (LSC) units, and included an assessment of the instrument efficiency for tritium measurement, the figure of merit, the tritium background measurement, and a chi-square test. An instrument must meet acceptability criteria on a weekly basis, or the unit is removed from service pending corrective maintenance or actions.

2.3.5.3 Assay Quality Control Tests

Reference standards traceable to NIST are prepared in-house, and are analyzed and checked against quality control acceptance criteria with every batch of liquid scintillation counting samples being analyzed.

All tests were performed as required with every assay throughout 2021, in order to ensure quality control of LSC laboratory processes.

3. Facility and Equipment SCAs

3.1 SCA – Safety Analysis

Our operating practices and processes in 2021 have continued to be conducted in full alignment with the latest version of SRBT's SAR.

There were no changes to the facility or our operations that had any direct bearing on the safety analysis in 2021.

Please refer to section 1.3 of the report for a complete assessment of SRBT compliance against the Operating Limits and Conditions in the SAR.

In summary, the overall safety case for SRBT continues to be effectively validated and maintained by the effective implementation of our management system. Preventive measures and strategies for potential hazards are built in to our programs and processes. Key safety processes include independent verification, frequent internal audit and oversight, and management by designated committees.

As always, SRBT will continue to respond to events in the nuclear industry and beyond that could influence or otherwise affect our safety analysis.

It is not expected that our facility, our licensed activities or our processes will change significantly over the coming years; however, SRBT will continue to manage and improve the SAR in line with our management system processes. As per the LCH, condition 5.1, CVC 2, the SAR is next due for scheduled periodic review in 2022.

3.2 SCA – Physical Design

As a manufacturing company, SRBT owns and operates several pieces of equipment, many of which constitute structures, systems and components which have a bearing on safety and our licensed activities.

Such equipment includes the active ventilation systems and associated emissions monitoring equipment, fire detection and suppression systems, tritium processing rigs, tritium-in-air monitors, and liquid scintillation counters.

The overall facility design is also a key aspect of our operations, and must be managed and controlled safely. The SRBT change control process helps to ensure that modifications are controlled, reviewed, accepted, and recorded using an Engineering Change Request.

Modifications to structures, systems and components associated with our licensed activities are conducted in accordance with these change control processes and overall management system.

No significant changes in physical design of production- or safety-related facility systems or components took place in 2021. There were no changes to the self-luminous tritium light source production capacity of the facility.

All minor and non-safety significant modifications to structures, systems and components were conducted in accordance with our change control processes.

3.3 SCA – Fitness for Service

All equipment, including all safety-related equipment, is kept in a condition that is fit for service through the implementation of the Maintenance Program. The facility and equipment associated with the facility were effectively maintained and operated within all manufacturer requirements.

Note that, although the Maintenance Program incorporates several program elements associated with nuclear power plants as best practice (such as critical spares, master equipment lists, etc.), aging management is not an element that is formally included as a specific strategy.

Documented maintenance meetings were initiated and held by the Maintenance Committee throughout 2021. As part of management review processes, an annual review of 2021 activities will be conducted in 2022, including data pertaining to equipment failures, maintenance activity success rates, non-conformances, procedural revisions, and audit findings.

Maintenance records are kept on file including completed work orders of preventative maintenance activities. A maintenance schedule is created and managed by the Fire Protection Specialist, which effectively captures all safety-significant planned preventative maintenance activities, whether performed by SRBT personnel or an approved contractor, and includes maintenance inspections as required by the Fire Protection Program.

As well, corrective maintenance was tracked, trended and reviewed to assess the performance of equipment, and to identify any preventative activities which may improve performance.

Preventative maintenance was scheduled and performed in 2021 on key facility equipment as per **Appendix B** of this report.

3.3.1 Ventilation

The ventilation of the facility is such that the air from the facility flows to the area with greatest negative pressure in Zone 3 which has the highest potential for tritium contamination where all tritium processing takes place. This area and part of Zone 2 are kept at high negative pressure with the use of two air handling units which combined provide airflow of approximately 10,000 cubic feet per minute.

The air handling units are connected to a series of galvanized stainless-steel ducts. In addition to providing ventilation for the facility these air handling units also provide local ventilation to a number of fume hoods which are used to perform activities that have a potential for tritium contamination and exposure.

All ventilation systems were maintained fit for service throughout 2021. Corrective and preventative maintenance was identified and performed according to the requirements of the Maintenance Program and operational procedures. Key equipment is maintained either on a quarterly or semi-annually basis, with technical equipment maintenance being performed by fully licensed and certified heating, ventilation and air conditioning contract providers.

A listing of the ventilation equipment maintained in 2021 can be found in **Appendix C** of this report.

3.3.2 Stack Flow Performance

Stack maintenance is performed by a third party, in order to ensure effective performance of the ventilation system and minimize airflow reductions from the beginning to the end of the maintenance cycle to ensure accuracy of results.

Pitot tubes that were installed in the stacks are maintained by a third party to ensure stack airflow are at design requirements. This essentially allows for daily stack flow verification in addition to more detailed annual stack flow verification performed by a third party.

The annual stack flow performance verification was performed on September 29, 2021 by a third party. The inspection confirmed that the stacks continue to perform to design requirements. SRBT continues to monitor and trend the results of the annual stack performance verification.

3.3.3 Liquid Scintillation Counters

The two TriCarb 2910 LSC units were subjected to an annual preventive maintenance procedure on August 17, 2021. No significant concerns or issues were identified during the maintenance activity.

There were no instances where corrective maintenance was required on either LSC unit in 2021.

Both systems will continue to be preventively maintained and calibrated on an annual basis by a qualified service representative from the manufacturer of the equipment, to ensure their functionality, accuracy and reliability.

3.3.4 Portable Tritium-in-Air Monitors

Portable tritium-in-air monitors are maintained and made available throughout the facility. The portable units are used to investigate potential sources of tritium leakage, and for personnel protection.

As of the end of 2021, SRBT owns a total of eight portable monitors, as well as an additional unit that is used by our sister company in North Carolina.

Six of these monitors are used at the facility (one in Zone 1, two in Zone 2 and three in Zone 3), a seventh is kept on emergency standby at the Pembroke Fire Hall as part of an emergency preparedness kit, and the eighth unit is kept as a ready spare in the LSC laboratory.

As required by our Radiation Safety Program, all in-service tritium-in-air monitors were calibrated and maintained at least once during 2021, with all records of the maintenance kept on file.

Corrective maintenance of portable monitors was initiated in three cases in 2021:

- Serial number (SN) 4196 was sent to the manufacturer to replace an internal component on the high voltage power supply.
- SN 4198 was sent to the manufacturer for a refurbishment, and
- SN 4198 was sent to the manufacturer for replacement of the liquid crystal display and associated circuitry.

3.3.5 Stationary Tritium-in-Air Monitors

The ambient air in selected key areas of the facility is continuously monitored using stationary tritium-in-air monitors.

There continues to be five stationary tritium-in-air monitors deployed for continuous airborne tritium monitoring at the facility, with two spare units available if needed.

The in-service monitors operate 24 hours a day to ensure that any upset conditions are identified and addressed quickly.

Three monitors are strategically located in Zone 3; one in the Rig Room where gaseous tritium light sources are filled and sealed; one in the Laser Room where a laser is used to cut and seal small gaseous tritium light sources, and light sources are inspected; and one in the Tritium Laboratory where tritium is transferred from bulk supply containers to filling containers.

One stationary tritium-in-air monitor is located in Zone 2 in the Assembly Area, where gaseous tritium light sources are pre-packed in preparation for shipping or installed into device housings.

A stationary tritium-in-air monitor is located in the Shipping area in order to provide an early warning signal of a problem should a light or device be damaged during packaging activities.

As required by our Radiation Safety Program all tritium-in-air monitors were calibrated and preventively maintained at least once during 2021. All facility monitors functioned effectively and continuously throughout the year, with all records of maintenance retained on file.

3.3.6 Stack Monitoring Equipment

Stack monitoring equipment is incorporated for each of two main air-handling units. For each air-handling unit, the monitoring equipment includes:

- A tritium-in-air monitor connected to a real-time recording device,
- An alarming remote display unit (RDU) in Zone 3,
- A bubbler system for discriminately collecting HTO and HT in the sampled stream of effluent,
- A flow measurement device with elapsed time, flow rate and volume of the sampled stream of effluent, and
- A dedicated back-up power supply servicing the monitors, bubbler systems and flow meters, capable of providing several hours of uninterrupted power to the equipment during a power failure.

Each tritium-in-air monitor is connected to real-time recording devices (chart recorders), and was calibrated and preventively maintained as required in 2021.

The chart recorders (analog and digital), tritium monitors and RDUs are included in calibration verification activities on a quarterly basis.

Bubbler systems (and spare systems) were also maintained throughout the year, with a bi-monthly maintenance cycle being implemented on all in-service stack monitoring equipment.

No corrective maintenance was required on any of the components that comprise the stack monitoring equipment.

3.3.7 Stack Monitoring Verification Activities

The annual verification activity for the bubbler systems was performed in February 2021, where independent third-party measurements provided validation that SRBT bubblers continue to effectively measure weekly gaseous tritium emissions (both HTO and HT).

The acceptance criterion for deviation between the assessed measurements of gaseous emissions is +/- 30%. In 2021, all results fell within this acceptance criteria, with SRBT measurements ranging between 72.7% and 112.5% of those obtained by the independent third party.

3.3.8 Weather Station

Maintenance of the weather station is performed as per the manufacturer's recommendation, every two years, with batteries being replaced every four years.

After the anemometer and wind direction functions of the weather station failed in 2020, a period of downtime followed while corrective maintenance and component replacement were planned out. The weather station was taken down from its tower in April 2021 for investigation and corrective maintenance.

After experiencing several shipment delays with replacement parts, the weather station was put fully back into service in September 2021, including a battery replacement. The batteries are next scheduled for replacement in 2025.

3.3.9 Air Compressor

Process tasks at SRBT require the use of a compressed air system. The air compressor is subject to quarterly preventative maintenance activities, and semi-annual belt changes, all of which were carried out throughout 2021. During periods of high usage rates, additional maintenance is performed on the compressor as an extra precaution to ensure ideal performance.

In early 2021, the motor that drives the compressor failed. SRBT replaced the compressor with a new motor, and also repaired the failed unit to prevent downtime in the future. SRBT now utilizes the new compressor for daily operation and maintains the old repaired unit as a back up in case of emergency. The motor failure had no impact on safety, and resulted in a short and limited impact on production operations.

4. Core Control Processes SCAs

4.1 SCA – Radiation Protection

4.1.1 Dosimetry Services

Pursuant to CNSC Dosimetry Service Licence 11341-3-28, SRBT assesses the radiation dose to its employees and to contract workers who may have exposure to tritium.

SRBT implements a dedicated Dosimetry Service Program in support of compliance with the requirements of this licence. The assessment of dose to personnel, due to tritium uptake, is performed in accordance with CNSC REGDOC-2.7.2, *Dosimetry, Volume II, Technical and Management System Requirements for Dosimetry Services*.

All dosimetry results were submitted on a quarterly basis to Health Canada in a timely fashion for input to the National Dose Registry. A final annual report was also submitted as required. A total of 42 individual staff members were included in reports to the National Dose Registry at some point in 2021.

SRBT participated in the annual Tritium Urinalysis Performance Test sponsored by the National Calibration Reference Centre for Bioassay, Radiation Surveillance and Health Assessment Division, Radiation Protection Bureau of Health Canada. The participation is a regulatory requirement for Dosimetry Service Providers.

SRBT received the Certificate of Achievement for successful participation in the Tritium Urinalysis Performance Test from the National Calibration Reference Centre for Bioassay and In Vivo Monitoring for the year 2021[33].

As required by the licence, SRBT has submitted the 2021 Annual Compliance Report to CNSC staff for the Dosimetry Service Licence[34].

4.1.2 Staff Radiation Exposures and Trends

All SRBT staff members are classified as Nuclear Energy Workers and participate in the dosimetry program.

Those who work in Zones 1 and 2 provide bioassay samples for tritium concentration assessment on a bi-weekly frequency due to the very low probability of uptake of tritium. Those assigned to work in Zone 3 provide bioassay samples on a weekly frequency due to the higher probability of chronic uptake of tritium.

There were no occurrences of any personnel contamination events in 2021.

The maximum effective dose received by any person employed by SRBT in 2021 was 0.36 mSv, a value which is well within the regulatory limit for a nuclear energy worker of 50.0 mSv per calendar year.

The average effective dose for all staff was calculated to be 0.056 mSv, while the collective dose for all workers was measured as 2.35 person·mSv (for 42 persons total).

The tables found in **Appendix D** of this report provide the radiological dose data for workers at SRBT for 2021, as well as a comparison of dosimetry results for the preceding five years.

4.1.3 Action Levels for Dose and Bioassay Level

Dose and bioassay tritium concentration action levels are defined in SRBT's *Licence Limits, Action Levels and Administrative Limits* document.

Radiation protection-related action levels were last reviewed and revised in 2019, in line with the requirements of the LCH.

The current radiation protection-related action levels are as follows:

TABLE 9: ACTION LEVELS FOR RADIATION PROTECTION

PERSON	PERIOD	ACTION LEVEL
NUCLEAR ENERGY WORKER	CALENDAR QUARTER	1.0 mSv
	1 YEAR	3.0 mSv
	5 YEAR	10.0 mSv
PREGNANT NUCLEAR ENERGY WORKER	BALANCE OF THE PREGNANCY	0.5 mSv

PARAMETER	ACTION LEVEL
BIOASSAY RESULT	1,000 Bq / ml FOR ANY PERIOD

In 2021 there were no exceedances of an action level for dose or bioassay tritium concentration at SRBT.

4.1.4 Administrative Limits for Dose and Bioassay Level

Dose and bioassay tritium concentration administrative limits are also defined in SRBT's *Licence Limits, Action Levels and Administrative Limits document*.

Radiation protection-related administrative limits are as follows:

TABLE 10: ADMINISTRATIVE LIMITS FOR RADIATION PROTECTION

PERSON	PERIOD	ADMINISTRATIVE LIMIT
NUCLEAR ENERGY WORKER	CALENDAR QUARTER	0.67 mSv
	1 YEAR	2.00 mSv
	5 YEAR	8.50 mSv

PARAMETER	ADMINISTRATIVE LIMIT
BIOASSAY RESULT	500 Bq / ml FOR ANY PERIOD IN ZONE 3 100 Bq / ml FOR ANY PERIOD IN ZONE 1 OR 2.

In 2021 there were no exceedances of an administrative limit for dose or bioassay tritium concentration at SRBT.

4.1.5 Contractor Dose

In 2021, SRBT did not employ contract staff to perform work that presented a significant radiological hazard.

Eleven screening bioassay samples were obtained and measured from contracted tradespersons who provided maintenance support in areas other than Zone 1.

None of these samples exceeded our internal screening criteria requiring the calculation of effective dose.

To summarize, no contractor received a recordable dose due to activities performed at the SRBT facility in 2021.

4.1.6 Discussion of Significance of Dose Control Data

A tabular summary of effective dose metrics for 2021 is provided in **Appendix D.**

4.1.6.1 Maximum Dose

The maximum effective dose to any staff member in 2021 was 0.36 mSv. This individual works in Zone 3 and performs tritium processing operations in Zone 3 as their primary duty.

In 2020, the maximum dose to a staff member was 0.43 mSv; the 2021 value of 0.36 mSv thus represents a 16% decrease in the maximum dose to a worker from the previous year.

The variance in maximum dose is within expected operational variance given the activities conducted during the year.

A maximum dose of 0.36 mSv represents the achievement of our internal target for 2021 of less than 0.60 mSv. This supports the conclusion that the Radiation Safety Program and the Health Physics Team are achieving a high level of performance, and that workers are properly and adequately trained in safely conducting activities that may pose a radiation hazard.

This also marks the seventh consecutive year where no SRBT worker received an effective dose in excess of 1 mSv, despite a consistently high rate of production throughput.

The maximum individual dose for the current five-year dosimetry period (January 1, 2021 – December 31, 2025) is 0.36 mSv.

SRBT continuously strives to lower the maximum dose to workers by using several strategies, including training, contamination monitoring, frequent and routine use of portable tritium in air monitors during processing operations, and the continuous oversight of the Health Physics Team during key activities on the shop floor.

The maximum worker dose over the past five years is trended in Figure 3 for comparison, as well as a distribution chart in Figure 4 for worker doses in 2021.

FIGURE 3: MAXIMUM ANNUAL WORKER DOSE (2017-2021)

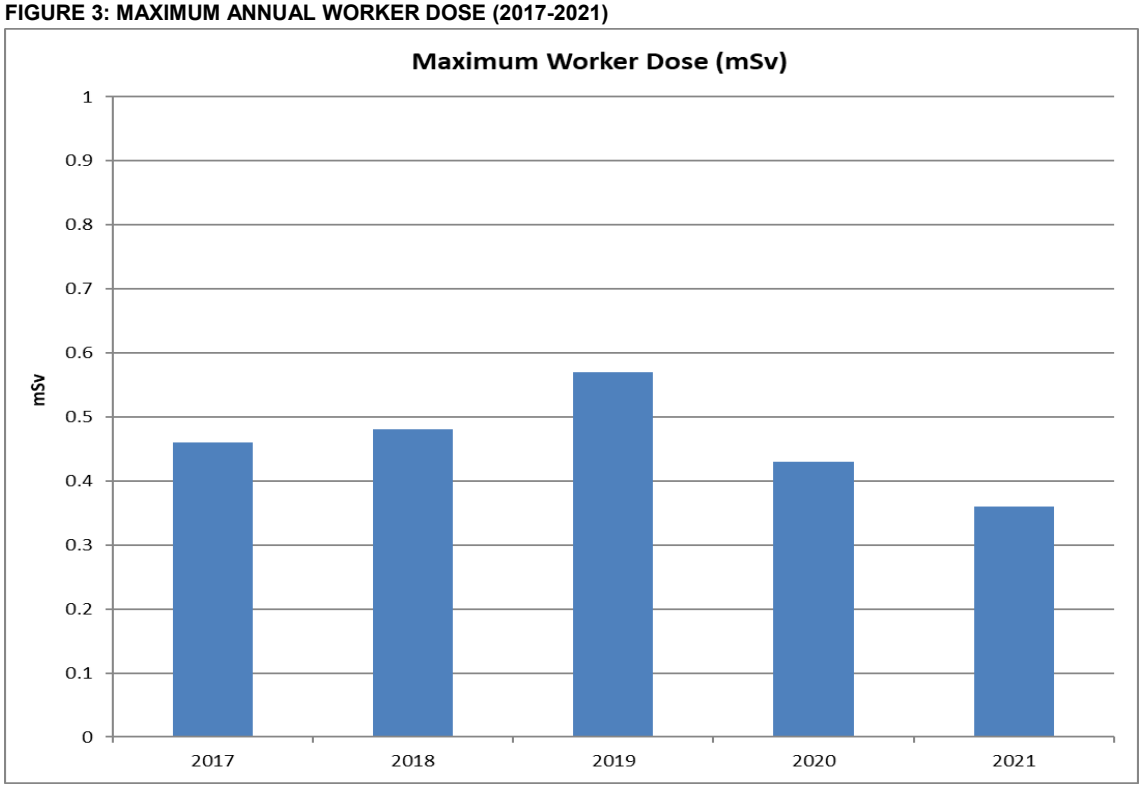
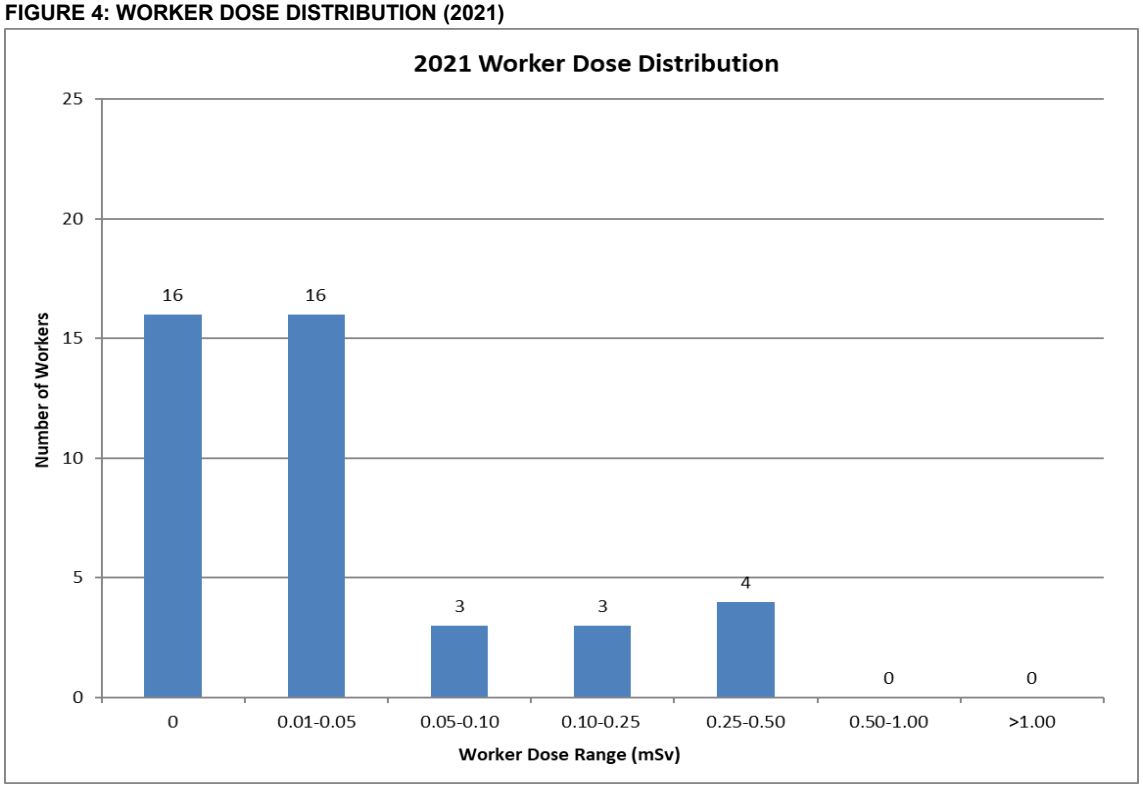


FIGURE 4: WORKER DOSE DISTRIBUTION (2021)



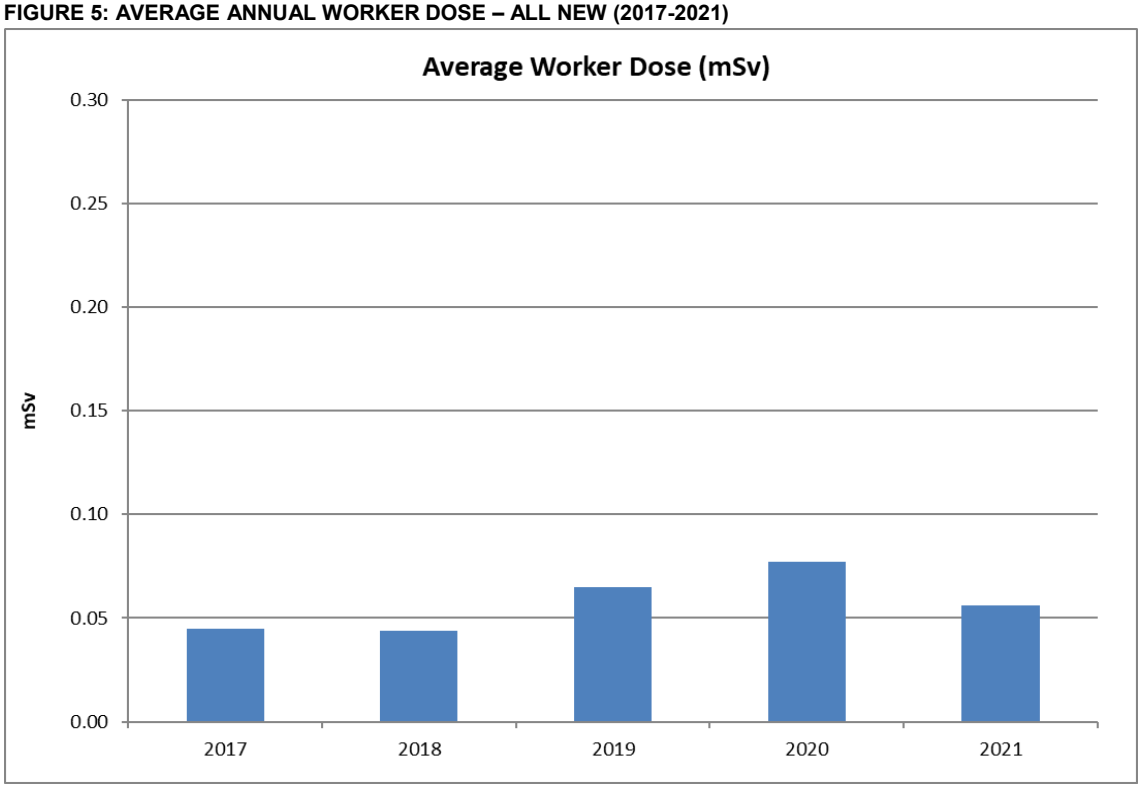
4.1.6.2 Average Dose

The average dose to workers at SRBT in 2021, including those workers whose dose value was zero, was 0.056 mSv.

In 2020, this average was 0.077 mSv, thus the 2021 data represents a decrease in the average dose to staff after two years of slight increases.

The average dose to all nuclear energy workers (NEW) at SRBT over the past five years is trended in Figure 5 for comparison.

FIGURE 5: AVERAGE ANNUAL WORKER DOSE – ALL NEW (2017-2021)

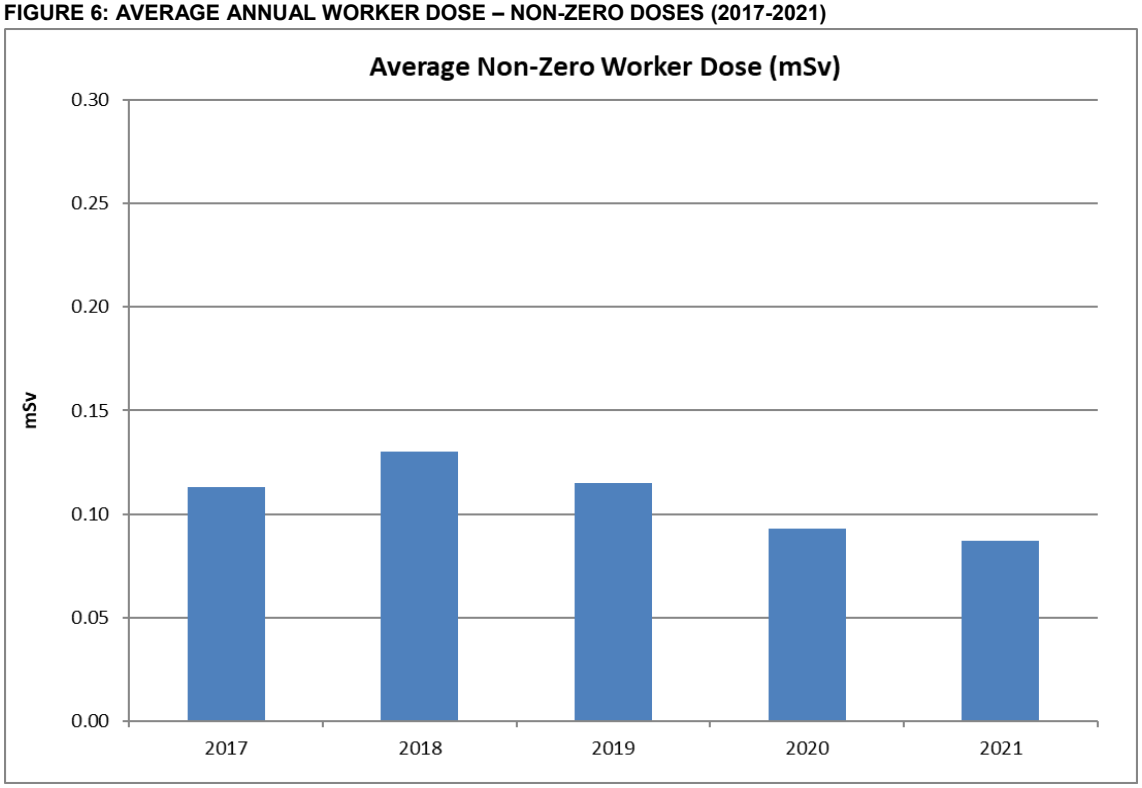


A total of sixteen workers incurred effective doses of less than 0.01 mSv in 2021 (i.e. zero dose).

Taking into consideration only ‘non-zero’ doses, the average effective dose was 0.09 mSv in 2021.

The average dose to all workers at SRBT incurring ‘non-zero’ doses over the past five years is trended in Figure 6 for comparison.

FIGURE 6: AVERAGE ANNUAL WORKER DOSE – NON-ZERO DOSES (2017-2021)

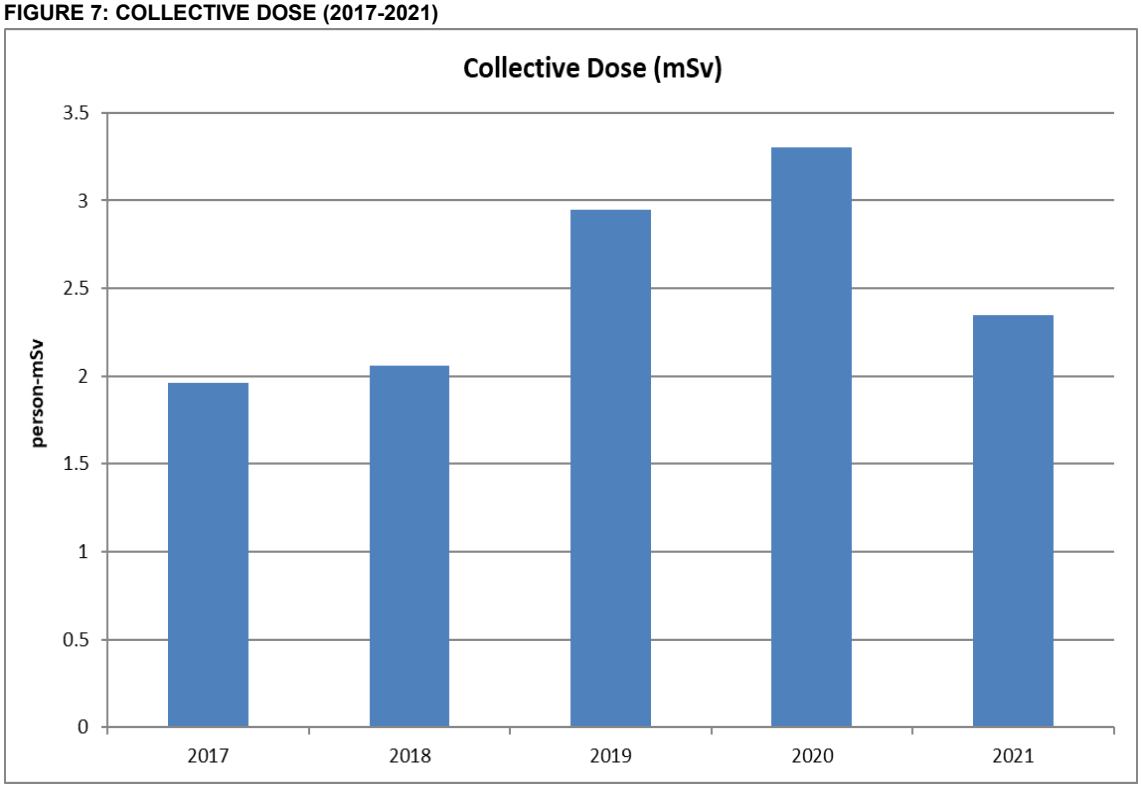


4.1.6.3 Collective Dose

The collective dose to all workers at SRBT in 2021 was 2.35 person·mSv. In 2020, the collective dose was 3.30 person·mSv. The annual collective dose for SRBT workers decreased by about 29% in 2021.

The collective dose to all workers at SRBT over the past five years is trended in Figure 7 for comparison.

FIGURE 7: COLLECTIVE DOSE (2017-2021)



4.1.6.4 Dose to Members of the Public

The effective dose to members of the public is discussed extensively in section 4.3.5 of this report.

4.1.7 Contamination Control and Facility Radiological Conditions

Tritium contamination control is maintained by assessment of non-fixed tritium contamination levels throughout the facility by means of swipe method and liquid scintillation counting of the swipe material. SRBT has in place the following administrative surface contamination limits:

TABLE 11: ADMINISTRATIVE LIMITS FOR SURFACE CONTAMINATION

ZONE	SURFACES	ADMINISTRATIVE SURFACE CONTAMINATION LIMITS
1	ALL SURFACES	4.0 Bq/cm^2
2	ALL SURFACES	4.0 Bq/cm^2
3	ALL SURFACES	40.0 Bq/cm^2

An overview of contamination monitoring results for 2021 has been tabulated and is included in **Appendix E** of this report. A total of 8,161 assessments were performed in various work areas in 2021.

A total of 624 swipes were taken in Zone 1 resulting in a pass rate of 97.12% of assessments being measured below the administrative level of 4 Bq/cm^2.

A total of 1,729 swipes were taken in Zone 2 resulting in a pass rate of 97.51% of assessments being measured below the administrative level of 4 Bq/cm^2.

A total of 5,808 swipes were taken in Zone 3 resulting in a pass rate of 95.61% of assessments being measured below the administrative level of 40 Bq/cm^2.

All swipe results are reported to the area supervisors. The area supervisor and the Health Physics Team reviews the results to determine where extra cleaning effort is necessary.

A comparison of the data for the last five years is presented:

TABLE 12: PASS RATE FOR CONTAMINATION ASSESSMENTS

ZONE	2017	2018	2019	2020	2021
1	98.7%	97.0%	96.5%	96.4%	97.1%
2	97.1%	93.2%	93.1%	96.7%	97.5%
3	95.2%	94.9%	93.5%	96.1%	95.6%

Overall, routine contamination measurements conducted throughout the facility in 2021 fell below the administrative limits 96.13% of the time, achieving the internal target of ≥ 95% by a margin of 1.13%.

This marks the second consecutive year where the surface contamination target of >95% pass rate has been achieved.

The Health Physics Team continues to track and trend all facility contamination control data throughout the year, with a focused quarterly review to identify areas for improvement.

With respect to the monitoring of airborne tritium contamination throughout the facility, SRBT's Radiation Safety Program includes several processes that measure and control airborne tritium hazards in our facility:

- Stationary tritium-in-air monitors are strategically located throughout the facility, with audible alarms triggered at conservative tritium concentrations.
- All staff are trained in the use of portable tritium-in-air monitors for self-protection purposes; these are also strategically located in the facility for quick use when needed.
- A series of passive air samplers are distributed throughout the facility, allowing for weekly averaging of tritium concentrations in key areas.
- The Health Physics Team logs all stationary tritium-in-air monitor alarm events, in order to track and trend frequency of occurrence, to facilitate radiological assessments and/or investigations, and to drive improvements in process safety.

Zone alarm cause / frequency and passive air sampling data is routinely assessed by the Health Physics Team in order to identify any areas of concerns or trends.

The frequency of zone alarms decreased in 2021 when compared with 2020. A total of 72 recorded alarm conditions for stationary tritium-in-air alarms occurred in 2021; a total of 118 such occurrences took place in 2020, and 135 in 2019.

4.1.8 Discussion on the Effectiveness of Radiation Protection Program

Based upon the following factors and the overall evidence presented in this report, it is concluded that the SRBT's radiation protection program has been effective throughout the year.

Key points:

- The highest worker dose for 2021 was 0.36 mSv, or 0.72% of the regulatory limit of 50 mSv.
- For the seventh consecutive year, every SRBT NEW incurred an effective dose of far less than 1 mSv (which represents the annual regulatory limit defined in the *Radiation Protection Regulations* for a person who is not a NEW).
- Collective dose and average dose remain low in relation to production levels, with both of these data points decreasing compared to the previous year. Improvement measures have been effective at helping to reverse the trend of minor increases in these data points.
- Contamination control data demonstrates a high level of control and a low rate of contamination in excess of administrative limits. The internal target of a pass-rate of 95% or greater was achieved for the second consecutive year.
- There were no personnel contamination events at the facility in 2021.
- Radiation protection equipment issues are minimal, with a continuing investment in new equipment leading to an excellent track record of maintenance and fitness for service.
- Radiation protection training results demonstrate that staff has a good appreciation and knowledge of how to protect themselves from hazards.

4.1.9 Occupational Dose Targets

As described in the 2020 annual compliance report, the occupational dose targets for 2021 were set as 0.60 mSv (maximum dose to staff member) and 0.060 mSv (average dose to all staff).

The maximum dose to any worker was 0.36 mSv (target met). The average dose to all workers was 0.056 mSv (target met). There were no action level exceedances.

SRBT projects that in 2022, the maximum and average doses to workers should remain low and relatively stable.

With these considerations, the targets for calendar year 2022 have been set as follows:

- Maximum dose: ≤ 0.50 mSv (decrease of 0.10 mSv)
- Average dose: ≤ 0.060 mSv (no change)
- Action level exceedances: No more than 1 instance (no change)

4.1.10 Summary of Radiation Protection Training and Effectiveness

All new staff members receive introductory training in radiation safety, even if they are not expected to handle nuclear substances as part of their responsibilities.

In 2021, three new employees were hired and was provided with this initial training that is required for declaration as a NEW. All three employees passed the associated test and were declared as NEWs.

Over the course of two days in December, SRBT held its annual all-staff training session, which includes a comprehensive training presentation specifically regarding radiation protection concepts and requirements, specifically tailored to the type of hazard at SRBT. Open dialogue is always encouraged with a question-and-answer session, and a closed-book written test is provided to all participants.

In 2021, all thirty-seven participants successfully challenged the test, averaging a score of 97.6% on the ten-question multiple choice test, against a performance benchmark of 75%. Any incorrect answer on the test was discussed in detail with each employee individually to ensure full understanding following the completion of the training.

4.1.11 Summary of Radiation Protection Equipment Performance

In 2021, all equipment associated with radiation protection at SRBT performed acceptably, and all key maintenance activities, such as instrument calibration, were performed as required.

Radiation protection equipment includes liquid scintillation counters, portable tritium in air monitors, stationary tritium in air monitors and portable radiation detectors (‘RadEye’ type alpha/beta/gamma detectors).

There were no instances of corrective maintenance required for the liquid scintillation counters. There were relatively few instances where stationary and portable tritium-in-air monitors were sent to the manufacturer for corrective maintenance.

The rate of the need for corrective maintenance on all radiation protection equipment remains acceptable, and SRBT owns and maintains spare instruments that remain ready to be put into service should the need arise.

4.1.12 Summary of Radiation Protection Improvements

SRBT's Radiation Safety Program continues to provide an effective level of radiological protection to our workers, and continues to be improved over time. In 2021, the following improvements were implemented:

- The process improvements initiated in 2020 when receiving and assessing pallets of expired tritium safety signs from customers continued to result in reductions in effective doses and chronic airborne contamination levels.
- In 2021, SRBT conducted a gap analysis of our Dosimetry Services Program against the requirements of CNSC REGDOC-2.7.2, *Dosimetry, Volume II, Technical and Management System Requirements for Dosimetry Services*. This gap analysis resulted in various administrative changes to certain specific methods used by SRBT to carry on the licensed activity. An action plan was documented and submitted to CNSC staff[35], who accepted the plan[36]. The plan was fully completed in September[37], and in December, an amended Dosimetry Services Licence was issued by a CNSC designated officer[38].
- The Radiation Safety Program document was revised and submitted to CNSC staff as a component part of the application for renewal of the facility operating licence[25]. The program was revised to ensure all administrative information was correct and incorporated, and to transfer a key form from the program document into a stand-alone management system form.
- Procedure RSO-020, *Betalight Leak Testing* was revised, in order to align with the latest version of the applicable standard (ANSI 43-4). The soak time and acceptance criteria for certain light sources was reduced, which contributed to lower tritium contamination levels in any soak water containing leaking light sources. This helps to reduce dose risks associated with handling these liquids, and also lowers water-soluble tritium releases in liquid effluent.
- Procedure RSO-015, *Health Physics Team Training* was revised in order to better define the scope of this type of training, and ensure the procedure reflects the current organization.

4.2 SCA – Conventional Health and Safety

4.2.1 Jurisdiction

SRBT is subject to federal jurisdiction thus, the Canada Labour Code Part II (CLC Part II) and the Canada Occupational Health and Safety Regulations.

4.2.2 Conventional Health and Safety Program

Being under federal jurisdiction in 2021, the Health and Safety Policy for the SRBT facility was compliant with the requirements of the CLC Part II, and the Canada Occupational Health and Safety Regulations.

4.2.3 Workplace Health and Safety Committee

In accordance with Section 135 (1) of the CLC Part II, SRBT maintains a Workplace Health and Safety Committee (WHSC).

The Committee is comprised of four representatives. Under section 135(10) of the CLC Part II the Committee is required to meet no less than 9 times per year.

The Committee met a total of 14 times in 2021 (12 regular and 2 special meetings), with all meeting minutes kept on file.

An election was held in December 2021 for the 2 employee members of the Health and Safety committee as required by the 2-year term limit. Three employees in total put their name forward for the election. Final results saw one employee newly elected to the committee, while a second employee was re-elected to the committee for another term.

4.2.4 Inspections, Audits and Reviews

The following inspections, audits and reviews were conducted in 2021:

- Twelve monthly facility-wide safety inspections, conducted by members of the WHSC, and
- One internal audit of the SRBT Health and Safety program.

The following are the findings and corrective actions from the inspections, audits and reviews:

- The monthly safety inspections identified only minor issues that were immediately corrected such as the first aid kit requiring some re-stocking of items and eye wash bottles requiring fluid changing due to expiry dates.

- The internal Health and Safety program audit resulted in the issuance of one NCR and four OFIs. The non-conformance has been addressed and closed, while the improvement opportunities are being considered and addressed.

4.2.5 Minor Incidents

There were 7 minor incidents that met internal reporting criteria in 2021. This is a continued decrease from the 16 minor incidents reported in 2020.

A breakdown of the type of minor incidents occurring in 2021 is provided:

- Minor Cuts – 3
- Burns (flame) – 1
- Pinched finger – 1
- Overexertion (back) – 1
- Skin exposure to molding machine cleaning agent – 1

None of these minor incidents required a visit to the hospital, nor a report to the Workplace Safety and Insurance Board.

4.2.6 Lost Time Incidents

In 2021, no lost time incidents (LTI) occurred.

The following table summarizes the frequency of occurrence of LTIs over the past five years:

TABLE 13: LOST TIME INCIDENTS FIVE-YEAR TREND (2017-2021)

DESCRIPTION	2017	2018	2019	2020	2021
LOST TIME INCIDENTS	3	0	0	0	0

SRBT's continuing goal is to have zero LTIs each year; the fact that this goal was achieved in 2021 speaks to the effectiveness of our conventional health and safety program.

4.2.7 Health and Safety Performance Targets

SRBT sets programmatic targets that are tracked by responsible safety committees throughout the year. Actions are taken that are intended to help the organization reach safety goals / objectives / targets, as well as when they may be missed.

In 2021, SRBT set the following targets for the area of Conventional Health and Safety:

- Zero lost time incidents (experienced zero – goal achieved)
- Less than or equal to 5 workplace injuries classified as **reportable** to Workplace Safety and Insurance Board (experienced zero – goal achieved)
- No more than 15 minor incidents (7 were recorded – goal achieved)

These three conventional health and safety targets remain unchanged for 2022.

4.2.8 Reporting

In accordance with Section 15.10 (1) of Part XV of the *Canada Occupational Health and Safety Regulations,* the Employer's Annual Hazardous Occurrence Report was submitted to Employment and Social Development Canada prior to March 1, 2021, as required.

In accordance with Section 9 of the *Policy Committees, Work Place Committees and Health and Safety Representatives Regulations*, the Work Place Committee Report was submitted to the Regional Safety Officer at Canada Labour prior to March 1, 2021, as required.

4.2.9 Health and Safety Training

Due to the COVID-19 pandemic, all training conferences that were normally attended yearly were again cancelled in 2021.

The following training did take place:

- Forklift licence training was conducted; 6 employees have valid forklift licences
- First Aid/CPR training was conducted; 11 employees have valid first aid certificates

4.2.10 Health and Safety Initiatives and Improvements

In 2021, the following health and safety initiatives and improvements were implemented:

- The Health and Safety Policy document was revised and implemented on June 4, 2021.
- The Hazard Prevention Program document was revised and implemented on July 30, 2021.
- One new health and safety procedure was created.
- Hexafluorine and diphoterene safety kits were procured for the facility, to help treat any incidences of accidental exposure to acids.

4.3 SCA – Environmental Protection

This section of the report will provide environmental protection compliance information, including results from environmental, effluent and groundwater monitoring, an assessment of compliance with any licence limits, historical trending where appropriate, and quality assurance/quality control results for the monitoring.

As part of SRBT's overall Environmental Protection Program, and as an input into the design of the environmental, effluent and groundwater monitoring programs, a conceptual site model (CSM) can provide a valuable representation of the factors and elements that are considered for monitoring within the boundaries of the program.

SRBT has been in operation since 1990, and has performed extensive monitoring of effluent, the environment and groundwater over the course of operations since then. In 2007, a comprehensive analysis was performed of the operations of the facility (including historical practices) in order to identify the sources of tritium that could affect the environment and the groundwater.

As well, in 2008 the significant environmental aspects of facility operation were initially established, and have been reviewed periodically since then in order to identify if there are other processes or operations that have been introduced that could lead to an impact on the environment.

These analyses, coupled with decades of operational experience, leads to the establishment of a simplified CSM that shows the significant pathways and environmental interactions pertaining to the release of the sole radiological contaminant of potential concern – tritium.

A pictographic representation of these source – receptor pathways is provided below in Figure 8, and should be consulted when considering the information provided in the next three subsections of this report.

On April 22, 2021, CNSC staff accepted SRBT's Environmental Risk Assessment[21], after comments and feedback had been addressed by SRBT[20]. The ERA complies with the requirements of CSA Standard N288.6-12, *Environmental risk assessments for Class I nuclear facilities and uranium mines and mills*.

Human and ecological conceptual models of tritium interactions with the environment near the site are described within the ERA, and are included in Figures 9, 10, 11 and 12. Species included are conservatively representative of the local flora and fauna.

FIGURE 8: CONCEPTUAL SITE MODEL

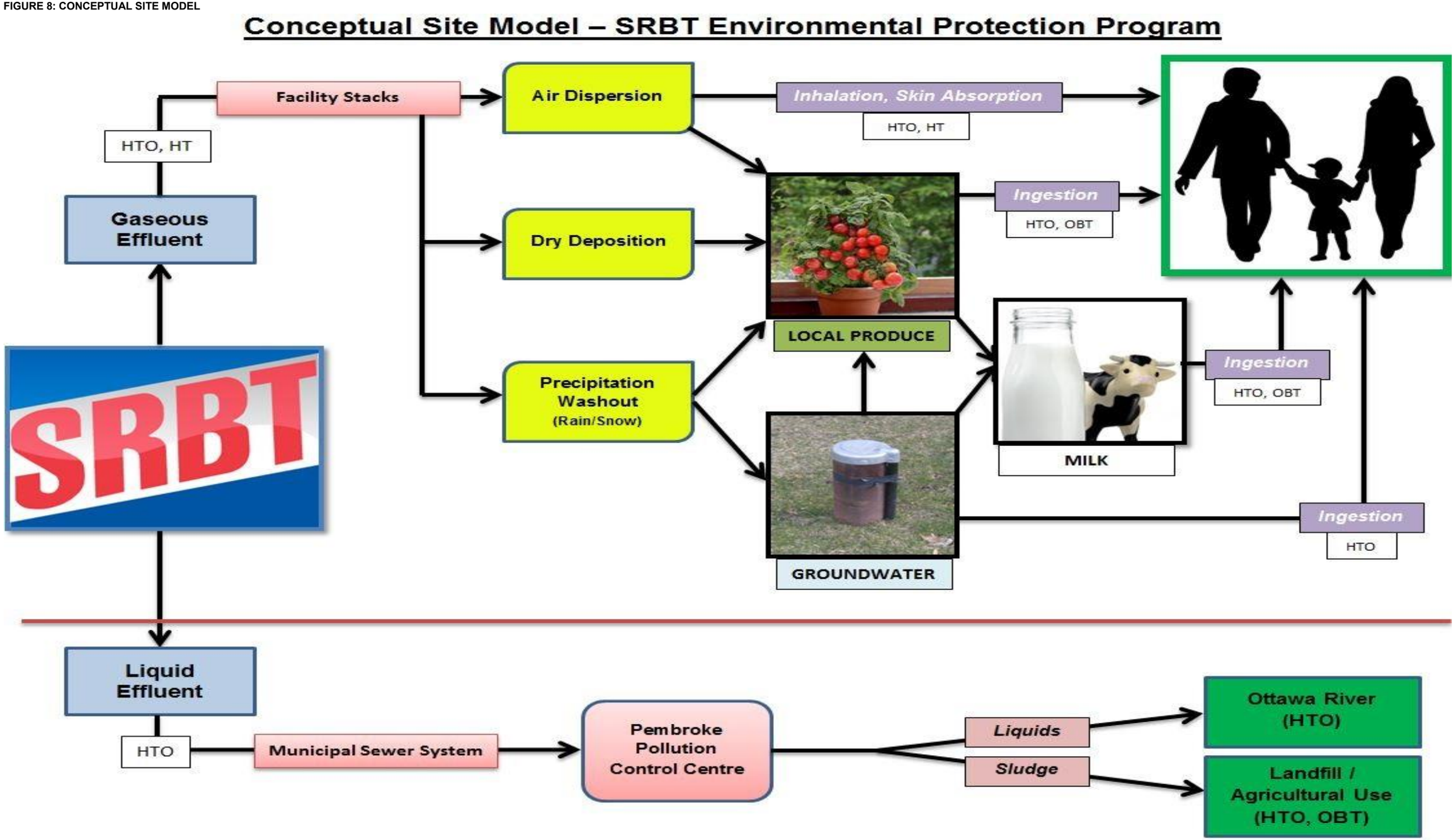


FIGURE 9: HUMAN EXPOSURE PATHWAYS (HTO/T2, GASEOUS SOURCES)

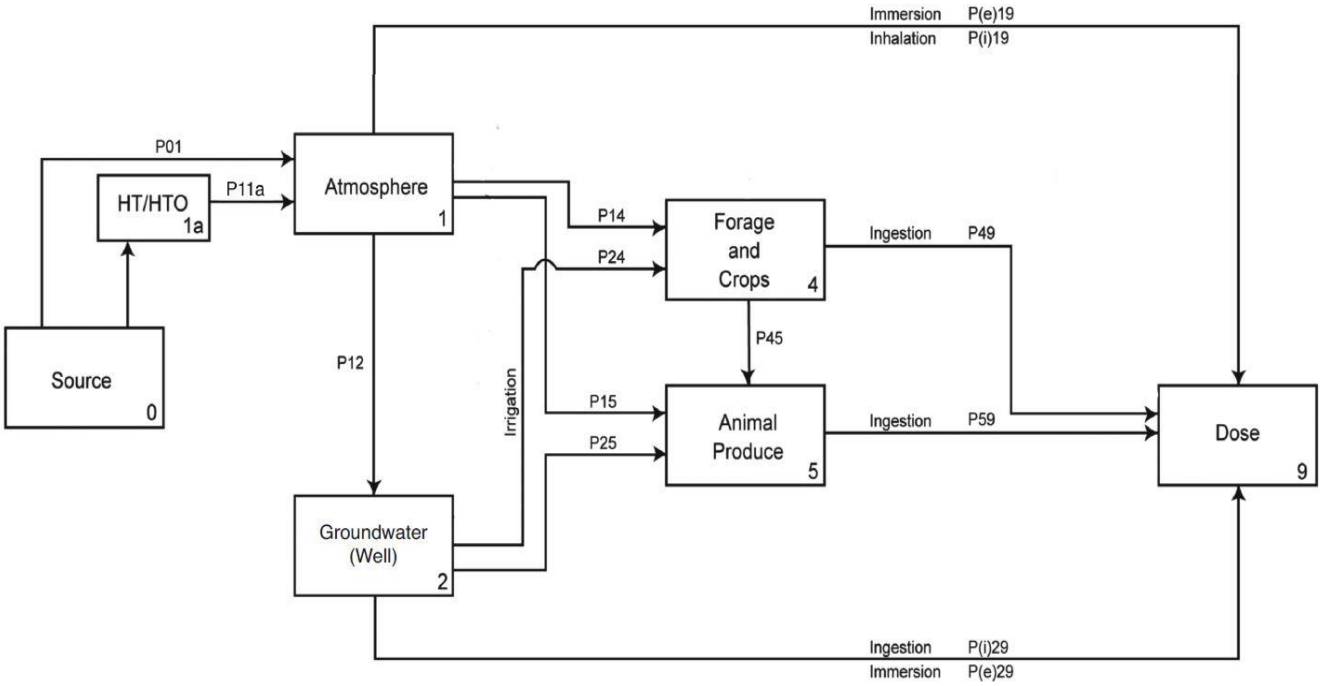


FIGURE 10: HUMAN EXPOSURE PATHWAYS (HTO/T2, LIQUID SOURCES)

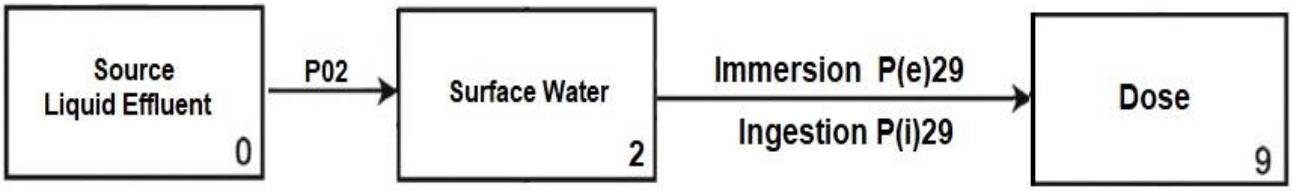


FIGURE 11: CONCEPTUAL ECOLOGICAL MODEL - TERRESTRIAL

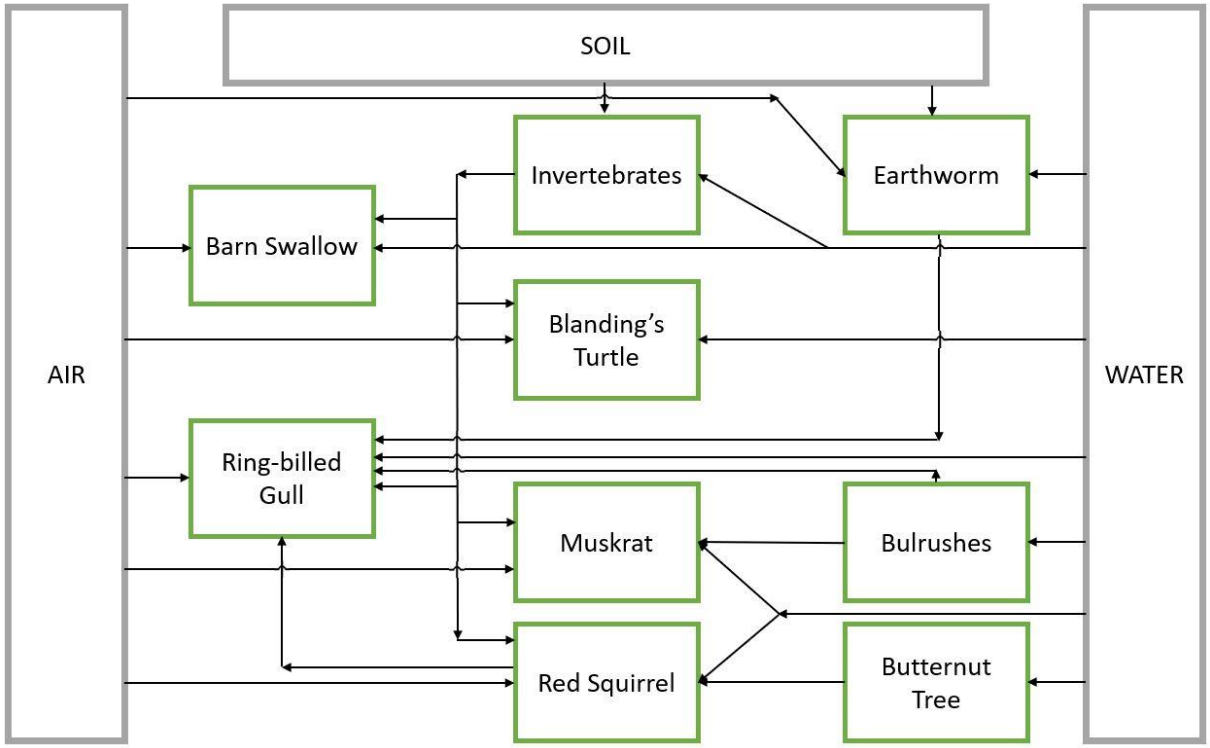
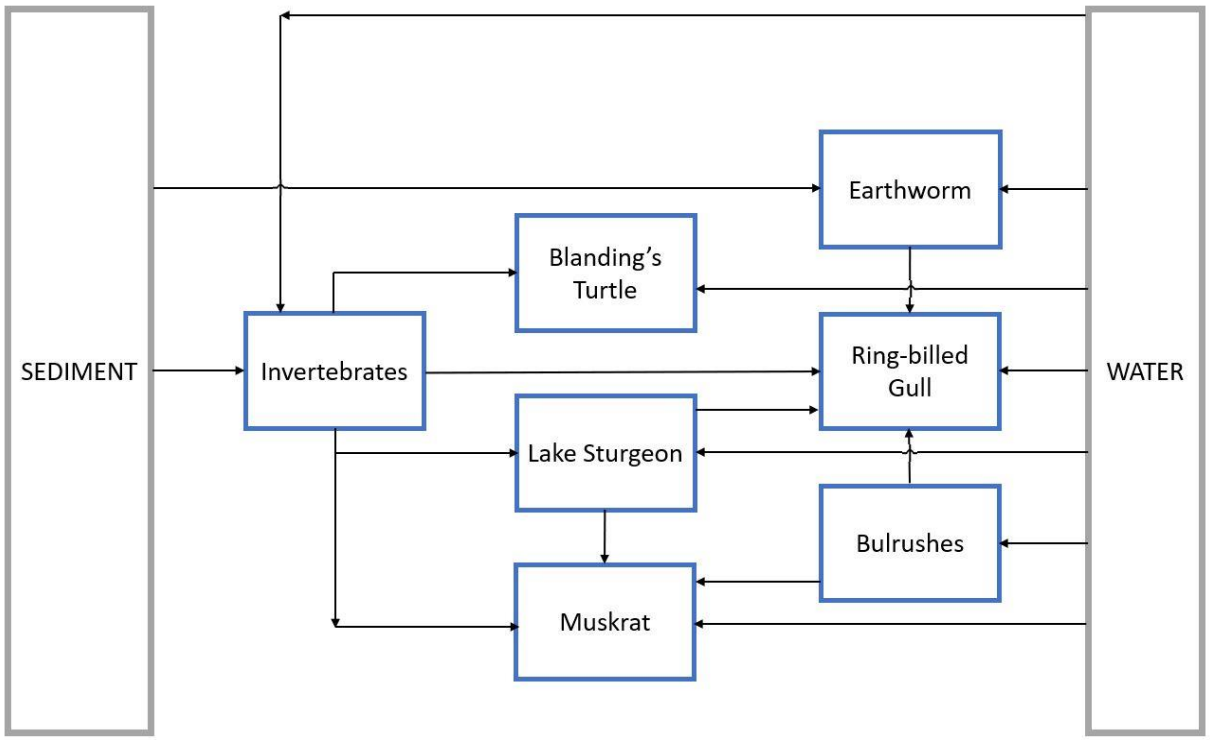


FIGURE 12: CONCEPTUAL ECOLOGICAL MODEL – AQUATIC / RIPARIAN



As part of ensuring compliance with the reporting requirements of several N288-series of standards, SRBT has committed to ensuring that the information required by each applicable in-force standard to be reported annually pertaining to the Environmental Monitoring Program (EMP), Effluent Monitoring Program (EffMP) and Groundwater Monitoring Program (GMP) is included our annual compliance report.

A summary of the requirements of each of the applicable standards is provided here.

N288.4-10: Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills: Section 11.2.2 – "The report shall include":

TABLE 14: REPORTING REQUIREMENTS (N288.4-10)

	REQUIREMENT	**REPORT SECTION**
a	The results of the EMP, including measurements of the monitored hazardous and/or nuclear substances, physical stressors, and physical and biological parameters, including their statistical analyses (i.e. assessment of changes through space and time).	4.3.1 **Appendices F through M**
	Radiation doses calculated as doses to receptors where this is required.	4.3.5 **Appendix R**
	An assessment of the EMP results compared with the previous performance indicator targets.	4.3 Reference is made to previous years for performance indication.
	Documentation and justification of any deviations from field sampling, and analytical and data management procedures.	4.3.1.10 4.3.1.11
b	A summary and assessment of the field and laboratory QA/QC results including any non-conformances.	4.3.1.12
c	A summary of the audit and review results and subsequent corrective actions.	4.3.7
d	A summary of any proposed modifications to the EMP.	4.3.8
e	Documentation, assessment and review of any supplementary studies that have been initiated, completed, or both.	4.3.1.13

N288.5-11: Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills: Section 11.2.2 – "The report shall include the results of the effluent monitoring program, including at least":

TABLE 15: REPORTING REQUIREMENTS (N288.5-11)

	REQUIREMENT	REPORT SECTION
a	The amount or concentration of radioactive nuclear substances and hazardous substances released, as required to demonstrate compliance with regulatory limits and performance with respect to any other release target (e.g., action levels).	4.3.2 Action levels and other targets: 4.3.2.2, 4.3.2.4 and 4.3.2.5 **Appendices O and P**
b	The characteristics of the effluents.	4.3.2
c	The results of any toxicity testing conducted (if required).	Not applicable
d	A summary and assessment of the field and laboratory QA/QC results, including any non-conformance.	4.3.2.6
e	A statement of uncertainties inherent in the monitoring results and any dose estimates derived from them.	4.3.2.7 Dose estimates are derived using EMP data
f	A summary of the audit and review results and subsequent corrective actions.	4.3.7
g	A summary of any proposed modifications to the effluent monitoring program.	4.3.8
h	Documentation, assessment, and review of any supplementary studies that have been initiated or completed, or both.	4.3.2.8

N288.7-15: Groundwater protection programs at Class I nuclear facilities and uranium mines and mills: Section 11.1 – "A facility should prepare annual monitoring reports documenting the GWMP, which include the following":

TABLE 16: REPORTING REQUIREMENTS (N288.7-15)

	REQUIREMENT	REPORT SECTION
a	The results of the GWMP including i) completeness of monitoring activities (identify if all planned activities were accomplished); ii) measurements of the monitored substances, biological, and hydrogeological parameters based on program objectives; and iii) data analysis and interpretations.	4.3.3 **Appendix N**
b	Relevant groundwater and hydrogeological characteristics.	4.3.3 **Appendix Q**
c	Doses calculated for the identified receptors (if doses have been calculated to aid in interpreting GWMP results).	Not applicable: GMP data does not contribute to dose calculations (residential wells fall within scope of EMP)
d	A summary and assessment of the field and laboratory QA results, including any non-conformances.	4.3.3.3
e	A statement of uncertainties inherent in the monitoring results and any dose estimates derived from them (where applicable).	4.3.3.4 4.3.5
f	Documentation of any supplementary studies that have been initiated, completed, or both (with references to the original studies).	4.3.3.5
g	An overall statement of data quality and discussion of results in terms of data performance and acceptance criteria.	4.3.3.6
h	Discussion of monitoring results in terms of program objectives and the conceptual site model.	4.3.3.7
Note 1	A summary of any audits performed, their results, and any corrective actions taken as a result of the audit's findings may also be included in the reporting.	4.3.7

4.3.1 Environmental Monitoring

SRB Technologies (Canada) Inc. implements a comprehensive EMP that provides data for site-specific determination of tritium concentrations along the various pathways of exposure to the public due to the activities of the operations.

4.3.1.1 Passive Air Monitoring

A total of 40 passive air samplers (PAS) are deployed in the environment near the SRBT facility.

Air at each location is sampled over the course of a month, and an average air concentration for that period is derived based on the concentration of tritium in the sampling liquid, and known air sample exchange rates. A minimum detectable activity of between 0.60 – 0.80 Bq/m^3 is typically achieved.

Thirty-five of these samplers are located within a two-kilometer radius from the SRBT facility, in eight sectors, ranging in stepped distances of 250, 500, 1,000, and 2,000 meters. The remaining five samplers are much further from the facility, and are intended to assess areas not expected to be impacted by routine SRBT processing operations.

Several duplicate samplers are included for quality assurance purposes. A number of samplers are also located specifically to provide data for assessment of the defined critical group members.

EMP PAS results for 2021 can be found in the table in **Appendix F** of this report, along with maps of the position of each sampler in the array. The table shows the average tritium oxide (HTO) concentrations for the samplers located in each of the eight compass sectors for the given sampling period.

Average tritium oxide in air concentrations for each month of 2021 are graphically represented for each of the eight compass sectors, and for each sampled distance from the facility, in **Appendix G** of this report.

The PAS array represents the tritium exposure pathways for inhalation and skin absorption; results are used in the calculations for effective dose to representative persons (members of the public) for 2021.

The sum of the average concentration for the passive air samplers in 2021 was 69.75 Bq/m^3, a value that reflects a decrease of 18.1% from that observed in 2020 (85.15 Bq/m^3).

Gaseous tritium oxide releases in 2021, as measured as part of the Effluent Monitoring Program, were 8,387.44 GBq, a value that reflects a decrease of 14.0% from that measured in 2020 (9,755 GBq).

The similar magnitude of the relative year-over-year change for these two key metrics provides a significant level of confidence in the data generated by both monitoring programs.

4.3.1.2 Precipitation Monitoring

Eight precipitation monitors are installed near existing air monitoring stations that are located approximately 250 m from the facility. Precipitation is collected as an aggregate sample over the course of each month, and then analyzed for tritium concentration.

Typically, SRBT's analysis of precipitation samples results in a minimum detectable activity (MDA) of between 19 - 21 Bq/L, a value which can identify significant concentrations of tritium in precipitation, and provides the resolution needed to determine the level of risk to the public and the environment.

Results in 2021 ranged between values that were below the MDA (49.5% of all samples obtained), up to a maximum of 560 Bq/L (sampler 18P during February). The maximum value measured in 2020 was 518 Bq/L.

The average tritium concentration for all eight precipitation monitors in 2021 was 46 Bq/L, which compares very well with the average of 34 Bq/L in 2020, 33 Bq/L in 2019 and 34 Bq/L in 2018.

The geographic distribution of the sample collectors, coupled with any given meteorological conditions during and shortly after tritium processing, is expected to yield some variations in the data year-to-year.

Precipitation monitoring results for 2021, along with maps showing locations, and five-year trends for each sampling location, can be found in **Appendix H** of this report.

4.3.1.3 Muskrat River Monitoring

Samples of the Muskrat River downstream from SRBT are collected and analyzed monthly, in duplicate, as part of the EMP.

Typically, SRBT's analysis of Muskrat River samples results in an MDA of around 10 - 12 Bq/L, a value which can identify significant or abnormal

concentrations of tritium in the river, and provides the resolution needed to determine the level of risk to the public and the environment.

All obtained samples of the river water in 2021 fell below the MDA for tritium concentration, with the exception of the November spot sample, when one of the two duplicate samples was analyzed by SRBT as exhibiting a concentration of 10.0 Bq/L, which was very slightly over the MDA for the analysis (MDA = 9.76 Bq/L for the November river water analysis).

The duplicate sample was measured as lower than the MDA; however, the sample above the MDA was accepted as the representative sample for that period.

Muskrat River monitoring results are trended in **Appendix I** of this report, along with a map showing the location where the sampling is routinely performed.

4.3.1.4 Downspout Runoff Monitoring

Tritium concentrations are measured in all facility downspouts (DS). The samples were collected periodically by SRBT for tritium concentration assessment. Runoff from downspouts was collected during five precipitation events during 2021, with a total of 65 samples being assessed.

In the second half of 2021, during certain periods of rainfall where qualified technicians were available to obtain samples, multiple samples from downspouts were obtained over time, with various intervals between sampling, in order to provide data on spatial and temporal variability in tritium concentrations for this sample type.

As well, operational and meteorological history between rainfall events was also assessed for certain sample sets, in order to add context to the concentrations being measured at any given time.

The complete set of data for 2021 can be found in **Appendix J**, along with a map of the sample points around the building housing the facility.

The average tritium concentration for all downspouts / facility runoff samples in 2021 was 58 Bq/L; in 2020, this value was 1,030 Bq/L. Excluding results that were less than the MDA, the average result in 2021 was 222 Bq/L.

The highest value measured was from DS-6 on June 18 (678 Bq/L), while the lowest values measured were 48 individual measurements that were less than the MDA of between 35.0 – 46.1 Bq/L.

The practice of monitoring the water that is shed from the building rooftop drainage systems (the ‘downspouts’) represents only a very brief snapshot in time of the conditions at the time of sampling.

Downspout monitoring was originally initiated as part of the efforts to characterize sources of tritium impacting the groundwater aquifer beneath the SRBT facility in the mid-2000s.

There is no significant impact from tritium present in downspout water, as demonstrated by the continuing decrease in groundwater tritium concentrations over the past several years.

It is important to recognize that there are several independent factors that influence the measured tritium concentration in any given sample, including:

- Significant rainfall after periods of time with elevated gaseous tritium-oxide releases tend to result in higher downspout concentrations being measured.
- How long it has been since a significant rainfall event has occurred – drier periods with high rates of tritium processing, followed by a significant rainfall tend to result in higher measured concentrations.
- The overlap between the time the rainfall event began and was detected, and the time it took to put tritium processing operations into a safe state. On occasion, quick onset of a heavy rainfall event can result in probable deposition from entrainment of any released tritium as processing operations are shut down.
- The time between the onset of precipitation and the act of obtaining the samples – the longer amount of time between these events, the lower the concentration of tritium is expected to be.
- Higher rainfall rates can lead to lower concentrations due to the sheer volume of water being drained; however, higher rates of rain can also cause rooftop ponding which will entrain surface tritium that may not have otherwise been taken up by a less intense rainfall.
- Weather factors during processing can influence deposition patterns. Rainfall that occurs quickly after periods of processing where west to east wind patterns dominate have a greater impact on downspout results, as opposed to other wind directions, since the active ventilation system effluent plume will drift over the facility.

4.3.1.5 Produce Monitoring

Produce from a local produce stand and from four local residential gardens were sampled in 2021.

The samples were collected and assessed by a third-party laboratory to establish free-water tritium concentration, as well as an assessment of organically-bound tritium (OBT) in specific samples (produce sample minimum detectable activity = approximately 3 Bq/kg).

The official results were compiled and reported to the participating members of the public, and are also posted on our website. This data is used in the calculations for annual estimated dose to the public for 2021.

The average free water tritium concentration in all produce offered by local residents in 2021 was 60.7 Bq/kg, a value that is comparable to the 2020 value of 29.8 Bq/kg.

The maximum measured value in 2021 was 117 Bq/kg measured in a sample of tomatoes; this measurement represents 0.12% of the SRBT benchmark value, as well as the CNSC Independent Environmental Monitoring Program screening value for free water tritium in fresh produce.

The average free water tritium concentration in locally-grown produce offered by commercial entities was measured as 3.7 Bq/kg, a measurement that is very comparable with the value of 3 Bq/kg obtained in 2020 from the same commercial farm gate.

For OBT, samples of tomatoes from a nearby residential garden showed a concentration of 1 Bq/kg, while tomatoes from the commercial garden were measured at 4 Bq/kg.

Produce monitoring results and maps showing produce sampling locations for calendar year 2021 can be found in **Appendix K** of this report, along with graphs comparing the five-year trends of each location.

4.3.1.6 Milk Monitoring

Milk from both a local producer and from a local distributor is sampled every four months. The samples were collected and analyzed for tritium concentration by a qualified third-party laboratory. This data is also used in the calculations for critical group annual estimated dose for 2021.

Tritium concentrations in milk remained very low; all assayed samples were reported by the third-party laboratory to have measured less than the MDA of 4 Bq/L. Milk monitoring results for 2021 can be found in **Appendix L** of this report.

4.3.1.7 Weather Data

A weather station near the facility collects data on a continuous basis. See weather data for 2021 in **Appendix M**.

Note that beginning with the April 2020 data, it became apparent that the weather station sensors that determine wind speed and direction had malfunctioned. A period of downtime followed while corrective maintenance and component replacement were planned. After experiencing several shipment delays with replacement parts, the weather station was put fully back into service in September 2021.

Weather data is primarily used as part of the continuous meteorological characterization of the site over time, in support of the establishments of Derived Release Limits and the Environmental Risk Assessment. The loss of weather station data over the time period in question has no bearing on operational safety or compliance.

4.3.1.8 Residential Drinking Water

Several nearby local residences permit SRBT to acquire samples of drinking water during the year, to provide additional data for our program.

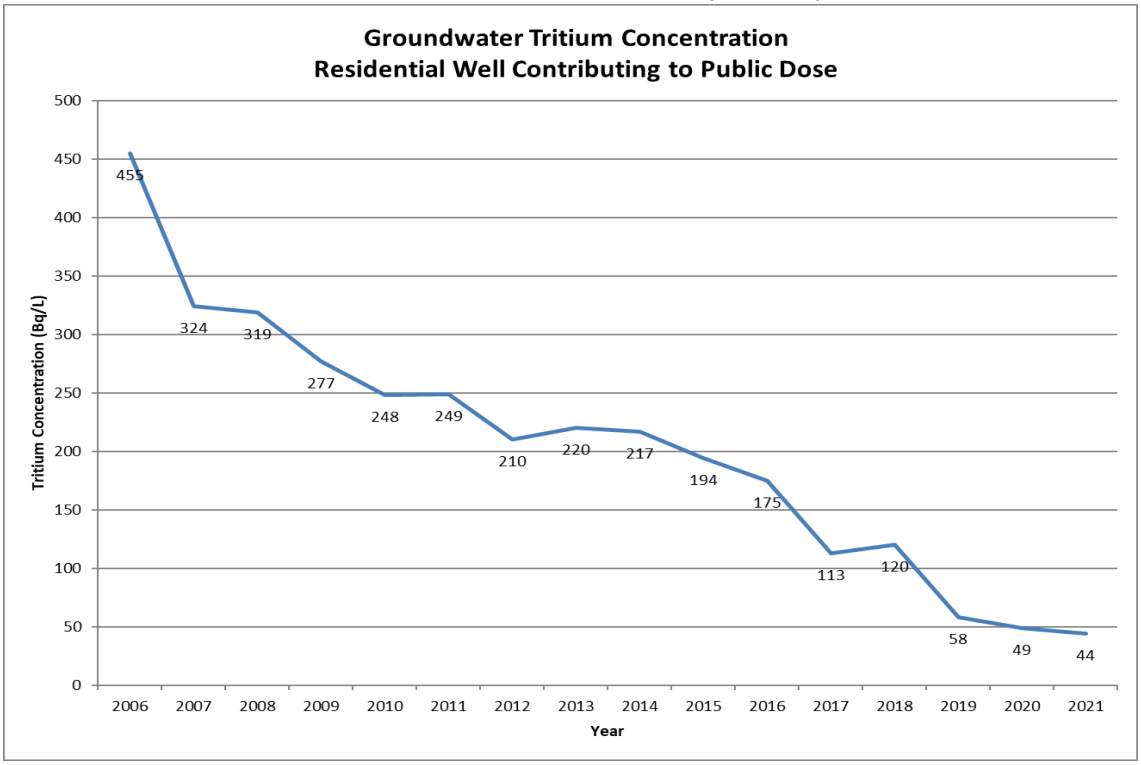
In 2021, the frequency of this sampling activity was reduced from three times per calendar year to twice a year (March and September) as part of a revision of the Environmental Monitoring Program; however, three samples were still obtained in 2021 (March, July, September).

A qualified, independent third-party laboratory collects and analyzes residential drinking water samples (MDA = approximately 3 – 4 Bq/L).

In 2021, the highest residential well tritium concentration value was measured as 44 Bq/L (in July at RW-3), a value that is well below the Ontario Drinking Water Quality Standard of 7,000 Bq/L. In 2020, the highest measured value was measured as 49 Bq/L (in March 2020 from RW-3).

Figure 13 illustrates the trend in maximum sampled tritium concentration in all sampled residential wells, since the program of monitoring began in 2006.

FIGURE 13: RESIDENTIAL WELL TRITIUM CONCENTRATION TREND (2006-2021)



Derived public dose values attributed to residential well water consumption have decreased since the inception of the monitoring program as a direct result of our efforts to minimize our environmental impact.

Residential well monitoring results for 2021 can be found in **Appendix N** of this report.

4.3.1.9 Deviations from Field Sampling Procedures

In 2021, there were no noted occurrences of deviations from field sampling procedures.

SRBT performs field sampling activities in accordance with internal procedures for the following sample types:

- EMP passive air sampling
- Precipitation
- Muskrat River
- Facility downspouts

Qualified independent service providers continue to sample and analyze the following sample types:

- Produce
- Milk
- Residential drinking water
- Sludge cake from the Pembroke Pollution Control Centre

4.3.1.10 Deviations from Analytical and Data Management Procedures

In 2021, there were no noted occurrences of deviations from analytical and data management procedures.

SRBT routinely analyzes the following sample types, in accordance with internal procedures:

- EMP passive air sampling
- Precipitation
- Muskrat River
- Facility downspouts

Qualified independent service providers continue to analyze the following sample types:

- Produce
- Milk
- Residential drinking water
- Sludge cake from the Pembroke Pollution Control Centre

4.3.1.11 Field and Laboratory QA/QC Results and Non-conformances

Field and laboratory EMP operations include several quality assurance and quality control (QA/QC) activities.

Field QA/QC activities include duplicate sampling of five passive air sampler stations, duplicate sampling of the Muskrat River, and the use of trip / method blanks for samples obtained in the field.

Laboratory QA/QC activities include duplicate samples and blanks, as well as laboratory reference standards. Sample QC is tested using spike recovery and relative percent difference (RPD) tests.

The following table illustrates the five-year trend in pertinent QA/QC acceptance criteria data for the EMP:

TABLE 17: EMP QUALITY CONTROL DATA (2017-2021)

CALENDAR YEAR	2017	2018	2019	2020	2021
BENCHMARK VALUE EXCEEDANCES	0	0	0	0	0
DUPLICATE RPD EXCEEDANCES	2	1	4	10	7
REFERENCE STANDARD ACCURACY EXCEEDANCES	0	0	0	0	0
BLANK SAMPLE COUNT RATE > MAX ACCEPTABLE	0	0	0	0	0
SAMPLE ACQUISITION SUCCESS RATE	98.8%	98.8%	98.5%	98.5%	98.6%
QC CHECK PASS RATE	99.1%	99.6%	98.3%	96.6%	99.2%

In 2021, 626 of 635 planned, routine environmental samples were successfully obtained. The nine samples not successfully obtained included:

- Six PAS samples were either lost or spoiled in the field,
- One precipitation sample was spoiled in the field,
- One residential well not being sampled due to resident request in March, and
- One residential garden not being sampled due to lack of confirmation of access to the property the day of sampling.

A total of 905 of 912 EMP acceptance criteria / QC checks / benchmark value comparisons passed their check (99.2%). Most importantly, no measured EMP sample exceeded established benchmark values in 2021.

The seven failed QC checks all related to the derivation of an RPD greater than 40% between two duplicate sample results for passive air sampling. SRBT deploys duplicate samplers at four locations within 250 m of the facility. In five of these cases, the failure was evaluated as an artifact of the calculation when the compared values are low in terms of absolute values. Instances of this type of QC check failure are handled on a case-by-case basis, with the higher of the two compared values being conservatively taken as the measurement of record.

In one case, the RPD check failed two months in a row at the same location of two duplicate passive air samplers. The first action taken was to ‘blow-out’ the sampler orifice with compressed air in order to ensure that it was free of dust or dirt. The second action taken was to swap out the orifice heads of both units, and reposition the sampler cages so that they were equidistant from the ground. There have been no significant failures of the RPD check at this location since.

In the first two months of the year, continuing elevated sample blank values measured during EMP sample analysis suggested that cross-contamination remained an issue when sample materials were being prepared in the facility.

As a result, a new set of procedures were implemented where EMP sample materials were prepared for deployment at an off-site location. Samples were only brought into the facility once they were ready for liquid scintillation counting.

This process has proven to be extremely effective at eliminating cross-contamination of sample materials, and lowering the minimum detectable activity for all EMP samples.

4.3.1.12 Supplementary Studies

No supplementary studies were conducted relating to the EMP; however, a new procedure was implemented for the first time where a special annual sampling campaign (SASC) was conducted, focused on media that has not been traditionally sampled as a matter of routine under the SRBT EMP prior to the ERA process having been completed.

The data collected as a result of the SASC will be used as input into future revisions of the ERA.

The sample types obtained in 2021 included:

- Muskrat River water at two locations not previously sampled,
- Muskrat River sediment,
- Riparian and aquatic vegetation in and near the Muskrat River,
- Organically-bound tritium in sampled milk,
- Average tritium concentration in air at the Pembroke Pollution Control Centre,
- Sampling of various plants that are culturally or economically significant to the Algonquins of Pikwakanagan First Nation (AOPFN).

In all cases except one, the value for tritium concentration measured in the obtained samples were well below the selected benchmark values, indicating that the assumptions made in the Environmental Risk Assessment are conservative and valid for purpose.

The sole sample that exceeded a benchmark value was for the raspberry leaves sampled in the Pikwakanagan community.

Prior to the analysis, the selected benchmark was set at 10 Bq of OBT per kg of plant material. This value was semi-arbitrarily based on being approximately half of the value of 21 Bq/kg OBT, as measured in apples in this area by the CNSC in 2009[39]. The selected benchmark was chosen to be approximately half of this value.

The OBT measurement in the raspberry leaves was reported as 30.3 Bq/kg. As the measured value exceeded the benchmark, further assessment of the impact of this measurement was required.

This assessment was documented in a letter to the Algonquins of Pikwakanagan First Nation[40], where through the application of conservative assumptions on consumption characteristics, it is shown that the worst-case dose imparted would be very likely be less than 1 μSv per year.

The SASC will be conducted again in 2022, with sample selection and benchmark values to be determined in July in consultation with stakeholders if possible.

4.3.2 Effluent Monitoring

SRBT monitors two main effluent streams from the facility for tritium as part of our Effluent Monitoring Program (EffMP).

Tritium releases via the gaseous effluent pathway (active ventilation) are monitored in real time using 'bubbler' capture systems, with integrated measurements being conducted weekly to determine total emissions and verify compliance with licence limits and action levels.

Liquid effluent is retained in batches and analyzed for tritium concentration prior to being released to sewer.

4.3.2.1 Gaseous Effluent

In 2021, SRBT operated well within release limits to atmosphere that are prescribed as part of the operating licence of the facility.

The nuclear substance processing facility operating licence (NSPFOL-13.00/2022)[1] references limits defined in Appendix E of the Licence Conditions Handbook[2].

A summary of the releases of tritium oxide and total tritium in 2021 is tabulated below:

TABLE 18: GASEOUS EFFLUENT DATA (2021)

NUCLEAR SUBSTANCE AND FORM	ANNUAL LIMIT (GBq)	2021 RELEASED (GBq)	% LIMIT	WEEKLY AVERAGE (GBq)	HIGHEST WEEKLY RELEASE (GBq)
TRITIUM AS TRITIUM OXIDE (HTO)	67,200	8,387	12.48%	161	380 *(Aug. 24-31)*
TOTAL TRITIUM AS TRITIUM OXIDE (HTO) AND TRITIUM GAS (HT)	448,000	28,729	6.41%	553	1,346 *(Jun. 8-15)*

Please refer to **Appendix O** for a complete data set on tritium releases to atmosphere in 2021.

Details on the past five years of gaseous effluent data are provided below for ease of trend analysis:

TABLE 19: GASEOUS EFFLUENT FIVE-YEAR TREND (2017-2021)

NUCLEAR SUBSTANCE AND FORM	RELEASED 2017 (GBq)	RELEASED 2018 (GBq)	RELEASED 2019 (GBq)	RELEASED 2020 (GBq)	RELEASED 2021 (GBq)
TRITIUM OXIDE (HTO)	7,198	10,741	11,858	9,755	8,387
TOTAL TRITIUM AS TRITIUM OXIDE (HTO) AND TRITIUM GAS (HT)	24,822	33,180	31,769	25,186	28,729

When analyzing the operation's performance at reducing emissions it is important to assess the releases to atmosphere against the amount of tritium the facility processed. This provides an indication at how effective emission reduction initiatives have been successful in reducing emissions.

The following table defines the ratio of tritium released to atmosphere against tritium processed in the past five years.

TABLE 20: TRITIUM RELEASED TO ATMOSPHERE vs PROCESSED (2017-2021)

YEAR	TRITIUM RELEASED TO ATMOSPHERE (GBq/YEAR)	TRITIUM PROCESSED (GBq/YEAR)	% RELEASED TO PROCESSED	% INCREASE (+) REDUCTION (-)
2017	24,822	32,968,695	0.08	-20%
2018	33,180	31,251,329	0.11	+38%
2019	31,769	30,327,048	0.10	-10%
2020	25,186	27,887,498	0.09	-10%
2021	28,729	29,392,257	0.10	+11%

In 2021, the ratio of tritium released versus processed rose by 11% versus the 2020 value.

SRBT was able to achieve our internal target for this metric of 0.11% for the year.

4.3.2.2 Air Emission Targets

SRBT set an annualized total tritium emission target at the beginning of 2021 of ≤ 625 GBq / week (averaged over the year), and was successful in meeting this target (553 GBq / week).

For calendar year 2022, SRBT has put in place a tritium emission target of 625 GBq / week or less, on average, based upon projected production rates, and the value achieved in 2021.

The 2021 targeted tritium released to processed ratio of ≤ 0.11% was achieved (0.10%). The 2022 target has been again set at 0.11%.

4.3.2.3 Liquid Effluent

In 2021, SRBT operated well within release limits to sewer that are prescribed as part of the operating licence of the facility, as defined in Appendix E of the Licence Conditions Handbook[2].

TABLE 21: LIQUID EFFLUENT DATA (2021)

NUCLEAR SUBSTANCE AND FORM	LIMIT (GBq/YEAR)	RELEASED (GBq/YEAR)	% OF LIMIT
TRITIUM – WATER SOLUBLE	200	3.07	1.53%

Total liquid effluent releases in 2021 decreased when compared to 2020 values (3.07 GBq in 2021 vs 5.56 GBq in 2020).

Details on the past five years of liquid effluent data are provided below for ease of trend analysis:

TABLE 22: LIQUID EFFLUENT FIVE-YEAR TREND (2017-2021)

NUCLEAR SUBSTANCE AND FORM	RELEASED 2017 (GBq)	RELEASED 2018 (GBq)	RELEASED 2019 (GBq)	RELEASED 2020 (GBq)	RELEASED 2021 (GBq)
TRITIUM – WATER SOLUBLE	6.85	10.02	13.67	5.56	3.07

Please refer to **Appendix P** for a complete data set of liquid effluent releases to sewer in calendar year 2021.

4.3.2.4 Liquid Effluent Target

SRBT set a total tritium release target at the beginning of 2021 of ≤ 11 GBq for the year, a target that was achieved. SRBT has set the total liquid effluent release target at 10 GBq for 2022.

4.3.2.5 Action Level Exceedances

In 2021, there were no instances of an action level exceedance related to gaseous or liquid effluent monitoring at SRBT.

4.3.2.6 Summary of Field and Laboratory QA/QC

Effluent monitoring activities include several procedural steps that ensure acceptable quality assurance and control, including duplicate / triplicate sample acquisition and measurement, the use of process blanks, and the measurement of known reference standards as part of the assay of activity in collected sample media.

All EffMP QA/QC results obtained in 2021 were acceptable with no identified non-conformances.

4.3.2.7 Statement of Uncertainties Inherent in Monitoring Results

Uncertainties associated with effluent monitoring at SRBT may be present at several points in the process.

For gaseous effluent, such uncertainties include: sampling representativeness, total airflow collected, catalytic efficiency of HT to HTO conversion, capture efficiency of sample media, standard measurement errors associated with liquid scintillation counting, sample acquisition errors such as volume of drawn sample for analysis, and errors in stack flow rate and differential pressure measurement.

For liquid effluent, such uncertainties include: sample volume, liquid effluent volume, standard measurement errors associated with liquid scintillation counting, and sample acquisition errors such as volume of drawn sample for analysis.

In order to ensure that the uncertainties inherent in monitoring results are kept acceptably low, SRBT ensures that a third-party laboratory conducts independent verification procedures on the gaseous effluent monitoring system on an annual basis.

The acceptance criterion for deviation between the assessed measurements of gaseous emissions is +/- 30%. In 2021, all results were within this acceptance criteria, with SRBT measurements ranging between 73-113% of those obtained by the independent third party over the course of the intercomparison activity.

The QA/QC processes associated with gaseous effluent monitoring contribute to the confidence in the results. This includes independent verification of the assessment of gaseous releases at several levels. As well, the data gathered from the EMP is assessed against the data from the gaseous effluent monitoring process on a frequent basis to verify that results are relatively consistent with each other.

For liquid effluent, uncertainties inherent in monitoring results are addressed by QA/QC processes associated with liquid effluent monitoring, as well as independent verification of the assessment of releases.

The inherent uncertainties associated with effluent monitoring are well within acceptable bounds when contrasted against the measured releases, and the licenced limits for releases by each pathway.

4.3.2.8 Supplementary Studies

In 2021, no supplementary studies were conducted relating to effluent monitoring at SRBT.

4.3.2.9 Hazardous Substance Releases

In 2021, SRBT continued to operate the facility under a Certificate of Approval (Air), number 5310-4NJQE2, issued by the Ontario Ministry of the Environment in accordance with section 9 of the Ontario Environmental Protection Act.

No hazardous non-radiological substances are released from the facility through either gaseous or liquid effluent pathways in any significant quantity.

4.3.3 Groundwater Monitoring

SRBT implements and maintains a comprehensive Groundwater Monitoring Program (GMP) as part of our Groundwater Protection Program.

Dedicated, engineered sampling wells are used to establish tritium concentrations in the groundwater each month at various depths and in differing geologic strata. Variations are trended over time to measure the response of historical contamination of the local aquifer.

Since the program was established, groundwater measurements have been in very good agreement with established hydrogeological modelling predictions.

While most of the released tritium in the air is dispersed, some of it will reach the soil through dry and wet deposition. Infiltrated precipitation brings tritium into the groundwater below it. The deposition of tritium on and around the facility from air emissions and resulting soil moisture and standing water are the sole direct contributor to tritium found in groundwater.

Groundwater is affected by the percolation of soil moisture and standing water from the surface. Current concentrations in the wells are expected to gradually decrease once all historical emissions have flushed through the system and/or decayed with some influence of higher concentrations in nearby wells from lateral underground water flow.

This continues to be confirmed by routine monitoring of the existing network of wells. The rate at which this decrease will occur is dependent on the level and speed of recharge of the groundwater on and around the SRBT facility.

The Groundwater Monitoring Program was revised in July to incorporate a change to the sampling frequency of groundwater monitoring wells from monthly to quarterly, in consultation with CNSC staff, who accepted this change on August 25, 2021[26].

Data over the past several years demonstrates stability over time, justifying a less frequent sampling regime. Should negative trends develop at any time in the future, the frequency of sampling can be reviewed.

4.3.3.1 Groundwater Tritium Concentration

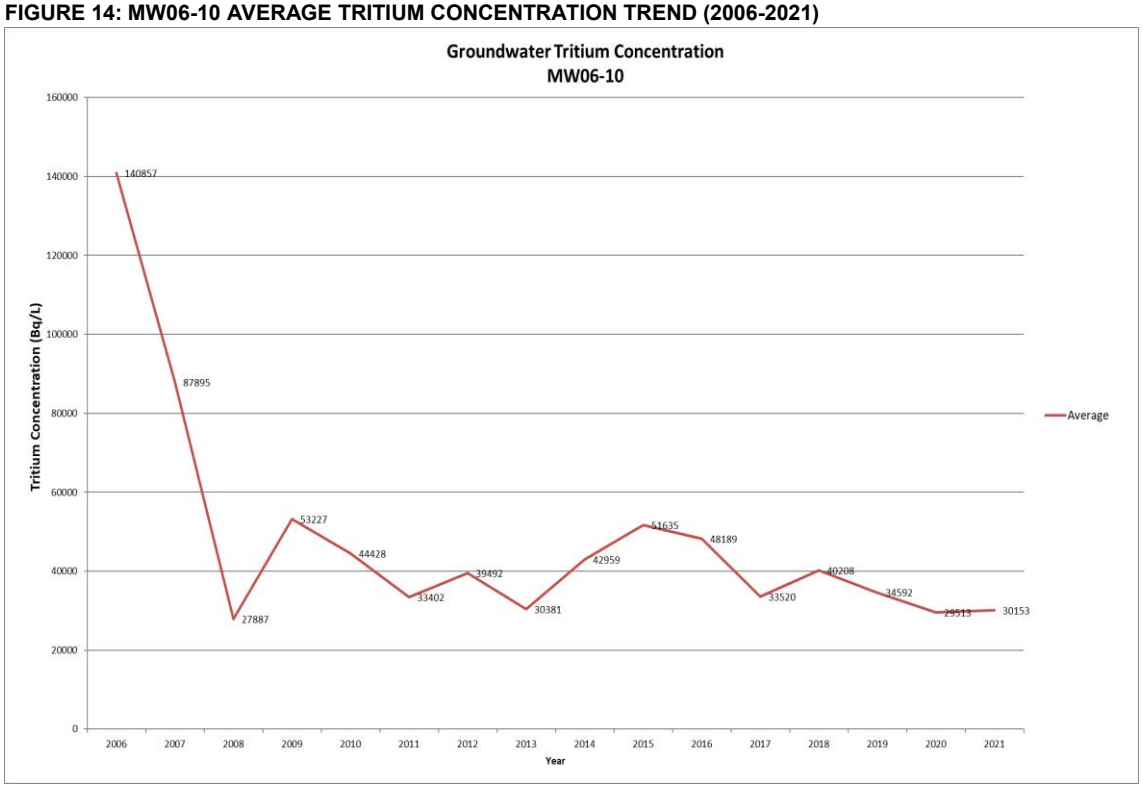
Groundwater monitoring well results for 2021 can be found in **Appendix N** of this report.

MW06-10: The highest average tritium concentration in any well remains in monitoring well MW06-10 which is directly beneath the area where the active ventilation stacks are located. As of the end of 2021, this represents the only well where tritium concentration exceeds the Ontario Drinking Water Guideline value of 7,000 Bq/L.

The average concentration of tritium measured in MW06-10 in 2021 was 30,153 Bq/L, a value that is slightly greater than the average measured in 2020 (29,513 Bq/L). This increase is not viewed as significant.

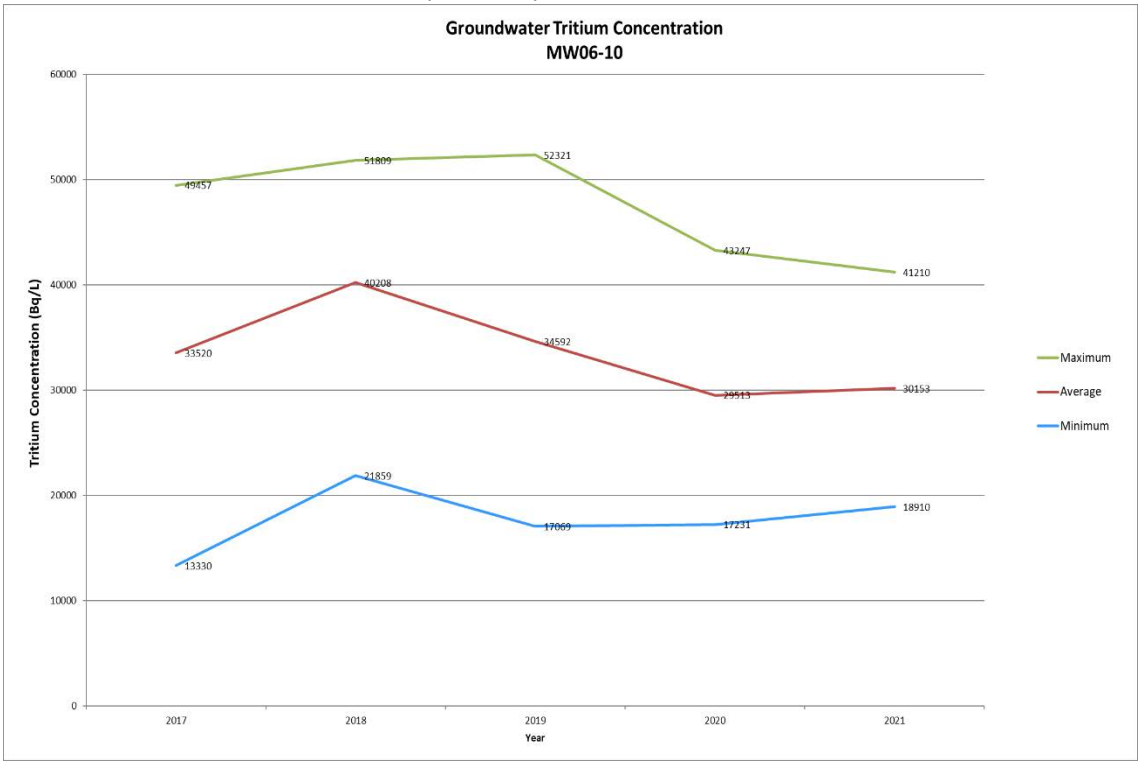
A graph trending the average annual concentration of tritium in MW06-10 since commissioning of the well is Figure 14.

FIGURE 14: MW06-10 AVERAGE TRITIUM CONCENTRATION TREND (2006-2021)



The five-year trend is highlighted in Figure 15 in red, along with trends of the maximum (green) and minimum (blue) monthly measurements each year.

FIGURE 15: MW06-10 FIVE-YEAR TREND (2017-2021)

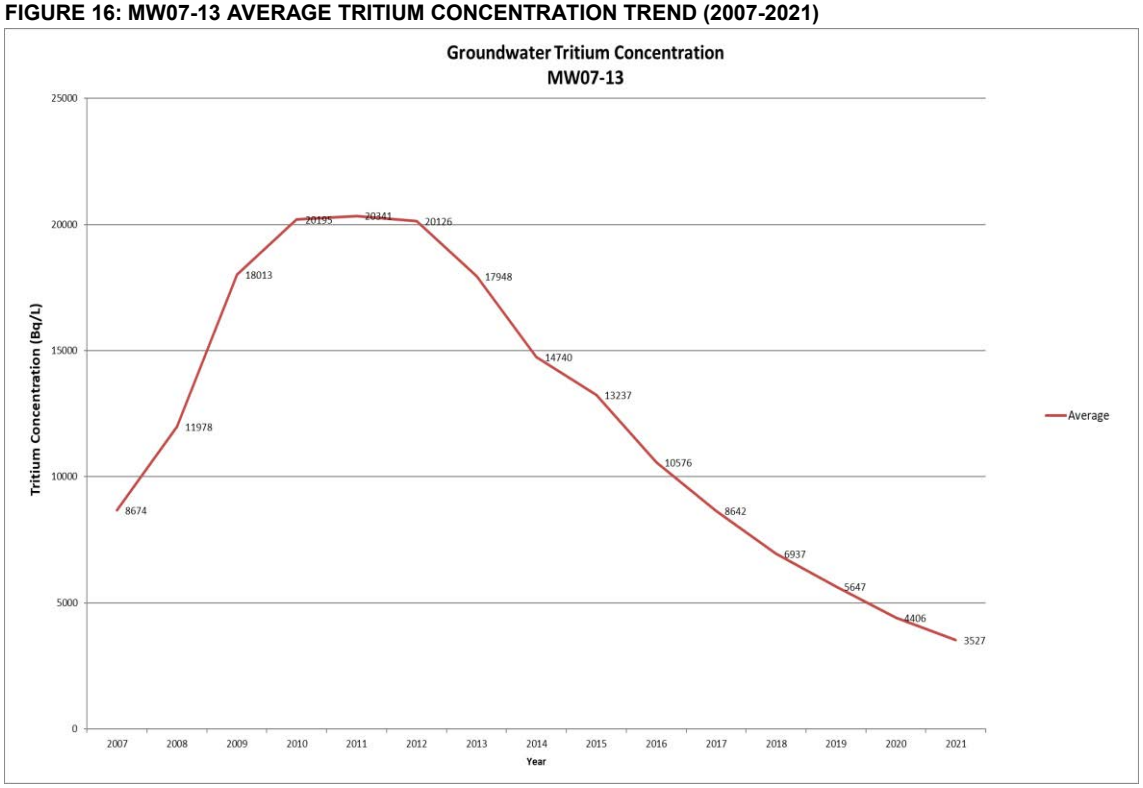


MW07-13: The average concentration of MW07-13 continues to fall; in 2021 the average measurement was 3,527 Bq/L. This well exhibits the highest tritium concentration of any monitoring well, other than MW06-10.

This well was the last monitoring well to have been measured above the provincial drinking water guideline value of 7,000 Bq/L (April 2018). The concentration of tritium at this location has continued to consistently trend downward over time, averaging 4,406 Bq/L in 2020, 5,647 Bq/L in 2019, 6,937 Bq/L in 2018, and 8,642 Bq/L in 2017.

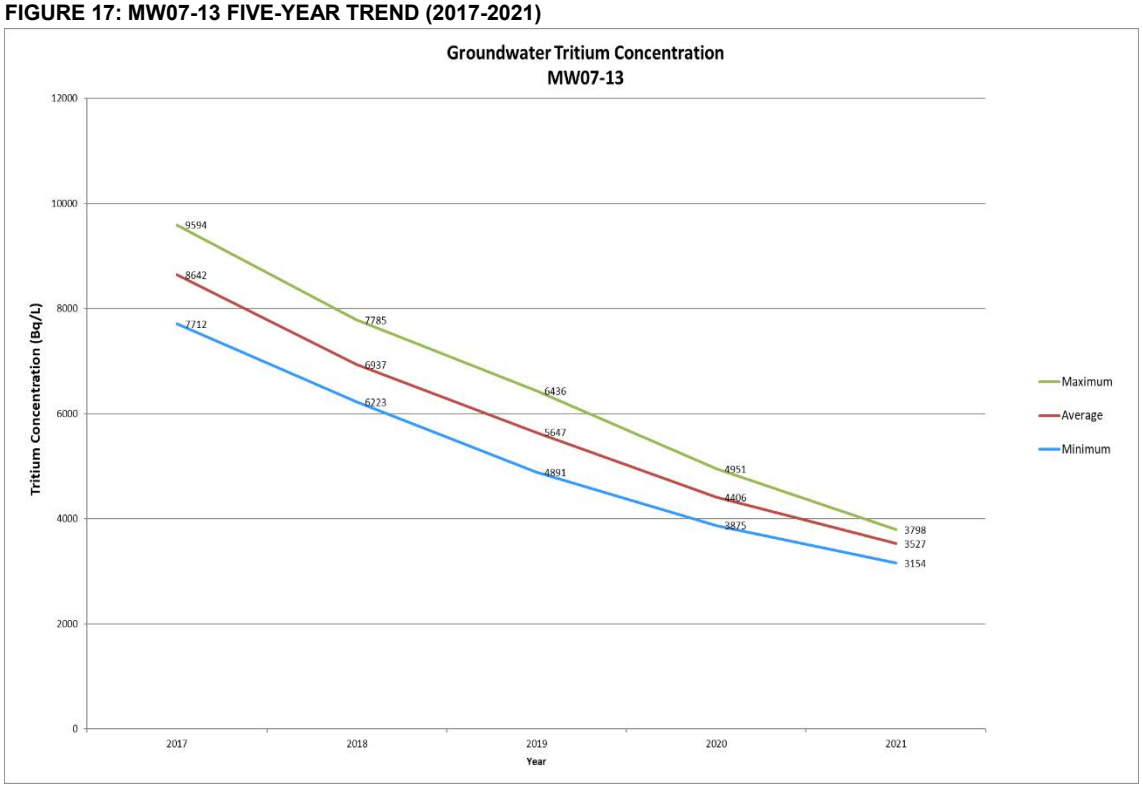
A graph trending the average annual concentration of tritium in MW07-13 since commissioning of the well is Figure 16.

FIGURE 16: MW07-13 AVERAGE TRITIUM CONCENTRATION TREND (2007-2021)



The five-year trend is highlighted in Figure 17 in red, along with trends of the maximum (green) and minimum (blue) monthly measurements each year.

FIGURE 17: MW07-13 FIVE-YEAR TREND (2017-2021)



Looking back over the term of the current licence, tritium concentrations in all monitoring wells have continued to decline.

Average annual concentrations across all dedicated monitoring wells in 2021 are **less than half** of measured values in 2015.

Well MW06-1 has shown the greatest change (85% decrease compared to 2015 conditions), while MW07-12 exhibited the smallest change (6%).

In 2021, 25 out of 29 SRBT-installed groundwater monitoring wells exhibited an average tritium concentration that was lower than the previous year. Only four wells exhibited a higher annual average concentration compared to 2020:

- MW06-10 was 2.2% higher on average (30,153 vs. 29,513 Bq/L)
- MW07-12 was 3.2% higher on average (435 vs. 422 Bq/L)
- MW07-17 was 8.9% higher on average (296 vs. 272 Bq/L), and
- MW07-31 was 78.7% higher on average (325 vs. 182 Bq/L).

The following table compares the annualized average tritium concentration of the 29 dedicated, SRBT-installed groundwater monitoring wells for seven years, between 2015 through 2021.

TABLE 23: 2015-2021 AVERAGE TRITIUM CONCENTRATION IN MONITORING WELLS

Well ID	2021	2020	2019	2018	2017	2016	2015	2021/2020	2021/2019	2021/2018	2021/2017	2021/2016	2021/2015
	(Annualized average tritium Bq/L)							(%)					
MW06-1	651	762	1,045	1,334	1,946	2,753	4,338	85.4	62.3	48.8	33.4	23.6	15.0
MW06-2	736	877	1,031	1,160	1,166	1,467	1,965	84.0	71.5	63.5	63.2	50.2	37.5
MW06-3	199	244	367	469	683	1,029	1,218	81.5	54.2	42.4	29.1	19.3	16.3
MW06-8	550	579	679	724	780	848	906	94.9	81.0	76.0	70.5	64.9	60.7
MW06-9	1,366	1,527	1,774	1,952	2,224	2,476	2,731	89.5	77.0	70.0	61.4	55.2	50.0
MW06-10	30,153	29,513	34,592	40,208	33,520	48,189	51,635	102.2	87.2	75.0	90.0	62.6	58.4
MW07-11	858	924	1,053	1,122	1,099	1,344	1,521	92.9	81.4	76.4	78.0	63.8	56.4
MW07-12	435	422	425	468	467	469	463	103.2	102.5	93.0	93.2	92.8	93.9
MW07-13	3,527	4,406	5,647	6,937	8,642	10,576	13,237	80.0	62.5	50.8	40.8	33.3	26.6
MW07-15	1,076	1,262	1,399	1,505	1,617	1,810	1,680	85.2	76.9	71.5	66.5	59.4	64.1
MW07-16	897	1,003	1,240	1,433	1,649	1,879	2,188	89.4	72.4	62.6	54.4	47.8	41.0
MW07-17	296	272	338	359	335	602	780	108.9	87.6	82.4	88.4	49.1	37.9
MW07-18	1,102	1,494	2,000	2,192	2,739	3,690	5,491	73.8	55.1	50.3	40.3	29.9	20.1
MW07-19	959	1,198	1,468	1,889	1,926	2,500	3,222	80.0	65.3	50.7	49.8	38.3	29.7
MW07-20	296	326	438	498	571	670	775	90.6	67.6	59.4	51.8	44.2	38.2
MW07-21	363	393	545	778	879	1,009	1,121	92.5	66.7	46.7	41.4	36.0	32.4
MW07-22	729	783	921	974	1,023	1,131	1,171	93.0	79.2	74.9	71.2	64.5	62.2
MW07-23	1,147	1,252	1,443	1,572	1,743	1,929	2,206	91.6	79.4	72.9	65.8	59.5	52.0
MW07-24	1,511	1,644	1,839	1,928	2,022	2,206	2,314	91.9	82.2	78.4	74.8	68.5	65.3
MW07-26	421	514	697	904	1,190	1,491	1,941	81.9	60.5	46.6	35.4	28.3	21.7
MW07-27	1,696	1,994	2,683	3,136	3,589	4,292	4,869	85.1	63.2	54.1	47.3	39.5	34.8
MW07-28	670	705	843	1,017	1,063	1,311	1,446	95.0	79.5	65.9	63.1	51.1	46.4
MW07-29	1,075	1,485	2,058	2,415	2,472	3,395	3,950	72.4	52.2	44.5	43.5	31.7	27.2
MW07-31	325	182	352	407	186	440	756	178.7	92.4	79.8	174.8	73.8	43.0
MW07-32	54	59	75	70	76	155	128	92.1	72.4	78.1	71.5	35.1	42.5
MW07-34	1,153	1,297	1,526	1,889	2,291	2,822	3,312	88.9	75.6	61.0	50.4	40.9	34.8
MW07-35	1,550	1,898	2,256	2,637	3,015	3,448	3,945	81.7	68.7	58.8	51.4	45.0	39.3
MW07-36	1,154	1,468	1,716	2,008	2,109	2,618	2,892	78.6	67.3	57.5	54.7	44.1	39.9
MW07-37	717	763	821	830	871	989	1,009	94.1	87.4	86.4	82.3	72.6	71.1
AVERAGE	**1,920**	**2,043**	**2,458**	**2,856**	**2,824**	**3,708**	**4,249**	**94.0**	**78.1**	**67.2**	**68.0**	**51.8**	**45.2**

In Table 23, comparisons are made in the columns on the right-hand side of the table using a three-colour gradient, where green indicates decreasing concentrations, white indicating stable, and red indicating a relative increase.

The magnitude of the increases in the four wells that exhibited a rise in average tritium concentration is not significant from the perspective of risk. All observed increases are either very small in proportional (MW06-10) or absolute terms, and are not viewed to be indicative of an adverse trend or represent operational impact.

Several factors can influence the concentration of tritium in any given well, including the rate of precipitation accumulation, contaminant dispersion patterns, and the lateral and vertical migration of historical contaminant plumes. Measured concentrations are also reflective of operational conditions from many years ago.

4.3.3.2 Groundwater Level Measurements

The water levels are measured in monitoring wells prior to purge and sampling. Analysis of this data shows consistent trends from year to year when comparing season to season.

A compilation of groundwater level measurements for 2021 can be found in **Appendix Q** of this report.

4.3.3.3 Summary of Field and Laboratory QA/QC

Field and laboratory operations pertaining to groundwater monitoring include several quality assurance and quality control activities.

Quality control activities include duplicate sampling of certain wells, duplicate laboratory subsampling, and the use of trip / method blanks during sampling campaigns.

As well, several quality control checks are performed as part of the liquid scintillation counting procedures employed by both the third party and SRBT.

In 2021, 264 samples of groundwater were successfully obtained and analyzed, with all planned groundwater monitoring activities being accomplished, except for the three instances where MW06-3 was found to be dry (February, March, September).

As such, 98.9% of all GMP samples were successfully obtained and measured in 2021, which is an excellent rate of sampling success.

There were no failures of field or laboratory quality control checks for GMP data during 2021.

SRBT's Groundwater Monitoring Program requires the completion of an inter-laboratory testing exercise on an annual basis. This exercise is typically completed during the May sampling period.

Five groundwater monitoring wells were sampled by SRBT in duplicate on May 5, 2021, and subsequently analyzed for tritium concentration by both SRBT and a qualified, independent laboratory.

The results obtained fell well within the acceptance criteria of +/-20% relative difference, adding confidence in the quality and accuracy of the data generated by the program.

4.3.3.4 Statement of Uncertainties Inherent in Monitoring Results

Uncertainties associated with SRBT groundwater monitoring may be present at certain points in the process.

The main uncertainties relate to standard measurement errors associated with liquid scintillation counting, and sample acquisition errors such as volume of drawn sample for analysis.

In order to provide assurance of accuracy and precision, SRBT conducts an intercomparison sampling and analysis activity with our primary contracted third party in May, as required by the GMP.

Five wells were sampled and measured by SRBT concurrently with the third party, with good agreement between the results obtained in-house and those obtained by the contracted service provider.

The inherent uncertainties associated with groundwater monitoring are well within acceptable bounds when contrasted against the tritium concentrations that may present an unacceptable risk to the public.

4.3.3.5 Supplementary Studies

In 2021, no supplementary studies were conducted relating to groundwater monitoring at SRBT.

4.3.3.6 Data Quality, Performance and Acceptance Criteria

Overall, the quality of data gathered as part of SRBT groundwater monitoring activities is successful in ensuring a high level of performance in monitoring, and in demonstrating that acceptance criteria (such as the limits on dose to the public) continue to be met.

All trip blanks, field duplicates, laboratory duplicates and quality control checks during liquid scintillation counting met performance criteria throughout 2021.

4.3.3.7 Program Objectives and Conceptual Site Model

The main objective of the GMP implemented by SRBT is to provide information to assess risks from site-affected groundwater to human health and the environment, ultimately to determine if the risk to the environment and the public from SRBT operations remains acceptably low.

Only one well monitored on a regular basis exceeds the Ontario Drinking Water Guideline value of 7,000 Bq/L. This well is a dedicated, engineered groundwater monitoring well very near to the facility within a secured area, and is not available to be used as a source of water consumption.

With respect to the conceptual site model, the highest average concentration of potable groundwater obtained from a residential well continues to show a generally stable or decreasing trend over time (see discussion in section 4.3.1.8 earlier in this report).

SRBT concludes that the comprehensive array of groundwater monitoring activities conducted continue to meet program objectives, and adheres to the conceptual site model developed as part of the Environmental Management System, as illustrated earlier in this report in Figure 8.

4.3.4 Other Monitoring

On occasion SRBT conducts monitoring of other environmental media in order to provide continued assurance of the safety of our operations.

4.3.4.1 Soil Monitoring

No soil monitoring was conducted in 2021.

4.3.4.2 Sludge Monitoring

In March and September 2021, SRBT collected routine samples of sludge cake from the Pembroke Pollution Control Centre.

These samples are analyzed for the concentration of tritium in the free water contained within (expressed in Bq/L), as well as for organically-bound tritium in the dry mass of material (expressed in Bq/kg).

Sludge data does not factor into the calculation of public dose; however, given previously expressed stakeholder interest, SRBT has integrated sludge cake monitoring as part of the routine EMP activities.

All sludge samples are analyzed by an independent laboratory. The averaged annual results obtained for the past five years are tabled below.

TABLE 24: SLUDGE MONITORING (2017-2021)

NUCLEAR SUBSTANCE AND FORM	2017	2018	2019	2020	2021
FREE-WATER TRITIUM (Bq/L)	57	40	41	31	30
OBT FRESH WEIGHT (Bq/kg)	901	420	216	260	167

4.3.5 Public Dose

The calculation methods used to determine the dose to the representative persons as defined in the SRBT Environmental Monitoring Program (EMP) are described in the program and in EMP-014, *Interpretation and Reporting Requirements for EMP Data.*

All data and tables relating to the calculation of the dose to the public can be found in **Appendix R**.

For 2021, the dose has been calculated using the effective dose coefficients found in Canadian Standards Association (CSA) Guideline N288.1-14[41].

TABLE 25: CSA GUIDELINE N288.1-14 EFFECTIVE DOSE COEFFICIENTS FOR H-3

AGE GROUP	EFFECTIVE DOSE COEFFICIENT – INHALATION (HTO) (µSv/Bq)	EFFECTIVE DOSE COEFFICIENT – INGESTION (HTO) (µSv/Bq)	EFFECTIVE DOSE COEFFICIENT – INGESTION (OBT) (µSv/Bq)
INFANT	8.0E-5	5.3E-5	1.3E-4
CHILD	3.8E-5	2.5E-5	6.3E-5
ADULT	3.0E-5	2.0E-5	4.6E-5

NOTE: The dose coefficients listed for inhalation account for skin absorption, as per Table C.1 of N288.1-14.

The dose assessed for the group of representative persons is a summation of:

- Tritium uptake from inhalation and absorption through skin at the place of residence and/or the place of work, ($P_{(i)19}$ and $P_{(e)19}$), and
- Tritium uptake due to consumption of well water (P_{29}), and
- Tritium uptake due to consumption of produce (P_{49}), and
- Tritium uptake due to consumption of dairy products (P_{59}).

Dose due to inhalation

The closest residence to SRBT is located by passive air sampler NW250 approximately 240 meters from the point of release. The 2021 average concentration of tritium oxide in air at passive air sampler NW250 has been determined to be **2.27 Bq/m^3**.

Three passive air samplers are located close to the SRBT facility and represent the tritium oxide in air ($P_{(i)19}$ and $P_{(e)19}$) concentrations for the representative person (adult worker) at samplers 1, 2, and 13. The sampler indicating the highest tritium oxide in air concentration is used to calculate the P_{19} dose values while at work. The highest average result for 2021 between these samplers is **5.82 Bq/m^3** at PAS # 1.

Using the inhalation rates found in CSA Guideline N288.1-14[42], and assuming 2,080 hours (23.744%) of work per year with 6,680 hours (76.256%) at home (a total of 8,760 hours per year):

TABLE 26: CSA GUIDELINE N288.1-14 INHALATION RATES

AGE GROUP	INHALATION RATE (m^3/a)
INFANT	2,740
CHILD	7,850
ADULT	8,400

$P_{(i)19}$: Adult worker dose due to HTO inhaled at residence

The average value for tritium oxide in air for the sampler taken as representing the place of residence for the defined representative person equals 2.27 Bq/m^3.

$P_{(i)19r}$ = [H-3$_{air}$] (Bq/m^3) x Resp. Rate (m^3/a) x Occup. Factor x DCF_{H3} (µSv/Bq)
= 2.27 Bq/m^3 x 8,400 m^3/a x 0.76256 x 3.0E-05 µSv/Bq
= 0.436 µSv/a

$P_{(i)19}$: Adult worker dose due to HTO inhaled at work

Taking the highest concentration between Passive Air Samplers #1, #2, and #13 is Passive Air Samplers #1 at 5.82 Bq/m^3.

$P_{(i)19w}$ = [H-3$_{air}$] (Bq/m^3) x Resp. Rate (m^3/a) x Occup. Factor x DCF_{H3} (µSv/Bq)
= 5.82 Bq/m^3 x 8,400 m^3/a x 0.23744 x 3.0E-05 µSv/Bq
= 0.348 µSv/a.

$P_{(i)19}$: Adult resident dose due to HTO inhaled at residence

The average value for tritium oxide in air for the sampler representing the place of residence for the defined representative person equals 2.27 Bq/m^3:

$P_{(i)19}$ = [H-3_{air}] (Bq/m^3) x Resp. Rate (m^3/a) x DCF_{H3} (µSv/Bq)
= 2.27 Bq/m^3 x 8,400 m^3/a x 3.0E-05 µSv/Bq
= 0.572 µSv/a

$P_{(i)19}$: Infant resident dose due to HTO inhaled at residence

The average value for tritium oxide in air for the sampler representing the place of residence for the defined representative person equals 2.27 Bq/m^3:

$P_{(i)19}$ = [H-3_{air}] (Bq/m^3) x Resp. Rate (m^3/a) x DCF_{H3} (µSv/Bq)
= 2.27 Bq/m^3 x 2,740 m^3/a x 8.0E-05 µSv/Bq
= 0.498 µSv/a

$P_{(i)19}$: Child resident dose due to HTO inhaled at residence

The average value for tritium oxide in air for the sampler representing the place of residence for the defined representative person equals 2.27 Bq/m^3:

$P_{(i)19}$ = [H-3_{air}] (Bq/m^3) x Resp. Rate (m^3/a) x DCF_{H3} (µSv/Bq)
= 2.27 Bq/m^3 x 7,850 m^3/a x 3.8E-05 µSv/Bq
= 0.677 µSv/a

Dose due to skin absorption

Beginning in 2016, the dose due to skin absorption is wholly accounted for by the application of the inhalation dose conversion factors applied above.

Please see CSA N288.1-14, Table C.1 footnotes for details on dose conversion factors and how they account for skin absorption.

Dose due to consumption of well water

The tritium uptake due to consumption of well water is calculated by taking the average tritium concentration of the water sampled.

Using the following annual consumption rates (at the 95th percentile) derived from information found in CSA Guideline N288.1-14[43]:

TABLE 27: CSA GUIDELINE N288.1-14 WATER CONSUMPTION RATES

AGE GROUP	WELL WATER CONSUMPTION RATE (L/a)
INFANT	305.7
CHILD	482.1
ADULT	1,081.1

In 2021, the highest average concentration in a residential well used as the sole source of the drinking water was found in RW-3 at 183 Mud Lake Road, equal to **38 Bq/L**. This value will therefore be used in the calculation of the public dose.

P_{29}: Adult dose due to consumption of well water

P_{29} = $[H\text{-}3]_{well}$ x M x 2.0E-05 µSv/Bq;
= [38 Bq/L] x 1,081.1 L/a x 2.0E-05 µSv/Bq
= 0.822 µSv/a

P_{29}: Infant dose due to consumption of well water

P_{29} = $[H\text{-}3]_{well}$ x M x 5.3E-05 µSv/Bq;
= [38 Bq/L] x 305.7 L/a x 5.3E-05 µSv/Bq
= 0.616 µSv/a

P_{29}: Child dose due to consumption of well water

P_{29} = $[H\text{-}3]_{well}$ x M x 2.5E-05 µSv/Bq;
= [38 Bq/L] x 482.1 L/a x 2.5E-05 µSv/Bq
= 0.458 µSv/a

Dose due to consumption of produce

The tritium uptake due to consumption of produce, both locally purchased and home grown is calculated by taking the average tritium concentration of produce purchased from the local market and assuming the consumption of 70% of the annual total of produce from this source, and by taking the average tritium concentration from local gardens and assuming the consumption of 30% of the annual total of produce from this source.

These fractions are based upon the site-specific survey previously conducted by SRBT, which determined that the home-grown fraction of plant products consumed by residents in the surrounding area was approximately 30% - a slightly higher value than that recommended in the generic guidance of N288.1-14 (20-25%).

Using the following annual consumption rates for produce derived using information found in CSA Guideline N288.1-14[44]:

TABLE 28: CSA GUIDELINE N288.1-14 PRODUCE CONSUMPTION RATES

AGE GROUP	FRUIT CONSUMPTION RATE (Kg/a)	ABOVE-GROUND VEGETABLES CONSUMPTION RATE (Kg/a)	ROOT VEGETABLES CONSUMPTION RATE (Kg/a)	TOTAL CONSUMPTION RATE (Kg/a)
INFANT	76.6	36.1	12.1	124.8
CHILD	124.4	97.6	43.2	265.2
ADULT	149.2	192.3	71.8	413.3

The average tritium concentration in produce purchased from the sampled market in 2021 was **3.7 Bq/kg**, while the highest average concentration in produce from a local garden was **117 Bq/kg** at 408 Boundary Road.

P_{49}: Adult dose due to consumption of produce (HTO)

P_{49HTO} = $[[H_{prod,market}] + [H_{prod,res}]]$ x 2.0E-05 µSv/Bq
= $[[H\text{-}3_{veg}]$ (Bq/kg) x (kg) x 0.7] + $[H\text{-}3_{veg}]$ (Bq/kg) x (kg) x 0.3]] x 2.0E-5 µSv/Bq
= [[3.7 Bq/kg x 413.3 kg/a x 0.7] + [117 Bq/kg x 413.3 kg/a x 0.3]] x 2.0E-05 µSv/Bq
= 0.311 µSv/a

P_{49}: Infant dose due to consumption of produce (HTO)

P_{49HTO} = [[$H_{prod,market}$] + [$H_{prod,res}$]] x 5.3E-05 µSv/Bq
= [[H-3_{veg}] (Bq/kg) x (kg) x 0.7] + [H-3_{veg}] (Bq/kg) x (kg) x 0.3]] x 5.3E-5 µSv/Bq
= [[3.7 Bq/kg x 124.8 kg/a x 0.7] + [117 Bq/kg x 124.8 kg/a x 0.3]] x 5.3E-05 µSv/Bq
= 0.249 µSv/a

P_{49}: Child dose due to consumption of produce (HTO)

P_{49HTO} = [[$H_{prod,market}$] + [$H_{prod,res}$]] x 2.5E-05 µSv/Bq
= [[H-3_{veg}] (Bq/kg) x (kg) x 0.7] + [H-3_{veg}] (Bq/kg) x (kg) x 0.3]] x 2.5E-5 µSv/Bq
= [[3.7 Bq/kg x 265.2 kg/a x 0.7] + [117 Bq/kg x 265.2 kg/a x 0.3]] x 2.5E-05 µSv/Bq
= 0.250 µSv/a

SRBT directly monitored OBT concentrations in tomatoes in the garden at 408 Boundary Road, as well as from tomatoes from the commercial market garden. The OBT concentration from the residential produce was measured as 1.0 Bq/kg, while for the commercial produce a value of 4.0 Bq/kg was measured.

P_{49}: Adult dose due to consumption of produce (OBT)

P_{49OBT} = [[$H_{prod,market}$] + [$H_{prod,res}$]] x 4.6E-05 µSv/Bq
= [[H-3_{veg}] (Bq/kg) x (kg) x 0.7] + [H-3_{veg}] (Bq/kg) x (kg) x 0.3]] x 4.6E-5 µSv/Bq
= [[4 Bq/kg x 413.3 kg/a x 0.7] + [1 Bq/kg x 413.3 kg/a x 0.3]] x 4.6E-05 µSv/Bq
= 0.059 µSv/a

P_{49}: Infant dose due to consumption of produce (OBT)

P_{49OBT} = [[$H_{prod,market}$] + [$H_{prod,res}$]] x 1.3E-4 µSv/Bq
= [[H-3_{veg}] (Bq/kg) x (kg) x 0.7] + [H-3_{veg}] (Bq/kg) x (kg) x 0.3]] x 1.3E-4 µSv/Bq
= [[4 Bq/kg x 124.8 kg/a x 0.7] + [1 Bq/kg x 124.8 kg/a x 0.3]] x 1.3E-4 µSv/Bq
= 0.050 µSv/a

P_{49}: Child dose due to consumption of produce (OBT)

P_{49OBT} = [[$H_{prod,market}$] + [$H_{prod,res}$]] x 6.3E-5 µSv/Bq
= [[H-3_{veg}] (Bq/kg) x (kg) x 0.7] + [H-3_{veg}] (Bq/kg) x (kg) x 0.3]] x 6.3E-5 µSv/Bq
= [[4 Bq/kg x 265.2 kg/a x 0.7] + [1 Bq/kg x 265.2 kg/a x 0.3]] x 6.3E-5 µSv/Bq
= 0.052 µSv/a

Total dose due to consumption of produce:

P_{49}: Adult dose due to consumption of produce (HTO + OBT)

P_{49} = P_{49HTO} + P_{49OBT}
= 0.311 µSv/a + 0.059 µSv/a
= 0.370 µSv/a

P_{49}: Infant dose due to consumption of produce (HTO + OBT)

P_{49} = P_{49HTO} + P_{49OBT}
= 0.249 µSv/a + 0.050 µSv/a
= 0.299 µSv/a

P_{49}: Child dose due to consumption of produce (HTO + OBT)

P_{49} = P_{49HTO} + P_{49OBT}
= 0.250 µSv/a + 0.052 µSv/a
= 0.302 µSv/a

Dose due to consumption of local milk

The tritium uptake due to consumption of milk, from a local producer and distributor is calculated by taking the average tritium concentration of the milk sampled.

Using the following annual milk consumption rates derived using information found in CSA Guideline N288.1-14[45]:

TABLE 29: CSA GUIDELINE N288.1-14 MILK CONSUMPTION RATES

AGE GROUP	MILK CONSUMPTION RATE (kg/a)
INFANT	340.0
CHILD	319.6
ADULT	188.5

The average concentration in milk in 2021 was measured as 4.00 Bq/L; adjusting for the density of milk, a specific activity of 4.00 Bq/L x 0.97 L/kg = **3.880 Bq/kg** is calculated.

P_{59}: Adult dose due to consumption of milk

P_{59} = $[H\text{-}3]_{dairy}$ x M x 2.0E-05 µSv/Bq;
= [3.880 Bq/kg] x 188.5 kg/a x 2.0E-05 µSv/Bq
= 0.015 µSv/a

P_{59}: Infant dose due to consumption of milk

P_{59} = $[H\text{-}3]_{dairy}$ x M x 5.3E-05 µSv/Bq;
= [3.880 Bq/kg] x 340.0 kg/a x 5.3E-05 µSv/Bq
= 0.070 µSv/a

P_{59}: Child dose due to consumption of milk

P_{59} = $[H\text{-}3]_{dairy}$ x M x 5.3E-05 µSv/Bq;
= [3.880 Bq/kg] x 319.6 kg/a x 2.5E-05 µSv/Bq
= 0.031 µSv/a

Representative persons annual dose due to tritium uptake based on EMP

Based on the EMP results and the coefficients and parameters taken or derived from N288.1-14[41-45], the annual dose (P_{total}) due to tritium uptake from inhalation and skin absorption, consumption of local produce, local milk and well water equates to a conservatively-calculated maximum of **1.991 µSv** in 2021.

TABLE 30: 2021 REPRESENTATIVE PERSONS ANNUAL DOSE BASED ON EMP

DOSE CONTRIBUTOR		ADULT WORKER ANNUAL DOSE (µSv/A)	ADULT RESIDENT ANNUAL DOSE (µSv/A)	INFANT RESIDENT ANNUAL DOSE (µSv/A)	CHILD RESIDENT ANNUAL DOSE (µSv/A)
DOSE DUE TO INHALATION and ABSORPTION AT WORK	$P_{(I)19}$	0.348			
DOSE DUE TO INHALATION and ABSORPTION AT RESIDENCE	$P_{(I)19}$	0.436	0.572	0.498	0.677
DOSE DUE TO CONSUMPTION OF WELL WATER	P_{29}	0.822	0.822	0.616	0.458
DOSE DUE TO CONSUMPTION OF PRODUCE	P_{49}	0.370	0.370	0.299	0.302
DOSE DUE TO CONSUMPTION OF MILK	P_{59}	0.015	0.015	0.070	0.031
2021 PUBLIC DOSE	P_{TOTAL}	**1.991**	1.779	1.483	1.468

Effective doses calculated from EMP data previously are as follows: 2.416 µSv in 2020, 2.151 µSv in 2019, 3.792 µSv in 2018, and 3.349 µSv in 2017.

Statement of Uncertainties in Calculation of Public Dose:

All parameters taken from N288.1-14 are at the 95th percentile where available. Actual ingestion and inhalation rates are likely to be lower for most of the population. Calculated doses are likely to be significantly higher than actual doses to persons as a result.

Statement of Compliance with Regulatory Limit:

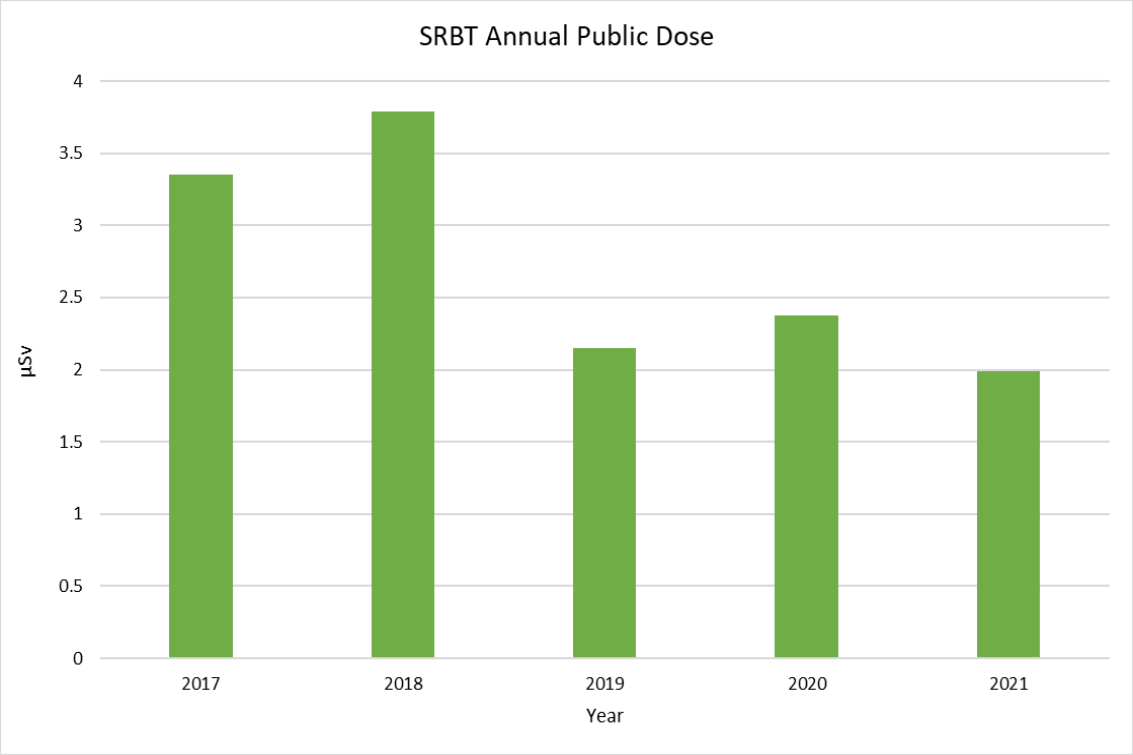
Based upon the analysis of the data from the environmental and effluent monitoring programs, the maximum effective dose imparted in 2021 by SRBT, to persons who are not categorized as Nuclear Energy Workers (0.0020 mSv), falls well below the prescribed limit of 1 mSv.

Public Dose Trends

The calculated effective dose of **1.991 µSv** to the most-exposed representative person is the lowest value when compared to the last five years of data.

The five-year trend for the effective dose to members of the public is illustrated below in Figure 18.

FIGURE 18: PUBLIC DOSE FIVE-YEAR TREND (2017-2021)



4.3.6 Program Effectiveness

The suite of SRBT environmental protection programs have continued to be effective in measuring tritium in the environment and at ensuring the prevention of unreasonable risk to the environment.

The Environmental Monitoring Program continues to be implemented effectively. The past year represents the fourth full year of operation since the program revision to comply with the requirements of CSA standard N288.4-10, and the program continues to be improved over time.

Our passive air sampling array is effective and provides a picture of the full extent of tritium concentrations in air resulting from the emissions from the facility, and in turn providing real data to accurately estimate the dose to representative persons resulting from the emissions from the facility.

Tritium concentrations in residential wells, and in milk and produce that are consumed by residents living near the facility are measured. This data is effective at providing the full extent of tritium concentrations in human food and potable water sources resulting from the emissions from the facility, and in turn providing data to reliably estimate the dose to representative persons resulting from the emissions from the facility.

The Effluent Monitoring Program was also implemented very effectively in 2021, and succeeded in achieving the defined objectives of the program, including confirming the adequacy of controls on releases from the source, providing high-quality data, and demonstrating adherence to licence limits.

The Groundwater Monitoring Program was highly effective at providing data on the full extent of tritium concentrations in groundwater resulting from the emissions from the facility, and demonstrating the effectiveness of operational changes that have taken place over the last several years.

4.3.7 Program Review and Audit Summary

All major elements of the Environmental Management System (EMS) are scheduled to be audited at least once every three years.

As part of this cycle, the Effluent Monitoring Program was internally audited in November, with no non-conformances being identified, and two OFIs being recommended. One of these OFIs has been implemented through the revision to two internal procedures, while the other is expected to be implemented before the end of 2022.

In addition for 2021, Senior Management directed the Compliance Manager to conduct a supplementary audit of EMP sample preparation and handling processes in 2021, as experience was gained in conducting these processes in-house after taking over this work with the onset of the COVID-19 pandemic in 2020.

This supplementary audit was completed in September, with no non-conformances being identified, and two OFIs being recommended. Both OFIs have been implemented through the revision of two internal procedures.

All programs under the EMS were subject to a full review, including comprehensive self-assessment and benchmarking, in the first quarter of 2021. The results of these review exercises were included as input into the annual facility management review process, as per SRBT procedure MSP-008, *Management Review*.

4.3.8 Proposed Modifications to EMS Programs

There are no proposed significant major changes to the monitoring programs that comprise SRBT's EMS, including the EMP, EffMP and GMP.

4.4 SCA – Emergency Management and Fire Protection

As most potential hazards associated with the facility would result from fire, emergency management and response for the facility are addressed by an extensive Fire Protection Program supported by an Emergency Plan.

4.4.1 Fire Protection

Various measures were taken at the facility in 2021 to improve and maintain fire safety. These activities included but were not limited to the following:

- The SRBT Fire Protection Program was updated to comply to the latest version of the *National Fire Code of Canada*. The latest revision of the program was submitted to CNSC staff for review, which yielded no comments.
- An audit of the SRBT Fire Protection Program was performed by a qualified and independent third-party contractor, in conformance with CSA N393-13, and a report issued and submitted to CNSC staff,
- Third party contractor completed a Site Condition Inspection at the facility (a detailed report was completed),
- The PFD completed an inspection of the SRBT facility, and
- Enhanced training for one Fire Protection committee member.

4.4.1.1 Fire Protection Committee

In 2021, two formal Fire Protection Committee meetings were held which resulted in the implementation of several improvements for fire protection and life safety at the facility. All Fire Protection Committee meeting minutes are kept on file.

4.4.1.2 Fire Protection Program, Fire Safety Plan and Procedures

In 2021 a new revision of the SRBT Fire Protection Program was introduced. The program was updated to conform with the latest edition of the *National Fire Code of Canada*. Upon completion, the new revision was sent to CNSC staff for review. The revised program was accepted without comment.

An audit of the SRBT Fire Protection Program was performed by a qualified and independent third-party contractor, in conformance with CSA N393-13, and a report issued and submitted to CNSC staff. The audit report described one finding related to inspections, testing and maintenance which was deemed to be minor in nature, and has since been rectified.

4.4.1.3 Fire Hazards Assessment

In December 2020, a qualified, independent third-party completed a revision to the Fire Hazard Assessment (FHA) for the SRBT facility. The FHA meets the requirements of CSA Standard N393-13, *Fire protection for facilities that process, handle or store nuclear substances.* CNSC staff accepted this revision in 2021.

The objective of the FHA was to identify the fire hazards at the facility, evaluate the impact of fires involving these hazards on the safety objectives at the facility, and assess the adequacy of the fire protection measures in place to mitigate these hazards.

It was determined by the FHA that fire hazards at the SRBT facility are being controlled, that worst-case fire events would not be expected to result in an unacceptable release of radiological or hazardous materials, and that there are adequate fire protection and life-safety features.

The conclusion of the FHA is that the performance goals, objectives and criteria of CSA N393-13 have been satisfied at the SRBT facility. The FHA is reviewed and revised on a five-year cycle; it is next due for review in 2025.

4.4.1.4 Independent Audit of the Fire Protection Program

In 2021, a qualified, independent third-party contractor performed an audit of the SRBT Fire Protection Program (FPP).

The audit objectives were to ensure the FPP was maintained and implemented at the facility in accordance with the following codes and standards:

- CSA Standard N393 13, *Fire protection for facilities that process, handle or store nuclear substances*
- NFCC 2015, *National Fire Code of Canada*
- NBCC 2015, *National Building Code of Canada*

The audit consisted of a site visit as well as review of inspection, testing and maintenance (ITM) records of all fire protection equipment and activities.

A detailed audit report was provided to SRBT in December. The audit produced a single minor finding of low risk significance which has been addressed.

4.4.1.5 Maintenance of the Sprinkler System

In 2021, quarterly and annual maintenance was performed on the sprinkler system by a third party. In addition, a weekly check of various valves and line pressures were performed by trained SRBT staff.

In 2021 the five-year requirement of replacing gauges and performing an internal investigation of the piping was due. In compliance with the National Fire Code of Canada, these tasks were performed in October 2021.

4.4.1.6 Fire Protection Equipment Inspections

In 2021, in-house routine inspection, testing and maintenance was performed on all fire protection and life safety equipment at the SRBT facility on a daily, weekly, monthly and annual basis by trained staff.

Qualified third-party contractors also performed routine inspection, testing and maintenance of fire protection and life safety equipment at the SRBT facility. Annual inspection, testing and maintenance include fire extinguishers, emergency lighting, the fire panel and sprinkler system.

4.4.1.7 Fire Extinguisher Training

Fire extinguisher training is typically conducted annually for all SRBT employees; however, as a consequence of the COVID-19 pandemic, training had not been conducted in 2020.

This training resumed in 2021 for all SRBT employees. The PFD provided this training in December.

4.4.1.8 Fire Protection Committee Member Training

The Fire Protection Committee continues to include a member who volunteers as a firefighter for a local fire department, and receives fire protection training from this department.

4.4.1.9 Fire Alarm Drills

A total of seven in-house fire alarm drills were conducted in 2021.

Following each fire drill, a member of the Fire Protection Committee visits each department to discuss the drill. If any employee has comments or concerns regarding the drill they are provided with a Fire Alarm Drill Report to complete. Each report was reviewed by the Fire Protection Committee, and actions were taken as required to enhance fire and life safety at the facility.

4.4.1.10 Fire Protection Consultant Inspection

In May, a qualified third party (PLC Fire Safety Solutions) was contracted to complete a Site Condition Inspection, in order to meet the operating licence requirements, including the requirements of CSA standard N393-13, *Fire protection for facilities that process, handle, or store nuclear substances*.

The scope of the inspection was to evaluate the SRBT facility for compliance with the applicable inspection, testing and maintenance requirements of our operating licence.

The following codes and standards were reviewed for applicability to the specific systems at SRBT:

- NFCC-2015, *National Fire Code of Canada*
- NBCC-2015, *National Building Code of Canada*
- CSA standard N393-13, *Fire protection for facilities that process, handle, or store nuclear substances*.

Following the inspection, PLC prepared a “Site Condition Inspection Report”, there were no non-conformities identified as a result of the inspection.

4.4.1.11 Pembroke Fire Department Inspection

The PFD conducted a facility inspection to confirm compliance with the Ontario Fire Code in December, with no violations being identified.

4.4.2 Emergency Preparedness

SRBT ensures that we are prepared for an emergency at our facility. Staff, equipment and infrastructure are in place and ready to respond to an emergency in accordance with documented procedures.

4.4.2.1 Emergency Plan

The SRBT Emergency Plan has been developed based on the probability and potential severity of emergency scenarios associated with the operation of the facility.

The plan includes preparing for, responding to, and recovering from the effects of accidental radiological and/or hazardous substance releases from the SRBT facility.

The plan was last revised in 2017, and remains up-to-date for the facility's current state.

4.4.2.2 Emergency Exercises

In 2021, SRBT conducted a full-scale emergency exercise. Section 7.10.1.1 of the SRBT Emergency Plan requires that an emergency exercise be conducted at least once every five years.

This exercise was conducted in partnership with the City of Pembroke, the PFD and the County of Renfrew Paramedic Service, and was observed by CNSC staff as part of a compliance inspection.

Overall, the exercise proved to be a success, with a challenging, multi-faceted scenario being presented for all participants. Personnel response was found to be in line with the expectations and requirements of the Emergency Plan, and all exercise objectives were met.

A report capturing the findings, lessons learned and operating experience associated with the conduct of the exercise was submitted to CNSC staff on December 23, 2021[10], and posted on our website. The opportunities for improvement are now being addressed as part of SRBT processes.

The next full-scale emergency exercise at SRBT is expected to be conducted on or before October 26, 2026, pursuant to the requirements of the Emergency Plan and the facility operating licence in effect at that time.

4.5 SCA – Waste Management

SRBT implements a Waste Management Program (WMP) that is aligned with the applicable requirements and guidelines in the following CSA Standards:

- CSA N292.0-14, *General principles for the management of radioactive waste and irradiated fuel*
- CSA N292.3-14, *Management of low- and intermediate-level radioactive waste*
- CSA N292.5-11, *Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances*

4.5.1 Radioactive Consignments – Waste

Twelve shipments of low-level waste (LLW) were made to Canadian Nuclear Laboratories (CNL) in 2021.

All twelve shipments included expired gaseous tritium light sources. A total of 289 packages of expired gaseous tritium light sources were generated and safely shipped to CNL in 2021, which represents a decrease in comparison to the 445 packages shipped in 2020.

All twelve shipments also included tritium-contaminated waste materials generated by other processes, including material such as used protective clothing, used equipment components, crushed glass, filters, broken lights and cleaning material.

Four drums of waste liquid scintillation counting vials were also generated and disposed of through EnergySolutions in 2021.

A total LLW waste volume of 8.66 m^3 in 325 packages was generated and shipped by SRBT in 2021.

According to the 2016 report titled ‘Inventory of Radioactive Waste in Canada 2016’ published by Natural Resources Canada, the volume of waste generated at SRBT is significantly lower than other Class 1 nuclear facilities.

For example, in 2016, nuclear power generation in Ontario resulted in the generation of 3,217 m^3 of LLW, while licenced activities at another major licensee in Ontario resulted in a total accumulation rate of 1,222 m^3. As such, SRBT’s contribution to the total generated LLW in Canada is relatively small.

The following table is provided as a summary of the low-level waste material that was generated and routed to a licenced waste management facility in 2021.

TABLE 31: RADIOACTIVE WASTE CONSIGNMENTS (2021)

	Date of Shipment	Waste Description	Number of Packages	Waste Description	Total Weight (Kgs)	Total Activity H-3 (TBq)
CNL	Jan. 19, 2021	LLW	23	Expired light sources	92	316.460
			2	Crushed stub glass	42	0.018
			1	Drums of LLW	70	0.010
	Feb. 16, 2021	LLW	16	Expired light sources	64	244.920
			2	Crushed stub glass	42	0.018
			0	Drums of LLW	0	0.000
	Mar. 23, 2021	LLW	20	Expired light sources	80	301.000
			2	Crushed stub glass	42	0.018
			1	Drums of LLW	70	0.687
	Apr. 20, 2021	LLW	25	Expired light sources	100	368.680
			2	Crushed stub glass	42	0.018
			1	Drums of LLW	70	0.010
	May 18, 2021	LLW	37	Expired light sources	148	564.550
			2	Crushed stub glass	42	0.018
			0	Drums of LLW	0	0.000
	Jun. 15, 2021	LLW	18	Expired light sources	72	288.240
			1	Crushed stub glass	21	0.009
			1	Drums of LLW	70	0.010
	Jul. 20, 2021	LLW	34	Expired light sources	136	516.020
			3	Crushed stub glass	63	0.027
			1	Drums of LLW	70	0.596
	Aug. 17, 2021	LLW	28	Expired light sources	112	436.060
			1	Crushed stub glass	21	0.009
			0	Drums of LLW	0	0.000
	Sep. 21, 2021	LLW	16	Expired light sources	64	255.560
			3	Crushed stub glass	63	0.027
			1	Drums of LLW	70	0.596
	Oct. 19, 2021	LLW	16	Expired light sources	64	219.180
			2	Crushed stub glass	42	0.018
			1	Drums of LLW	70	0.596
	Nov. 16, 2021	LLW	25	Expired light sources	100	424.730
			1	Crushed stub glass	21	0.009
			0	Drums of LLW	0	0.000
	Dec. 14, 2021	LLW	31	Expired light sources	124	439.660
			3	Crushed stub glass	63	0.027
			1	Drums of LLW	70	0.406
ENERGY SOLNS	Mar. 17, 2021	LLW	2	Drums of LLW	209	0.010
	Oct. 7, 2021	LLW	2	Drums of LLW	209	0.010

4.5.2 Storage of Radioactive Waste

Radioactive waste was stored on-site and inventory records of the waste were maintained throughout the year, as per the WMP.

4.5.2.1 Low-level Waste Interim Storage

Low-level waste is any waste assessed as possessing activity levels that exceeds conditional clearance limits (for tritium), or in excess of the exemption quantities established in the *Nuclear Substances and Radiation Devices Regulations* (for all other radionuclides). Typical examples of such wastes are tritium-contaminated equipment or components, crushed glass, filters, broken lights, clean-up material, etc.

LLW was collected in dedicated receptacles, assessed and ultimately placed into approved containers in the Waste Storage Room within Zone 3. Once sufficient material was collected, it was prepared for transfer to a licensed waste handling facility (CNL), using approved processes.

TABLE 32: INTERIM STORAGE OF LOW-LEVEL WASTE (ZONE 3)

AMOUNT IN STORAGE AT YEAR END 2020	AMOUNT GENERATED THROUGHOUT 2021	TRANSFERRED OFF SITE 2021	AMOUNT IN STORAGE AT YEAR END 2021
1 x 200 L drum	8 x 200 L drums	8 x 200 L drums	1 x 200 L drum
0.69 TBq	2.23 TBq	2.91 TBq	0.01 TBq

As well, five drums of liquid scintillation counting vials were managed and stored in 2021, four of which were sent for disposal (via EnergySolutions). One drum remained in interim storage for disposal once filled in early 2022.

4.5.2.2 Clearance-level Waste Generation

Waste materials in Zone 2 and 3 that may be minimally contaminated and are likely to meet accepted clearance criteria are classified as very low-level waste (VLLW). This classification is temporary, as ultimately VLLW is assessed radiologically, and routed through one of two accepted disposal pathways – either as LLW or as clearance-level waste (CLW).

Examples of such materials are typically paper towels, gloves, disposable lab coats, shoe covers, and other such materials that are collected in various receptacles in the active areas of the facility. These materials are assessed, and should they meet the clearance criteria, disposed of via conventional pathways.

The approved WMP clearance criteria is set at 0.15 MBq/g, up to a maximum of 5,000 kg of cleared material per pathway. The mass of CLW generated in 2021 is tabulated below.

TABLE 33: CLEARANCE-LEVEL WASTE (2021)

TYPE OF MATERIAL	PATHWAY	AMOUNT GENERATED (kg)
GENERAL WASTE	LANDFILL	2,850
METAL	RECYCLER	108

4.5.2.3 Subject Waste

SRBT routinely manages and ships two types of non-radiological ‘subject’ waste at the facility.

Phosphorescent (zinc sulfide) powder (classified as mild environmental contaminant) is collected and shipped to a licenced hazardous waste management contractor. In addition, waste liquids from the 3-D printing process are also collected and shipped when they are generated.

This waste is picked up quarterly, and disposed of in accordance with the requirements of the Ontario Ministry of Environment and Climate Change.

In 2021, 296 kg of zinc sulfide powder was safely disposed of through this program. No 3-D printing process waste was shipped in 2021.

4.5.2.4 Waste Minimization

SRBT continues to minimize the generation of radioactive waste materials as part of our overall approach to waste management.

The Waste Management Committee met twice in 2021 to review and discuss initiatives that could ultimately minimize the amount of radioactive waste routed to licenced waste management facilities. As well, initiatives for the reduction of conventional waste materials and energy usage were also discussed.

Continued segregation of material prior to bringing items into active zones remains effective at reducing waste materials that require management.

The implementation of Conditional Clearance Levels for waste materials has continued to be successful in reducing the amount of waste material that is needlessly disposed of as radioactive waste.

4.5.2.5 Expired Product Management

SRBT continues to offer return and disposal services to customers who possess expired tritium-illuminated devices, such as ‘EXIT’ signs.

In 2021, a total of 24,510 expired (or otherwise removed from service) self-luminous safety ‘EXIT’ type signs were accepted by SRBT from Canadian and American sources, representing a total activity of 3,767.75 TBq of tritium. For comparison, in 2020, a total of 34,081 signs were processed representing 5,360.02 TBq of tritium.

As well, an additional 302.18 TBq of tritium was accepted from international origins (i.e. other than Canada and the United States) in the form of expired tritium illuminated devices, such as aircraft signs, dials, gauges and other smaller equipment. These were also processed for shipment to a licenced waste management facility.

Expired signs are disassembled safely and the light sources removed, in order to ensure that the volume of low-level radioactive waste that is generated is minimized.

The expired lights are then packaged and shipped to a licenced radioactive waste management service provider.

A small number of these signs were evaluated as being fit for service in other applications, or having light sources that could be reused in other self-luminous devices.

This practice is the only re-use of the lights and the tritium associated with these lights, and would represent a very small fraction of the total light sources managed.

4.6 SCA – Security

SRB Technologies (Canada) Inc. implements an accepted Facility Security Program for the facility, in accordance with CNSC regulatory requirements and expectations. This program was updated and revised in 2021, and accepted by CNSC staff as meeting all relevant requirements[30].

SRBT did not experience any security-related events in 2021. There were no CNSC inspections focused on the Security SCA in 2021.

New staff members are required to qualify for a Facility Access Security Clearance (FASC), even if they are not expected to handle nuclear substances as part of their responsibilities. Individuals and contractors that visit the facility are required to also have an FASC or be escorted at all times by a staff member with a valid FASC.

All staff receive both initial and annual refresher training in SRBT's Supervisory Awareness Program, for the purposes of ensuring compliance with section 48 of the *Nuclear Security Regulations.*

Maintenance of the physical facility security system is performed by a qualified, independent third party at least every 6 months.

4.7 SCA – Safeguards and Non-proliferation

SRBT possesses, uses, stores and manages a small quantity of depleted uranium, which is a controlled nuclear substance.

This material is used as storage media for tritium gas on our processing equipment, a well-understood and widely-used strategy for manipulating and storing tritium in its gaseous, elemental state. By using depleted uranium in this fashion, we can ensure that the quantity of gaseous tritium being used during any given processing operation is restricted. This helps to ensure that the consequences of any unplanned event are minimized with respect to radiation and environmental protection, by ensuring that any release of tritium is limited.

SRBT possessed a reported 9.368 kg of depleted uranium in metallic form at the beginning of 2021. The inventory of material changed once in 2021; as a result of the annual detailed mass assessment in July, the total inventory was adjusted upward by 229 grams, representing a 2.4% discrepancy over the previously measured mass.

This discrepancy is attributed to inherent uncertainties in the methodology for assessment of mass of the material, and is likely a correction for a similar, but opposite discrepancy observed in 2020 (-155 grams).

At the conclusion of 2021, the total mass of depleted uranium on site is 9.597 kg. A limit of 10 kg of this material in inventory is applied as part of the operating limits and conditions in the SAR.

4.8 SCA – Packaging and Transport of Nuclear Substances

SRBT prepared, packaged and shipped all manufactured products containing nuclear substances in accordance with the *Packaging and Transport of Nuclear Substances Regulations.*

For the purpose of packaging and offering for transport, shipments of product designated as dangerous goods, SRBT must comply with the requirements of:

- CNSC
- International Atomic Energy Agency (IAEA)
- International Air Transport Association (IATA)
- Transport Canada

The procedures used at SRBT are based on regulations and practices found in the following publications:

- *Packaging and Transport of Nuclear Substances Regulations*
- IAEA Safety Standards Series - No. SSR-6
- IATA Dangerous Goods Regulations
- The TDG Compliance Manual: Clear Language Edition (Carswell)

Staff members involved with the packaging, offering for transport and receipt of dangerous goods are given TDG training in accordance with the applicable regulations and are issued certificates by the employer.

4.8.1 Outgoing Shipments

In total, 811 consignments were safely shipped to various customers located in 28 countries around the world, including Canada. A table is provided comparing the number of outgoing shipments of our products over the past five years.

TABLE 34: OUTGOING SHIPMENTS OF PRODUCT FIVE-YEAR TREND (2017-2021)

YEAR	2017	2018	2019	2020	2021
NUMBER OF SHIPMENTS*	970	948	949	827	811
NUMBER OF COUNTRIES	23	22	20	19	28

*Note – SRBT often ships single palletized shipments of safety signs to the US which subsequently get broken down into multiple sub-consignments. These types of shipments are counted as a single consignment for the purposes of this table.

All outgoing shipments were conducted in compliance with all regulatory requirements pertaining to the transport of dangerous goods and / or nuclear substances. Packages were assessed for surface contamination prior to being offered for transport as required by SRBT procedures.

Information pertaining to the number of monthly outgoing shipments containing radioactive material for 2021 can be found in **Appendix S** of this report.

4.8.2 Incoming Shipments

In total, 165 consignments of radioactive shipments were received from various customers located in 10 countries around the world, including Canada. These returns held a total activity of 4,069.93 TBq of tritium.

The vast majority of the returned, expired devices were in the form of expired 'EXIT' signs that were destined to have the expired light sources removed and sent for storage at a licenced waste management facility.

A table is provided comparing the amount of incoming shipments of radioactive products that have been made over the past five years.

TABLE 35: INCOMING SHIPMENTS OF PRODUCT FIVE-YEAR TREND (2017-2021)

YEAR	2017	2018	2019	2020	2021
NUMBER OF SHIPMENTS	539	518	484	272	165
NUMBER OF COUNTRIES	6	7	8	8	10

All incoming shipments were received safely and in acceptable condition. Incoming packages containing nuclear substances are assessed for tritium leakage upon receipt.

Information pertaining to the number of monthly received shipments containing radioactive material for 2021 can be found in **Appendix T** of this report.

4.8.3 Reportable Events

No packaging and transport-related reportable events or dangerous occurrences occurred in 2021.

5. Other Matters of Regulatory Interest

5.1 Public Information and Disclosure

This section of the report will provide public information initiatives taken in 2021.

5.1.1 Direct Interaction with the Public

Historically, almost all public inquiries occur during re-licensing.

On September 20, 2021, SRBT received a voicemail message from an individual wondering if the work he performed on SRBT's ventilation systems over a decade ago while employed as a local HVAC contractor in Pembroke could have long term health effects. He also wanted to make sure those who are currently working on the units are made aware of the hazards.

SRBT's President returned the call and reassured the caller that the work they performed during maintenance activities on the HVAC systems was safe at all times, and that absolutely no long-term health effects would be expected for any person conducting such work.

On September 22, 2021 SRBT's President also sent this individual an e-mail further explaining how the ventilation systems function, the maintenance activities, the training provided to contractors and urine samples provided that evaluates the hazard by calculating the committed effective dose.

Also attached to the e-mail was SRBT's safety procedure that describes how SRBT trains contractors, SRBT's brochure that provides additional information on the facility and a tritium fact sheet published by the CNSC.

No further questions, comments or correspondence have been received from this individual.

In 2021, water was sampled from a number of wells belonging to the public, in line with our Environmental Monitoring Program. Sampling for tritium concentrations were performed three times in 2021, March, July and September.

With the approval of the CNSC the frequency of the monitoring of the residential and business wells were changed from every four months to semi-annually (March and September). On a yearly basis, SRBT also samples produce from gardens belonging to members of the public for tritium concentration.

Participating members of the public are provided with a report of their sample results, along with the anticipated radioactive exposure due to tritium from consuming either the water or produce. We provide members of the public a

comparison of this exposure against the CNSC limit and against radioactive exposure from other known sources, such as cosmic radiation, x-rays, etc. No questions or comments were received in 2021.

Plant tours have proven to be a useful tool for SRBT to reach the public. In 2021, we have provided plant tours to only 4 members of the general public (compared to 10 in 2020 and 17 in 2019) who had expressed interest in our facility. Ongoing COVID-19 controls have continued to restrict non-essential visitors, which contributed to the much lower number of plant tours in 2020 and 2021.

In 2021 we provided plant tours to local representatives of:

- Renfrew County Community Futures Development Corporation,
- The City of Pembroke,
- Pembroke Fire Department, and
- County of Renfrew Paramedic Service.

In 2021 as part of conducting our business in Pembroke we have also provided plant tours to local employee representatives of our existing and prospective suppliers of goods and/or services, including:

- EIP
- BSI
- Ottawa River Energy Solutions, and
- Harrington Mechanical

In 2021, due to the ongoing COVID-19 restrictions, we did not provide any plant tours to existing and prospective customers.

TABLE 36: FACILITY TOURS (2021)

	2021
GENERAL PUBLIC	4
LOCAL INSTITUTIONS	4
LOCAL SUPPLIERS	4
CUSTOMERS	0
TOTAL	**12**

A public meeting was held by the CNSC on December 16, 2021 regarding the annual regulatory oversight report. Questions regarding groundwater monitoring well MW06-10 were asked by a Commission Member, and were also included in a letter from the members of the Algonquins of Ontario community.

Questions were answered to the satisfaction of the Commission during the meeting, and were also answered directly to the members of the Algonquins of Ontario community, in writing on December 8, 2021.

In 2021, SRBT made presentations to members of the public:

- On May 26, 2021 the President of SRBT made a presentation to the Rotary Club of Pembroke to discuss several items such as, annual sales, growth strategy, training, annual tritium emissions, environmental monitoring, public dose, worker dose, emergency management and fire protection, Public Information Program, Financial Guarantee, future outlook and licensing. Questions were asked regarding SRBT's products. Positive comments were given regarding SRBT's operations and transparency.

- On August 10, 2021 the President and Vice-President of SRBT made a presentation to Pembroke City Council to discuss several items such as, annual sales, growth strategy, training, annual tritium emissions, environmental monitoring, public dose, worker dose, emergency management and fire protection, Public Information Program, Financial Guarantee, future outlook and licensing. The presentation was also televised. Questions were asked regarding environmental monitoring, tritium, supply to the Canadian military and the licensing process. Positive comments were given regarding SRBT's operations, community involvement and transparency.

- The President of SRBT is a member of the Pembroke Economic Development Tourism Advisory Committee, attending monthly meetings where updates on SRBT are often discussed. The Mayor of Pembroke and one Pembroke City Councillor are also members of this committee.

- The President of SRBT is also a member and chair of the Community Improvement Plan, attending meetings and discussing SRBT on occasion. The Mayor of Pembroke is also on the Committee.

- The President of SRBT is also a member of the Ontario River Energy Solutions, attending meetings and discussing SRBT on occasion. Pembroke's Deputy Mayor is also a member of this committee.

As part of SRBT's licence renewal application several public information initiatives have taken place:

- On June 30, 2021 SRBT's licence application was posted on our website.
- On July 1, 2021 SRBT's licence application was mailed and e-mailed to:
    - City of Pembroke Officials,
    - Local members of Federal and Provincial Parliament,
    - Indigenous Groups (Algonquins of Ontario, Metis Nation of Ontario, Algonquins of Anishinabeg Nation and Algonquins of Pikwakanagan First Nations),
    - Residents with wells and gardens monitored by SRBT, and
    - Members of local special interest groups.
- On July 3, 2021 a Press Release announcing SRBT's licence application renewal was posted on our website, on our social media accounts and sent to local media.
- On July 20, 2021 hard copies of thirty-eight requested appendices associated with the licence application were sent to the Algonquins of Ontario.
- On August 21, 2021 as a result of reviewing the interventions submitted for the BWXT licence application process, a copy of SRBT's licence application was sent to Kebaowek First Nation by mail and e-mail.
- Also, on August 21, 2021 SRBT's yearly pamphlet and a letter reiterating SRBT's first communication and commitment to providing any information required or answer any questions was sent by mail and e-mail to:
    - Local members of Federal and Provincial Parliament
    - Indigenous Groups (Algonquins of Ontario, Metis Nation of Ontario, Algonquins of Anishinabeg Nation and Algonquins of Pikwakanagan First Nations), and
    - Members of local special interest groups

- During the week of August 30, 2021, all households, apartments, farms and businesses located within a 10 km radius of SRBT were provided SRBT's yearly pamphlet. Approximately 13,000 residences received this pamphlet in the mail.
- On August 30, 2021 the CNSC-issued "Notice of Public Hearing and Participant Funding" was posted on our website and social media accounts.
- SRBT joined and became a member of the Canadian Council for Aboriginal Business (CCAB). On September 6, 2021, a Press Release was posted on the website and social media accounts.
- On October 21, 2021, SRBT's Executive Committee participated in First Peoples Group – CNA Indigenous Awareness Training via Zoom.
- On December 15, 2021, Mr. David Winfield, who is one of the individuals who is a recipient of the Participant Funding for SRBT's licence renewal contacted the Manager – Health Physics and Regulatory Affairs.
    - Mr. Winfield discussed his status as an intervenor for SRBT's upcoming hearing and requested a possible tour of the SRBT facility.
    - An e-mail was sent to this individual following the phone call noting a facility tour would be possible in the new year depending on COVID restrictions, noting our licence renewal application can be found on our website and suggesting to reconnect in the new year to set up a date for a tour.

5.1.2 Program Revision

In 2021, SRBT's Public Information Program (PIP) was revised to reflect the requirements and guidance of CNSC Regulatory Document REGDOC 3.2.1, *Public and Aboriginal Engagement, Public Information and Disclosure*.

As per procedure MSP-001, *Document Control,* the revision number of the program document was changed to align with the standard convention of using letters instead of numbers. The previous revision of the PIP, dated September 25, 2015, was identified as Revision 9. The new revision, dated September 15, 2021, has been newly designated as Revision A.

The following are some of the changes and improvements made to the PIP:

- Replaced the term 'Aboriginal' with 'Indigenous' throughout the program.
- Revised to be consistent with the Environmental Risk Assessment (ERA).
- Revised to reflect specific Indigenous groups as a target audience.
- Revised to reflect all social media outlets.
- Revised to reflect all additional information now being posted on the website, including the SAR and ERA documents.
- Revised to reflect expanded scope of the Public Information Protocol.

5.1.3 Program Audit

There were no internal audits conducted on the Public Information Program in 2021. The next internal audit is scheduled to take place in July 2022.

5.1.4 Public Information Committee

The Public Information Committee held two formal meetings in 2021, focused on outreach to the Algonquins of Pikwakanagan Indigenous community and SRBT's application for licence renewal.

5.1.5 Website and Social Media

SRBT continues to operate a website at www.srbt.com, which continues to provide current environmental monitoring data, information about tritium, content on emergency preparedness, the safe transport of tritium to the facility and products from the facility, how to safely dispose of products, and both our Operating Licence and LCH.

The main page provides a number of possible information sources for the public on tritium and radiation exposure.

The following information and documentation were added to our website in 2021:

- CNSC Compliance Inspection Reports 2020-02 and 2021-01
- SRBT DRL Final Report – October 30, 2021,
- Two reportable events documents,
- Environmental Risk Assessment, Revision B, April 2021
- Updated pamphlet and brochure,
- SRBT Annual Compliance Report, 2020, including addenda,
- Updated environmental and groundwater monitoring results,
- 2021 Presentation to City Council,
- 2021 Presentation to the Rotary Club of Pembroke,
- Revised PIP and Public Disclosure Protocol,
- New Social Media Links,
- Safety Analysis Report, Revision 4, November 2017,
- Application for the Renewal of SRBT's NSPFOL-13.00/2022,
- Notice of Public Hearing and Participant Funding,
- Notice of SRBT's Emergency Training Exercise,
- CNSC staff's Regulatory Oversight Report, 2020, and,
- Press Release "SRB joins the Canadian Council for Aboriginal Business (CCAB)"

With respect to social media, SRBT also maintains Facebook, Instagram, Twitter, LinkedIn, Reddit and TikTok accounts, all of which are updated periodically.

Our Facebook account has a total of 1,164 followers, with a total of 15 posts in 2021. The account has received no reviews and 4 page likes in 2021.

SRBT's Instagram account has a total of 303 followers, with a total of 10 posts in 2021. The account received an average of 25 likes per post in 2021.

SRBT's Twitter account has a total of 86 followers. A total of 11 posts have been made in 2021, receiving 48 likes.

SRBT's LinkedIn account has a total of 54 followers and has posted a total of 10 posts in 2021 receiving a total of 606 impressions.

SRBT's Reddit account only has one follower and has posted a total of 10 posts receiving 11 interactions.

SRBT's TikTok account has 10 followers and has posted a total of 10 posts receiving a total of 87 likes.

5.1.6 Community Support

SRBT continues to support the local community by providing support to various organizations and causes. Due to the pandemic, almost all in-person fundraising event were cancelled (trivia nights, skating, sports, etc.), which unfortunately resulted in less realized opportunities to provide community support in 2021.

During the Christmas season, SRBT donated several items to Destig: Mental Health as auction items to raise money. SRBT also supported the Christmas Angels gift collection for children in the area, aimed at supporting families who couldn't afford gifts at Christmas.

SRBT is a member of the Upper Ottawa Valley Chamber of Commerce. SRBT is a club member of the Muskrat Watershed Council in support of the water quality monitoring data report and ongoing work. The Manager – Health Physics and Regulatory Affairs is a member of the Algonquin College Radiation Safety Program Advisory Committee.

SRBT has supported the Main Street Community Services who provides research-based programs for children with special needs. SRBT also sponsors a local soft ball team.

SRBT supported causes such as Community Living Upper Ottawa Valley, Bernadette McCann House for Women and the Robbie Dean Family Counseling Center

SRBT also supports Festival Hall (Pembroke's local community theater), the Alice and Fraser Horse Association, and the Renfrew County Regional Science and Technology Fair.

SRBT is a member of the Canadian Council for Aboriginal Business (CCAB).

5.2 Preliminary Decommissioning Plan and Financial Guarantee

The SRBT Preliminary Decommissioning Plan (PDP) last underwent a significant revision in 2019, and was accepted by CNSC staff on February 3, 2020, while the Commission accepted SRBT's revised Financial Guarantee (FG) amount of $727,327.00 on December 8, 2020.

Both the PDP and FG are next due for review, revision and updating in 2024.

Details on our revised PDP, updated FG, and the CNSC's hearing and decision are available on our website.

The SRBT FG is a cash fund held in escrow, and does not rely on any letters of credit, bonds, insurance or other expressed commitments.

Interest accrued on the funds deposited remain held in escrow over time; as a result, at the end of 2021 the FG is over-funded to $747,760.51, a level that exceeds the required amount by $20,433.51.

6 Improvement Plans and Forecast

6.1 Emission Reduction Initiatives

SRBT continues to explore ways toward reducing tritium emissions from the facility in all forms, as per our continuing commitment to environmental protection and the ‘as low as reasonably achievable’ philosophy.

In early 2022, a procedural change on how the ‘heel’ of bulk tritium containers is handled should result in a reduction of the amount of tritium released to atmosphere each time a container is emptied of recoverable tritium.

We expect that the changes introduced to the manufacturing and leak testing of miniature light sources should continue to keep the rate of generation of tritium-contaminated liquid effluent very low in 2022.

Continued, systematically developed training of employees who process tritium and handle light sources will continue to impact our gaseous and liquid emissions in a positive way.

6.2 Safety Performance Targets for 2022

For the coming year, our safety committees, in consultation with SRBT Senior Management, have approved a set of performance targets which will be tracked and reported on as part of the 2022 ACR.

The following table documents the safety performance targets for SRBT in 2022:

TABLE 37: SAFETY AND PERFORMANCE TARGETS FOR 2022

PARAMETER	2022 TARGET
MAXIMUM WORKER DOSE	≤ 0.50 mSv
AVERAGE WORKER DOSE	≤ 0.060 mSv
CALCULATED DOSE TO MEMBER OF THE PUBLIC	≤ 0.0040 mSv
TOTAL TRITIUM EMISSIONS TO ATMOSPHERE (PER WEEK AVERAGE)	≤ 625 GBq / week
RATIO – TRITIUM EMISSIONS VS. PROCESSED	≤ 0.11
TOTAL TRITIUM EMISSIONS – LIQUID EFFLUENT PATHWAY	≤ 10 GBq
ACTION LEVEL EXCEEDANCES – ENVIRONMENTAL	≤ 1
ACTION LEVEL EXCEEDANCES – RADIATION PROTECTION	≤ 1
CONTAMINATION CONTROL – FACILITY-WIDE PASS / FAIL RATE	≥ 95%
LOST TIME INJURIES	0
MINOR INJURIES REPORTABLE TO WSIB	≤ 5
MINOR INCIDENTS / FIRST AID INJURIES (NON-REPORTABLE)	≤ 15

6.3 Planned Modifications and Foreseen Changes

The upcoming year of operation is not expected to involve significant modifications to the facility or our licensed activities, and production levels are expected to remain stable.

SRBT will be continuing to pursue and explore opportunities to reduce emissions in all forms, as part of our ongoing commitment to ensure that our environmental impacts are as low as reasonably achievable.

SRBT anticipates that a renewed operating licence will be issued by the Commission before June 30, 2022. A public hearing on our application for renewal is scheduled to take place in April 2022. Once the licence renewal process is completed, any changes to our licence and LCH will be integrated into our Management System and safety programs at that time, in close consultation with CNSC staff.

7 Concluding Remarks

Throughout the year, the management and staff of SRBT complied with all regulatory requirements and the conditions of our operating licence.

Our management system remains effective at achieving our operational and safety-related goals, and ensuring effective control of our operations. We continue to adjust and improve our processes in support of the safe and effective operation of our facility, and we continue to use operating experience to continuously improve the system.

Our facility remains within its designed safety basis, and continues to be fit for service. Key structures, systems and components have continued to be maintained diligently and effectively throughout 2021 through the implementation of our Maintenance Program.

Exposures to ionizing radiation to both workers and members of the public continue to remain low, and are far less than the regulatory limits prescribed.

The local environment has remained protected, and the already low level of impact of our operations continues to be reduced over time, as we continue to implement best practices each and every day. Licence limits for our nuclear substance effluent streams continue to be respected with significant margin.

Our conventional health and safety program has continued to ensure our workers are safe, and the security of the facility and all nuclear substances was maintained at all times.

SRBT remains well protected from fire hazards, and have maintained an accepted plan should an emergency condition arise. A successful full-scale Emergency Exercise was conducted in October, in partnership with the City of Pembroke, the Pembroke Fire Department, and local paramedics. CNSC staff were on hand to observe and inspect the exercise, and several opportunities for improvement have been identified which will add to our preparedness for emergency situations.

Our Public Information Program, which was revised and updated in 2021, fully satisfies the requirements of the CNSC. We continue to look for new ways to reach out into our local community in a positive and constructive fashion, and to provide information and data that is of interest to stakeholders and Indigenous communities.

Our website continues to provide the public with a wealth of easy-to-access information on our operations and our safety programs, including a very wide variety of environmental data and safety analyses.

We continue to effectively manage all forms of waste generated by our operations, and continue to look to minimize the amount of waste that must be managed and controlled.

Our decommissioning responsibilities are documented and accepted, and our financial guarantee is fully funded. Although we plan on operating the facility for at least the next two decades, if not longer, having a complete, self-funded financial guarantee is an important consideration with respect to our regulatory standing, as well as our commitment of being a good community partner.

Safety and excellence in operations shall always remain as the number one overall priority in everything we do, and 2021 was a direct reflection of the success at achieving these goals.

We also look forward to participating in the process of the renewal of our operating licence, as the current licence is set to expire on June 30, 2022. A hearing is scheduled to take place in April, where the Commission will consider our application for renewal.

Based on our performance over the term of the current licence, and the highly static nature of our operations, we strongly believe that a 15-year renewal of our operating licence is justified and warranted.

We will always continue to improve our operations and minimize our impact on people and the environment as our company continues to sustainably grow over the coming years.

8 References

[1] Nuclear Substance Processing Facility Operating Licence NSPFOL-13.00/2022, valid from July 1, 2015 to June 30, 2022. Link

[2] Licence Conditions Handbook – SRB Technologies (Canada) Inc. Nuclear Substance Processing Facility Operating Licence NSPFOL-13.00/2022 (CNSC e-Doc 4624621 (Rev. 0), 4899130 (Rev.1), 5127037 (Rev. 2), 6089149 (Rev. 3)). Link

[3] Email and report from J. MacDonald (SRBT) to L. Posada (CNSC), *Full Report – Implementation of Contingency Plan on February 19, 2021,* dated March 12, 2021. Link

[4] Letter from L. Posada (CNSC) to J. MacDonald (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Implementation of Contingency Plan – Feb 19, 2021,* dated March 16, 2021 (e-Doc 6513123). Link

[5] Email and report from J. MacDonald (SRBT) to L. Posada (CNSC), *Full Report – Implementation of Contingency Plan on August 16, 2021,* dated September 1, 2021. Link

[6] Letter from L. Posada (CNSC) to J. MacDonald (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Implementation of Contingency Plan on August 16, 2021,* dated September 20, 2021 (e-Doc 6641927). Link

[7] Letter and report from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Compliance Inspection Report No. SRBT-2021-01,* dated November 3, 2021 (e-Doc 6665013 and 6664959).

[8] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Response to Inspection Report SRBT-2021-01,* dated December 17, 2021.

[9] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Review of SRBT's Response to Inspection Report SRBT-2021-01,* dated January 24, 2022 (e-Doc 6707907).

[10] Letter and report from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Compliance Inspection Report No. SRBT-2021-02, October 25, 2021 to October 27, 2021,* dated January 19, 2022 (e-Doc 6714210 and 6679437).

[11] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Response to Inspection Report SRBT-2021-02,* dated January 25, 2022.

[12] Letter and report from S. MacDonald (CNSC) to J. MacDonald (SRBT), *SRB Technologies Dosimetry Services – CNSC Type II Inspection Report: DERPA-RPD-2021-11361, New Action Item CAS-11947,* dated September 21, 2021 (e-Doc 6643524 and 6630096).

[13] Letter from J. MacDonald (SRBT) to S. MacDonald (CNSC), *SRBT Response to CNSC Inspection Report DERPA-RPD-2021-11361 (Action Item CAS-11947),* dated September 22, 2021.

[14] Email from S. Rodrigue (CNSC) to J. MacDonald (SRBT), *CNSC staff review of SRBT Response to CNSC Inspection Report DERPA-RPD-2021-11361,* dated December 6, 2021.

[15] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Submission of Third-Party Fire Protection Program Audit Report - 2021,* dated December 23, 2021.

[16] Letter from L. Posada (CNSC) to R. Fitzpatrick (SRBT), *CNSC Staff Review of SRBT's Fire Hazard Assessment (FHA),* dated February 16, 2021 (e-Doc 6489411).

[17] Email from J. MacDonald (SRBT) to L. Posada (CNSC), *SRBT Submission of Two Revised Procedures (LCH Appendix C),* dated January 29, 2021.

[18] Letter from L. Posada (CNSC) to J. MacDonald (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Revised Two Procedures,* dated February 25, 2021 (e-Doc 6497145).

[19] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Environmental Risk Assessment,* dated March 12, 2021 (e-Doc 6506851).

[20] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *SRBT Response to CNSC Staff Comments on ERA,* dated April 12, 2021.

[21] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Follow-up Review of SRB Technologies (Canada) Inc.'s Environmental Risk Assessment,* dated April 22, 2021 (e-Doc 6539968).

[22] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Submission of Revised Health and Safety Policy,* dated May 5, 2021.

[23] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Revised Health and Safety Policy,* dated May 26, 2021 (e-Doc 6567291).

[24] Letter from S. Levesque (SRBT) to M.A. Leblanc (CNSC), *Application for the Renewal of SRB Technologies (Canada) Inc. Nuclear Substance Processing Facility Operating Licence NSPFOL-13.00/2022,* dated June 30, 2021. Link

[25] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Submission of Revised Program Documents,* dated June 30, 2021.

[26] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Submission of Revised Program Documents,* dated August 25, 2021 (e-Doc 6627320).

[27] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Submission of Revised Public Information Program,* dated September 15, 2021.

[28] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Revised Public Information Program,* dated October 29, 2021 (e-Doc 6669217).

[29] Email from S. Levesque (SRBT) to L. Posada (CNSC), *SRBT's Revised Facility Security Program,* dated September 28, 2021.

[30] Email from R. Duguay (CNSC) to S. Levesque (SRBT), *RE: SRBT's Revised Facility Security Program,* dated October 12, 2021.

[31] Letter from S. Levesque (SRBT) to L. Posada (CNSC), *Submission of Revised Derived Release Limits (DRL) for SRBT,* dated November 8, 2021.

[32] Letter from L. Posada (CNSC) to S. Levesque (SRBT), *CNSC Staff Review of SRB Technologies (Canada) Inc.'s Submission – SRBT Derived Release Limits – 2021 Update,* dated December 14, 2021 (e-Doc 6699117).

[33] Letter from M. Tremblay (Health Canada) to J. MacDonald (SRBT), *Certificate of Achievement,* dated June 14, 2021.

[34] Email and attached report from J. MacDonald (SRBT) to cnsc.acr-rac.ccsn@canada.ca, *2021 Annual Compliance Report – 11341-3-28.5,* dated January 21, 2022.

[35] Letter from S. Levesque (SRBT) to S. Rodrigue (CNSC), *First Quarterly Update on SRBT Implementation Plan for REGDOC 2.7.2, Dosimetry, Volume II: Technical and Management System Requirements for Dosimetry Services,* dated March 31, 2021.

[36] Email from S. Rodrigue (CNSC) to J. MacDonald (SRBT), *RE: CNSC Staff Review of SRBT's Quarterly Report: Implementation Plan for REGDOC 2.7.2, Dosimetry, Volume II,* dated April 8, 2021.

[37] Letter from S. Levesque (SRBT) to S. Rodrigue (CNSC), *Final Update on SRBT Implementation Plan for REGDOC 2.7.2, Dosimetry, Volume II: Technical and Management System Requirements for Dosimetry Services,* dated September 15, 2021.

[38] Letter from S. Rodrigue (CNSC) to J. MacDonald (SRBT), *Dosimetry Licence No. 11341-3-28.5,* dated December 20, 2021.

[39] *Tritium Analysis of Soils and Vegetation from Pembroke, Russell, Golden Lake, Hay River, RSP-0256 Final Report R387.1,* dated October 26, 2009. CNSC Link to Summary

[40] Letter from J. MacDonald (SRBT) to A. Two-Axe Kohoko (AOPFN), dated October 22, 2021.

[41] CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*

[42] CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, Tables C.1, C.2.

[43] CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, Table 19.

[44] CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, Table 21.

[45] CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, Table G.9c.

9 Appendices

DESCRIPTION **LETTER**

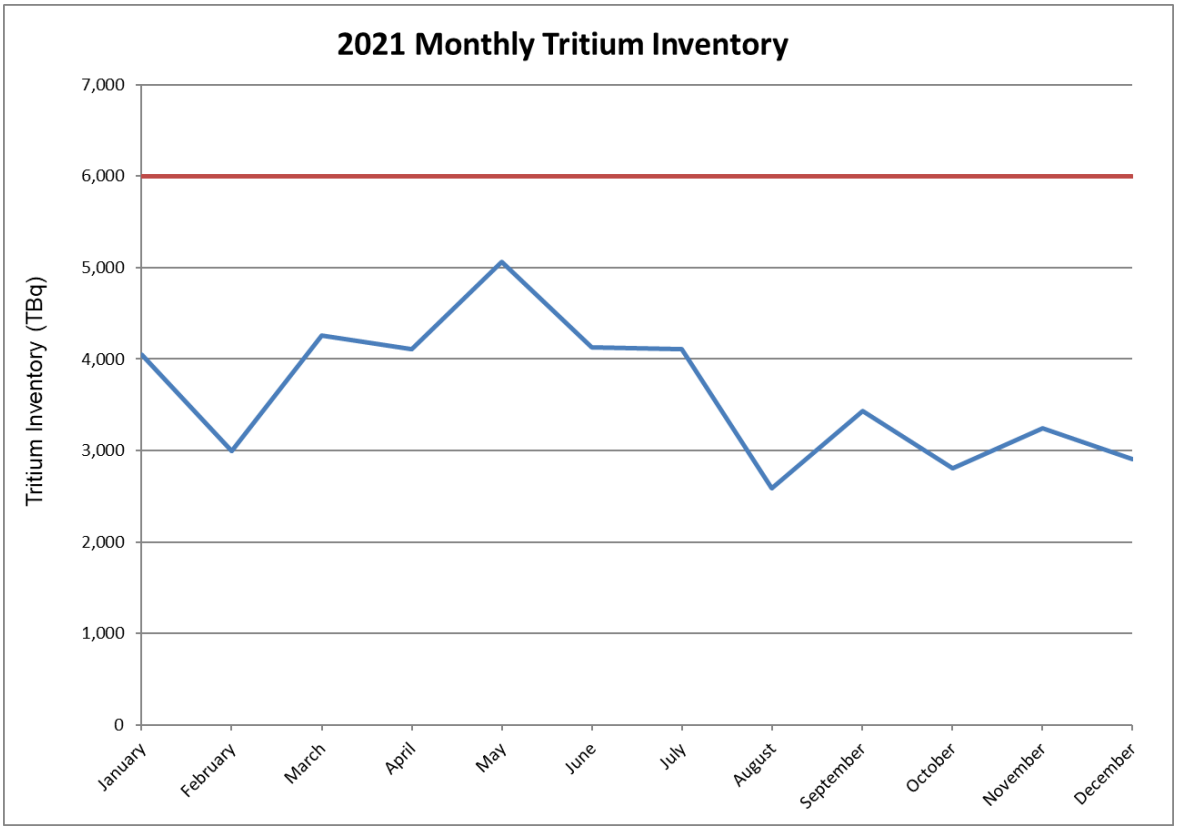
APPENDIX A

Tritium Inventory / Possession

Tritium Inventory / Possession

Month	Month-end H-3 Activity On-Site (TBq)	Percent of Licence Limit (%)
January	4,051	67.5
February	2,990	49.8
March	4,255	70.9
April	4,108	68.5
May	5,066	84.4
June	4,131	68.9
July	4,111	68.5
August	2,589	43.2
September	3,430	57.2
October	2,810	46.8
November	3,247	54.1
December	2,910	48.5
2021 Monthly Average	**3,641**	**60.7**

Note: Tritium possession limit = 6,000 TBq.



APPENDIX B

Equipment Maintenance Information

Equipment Maintenance Information

Semi-Annual maintenance on HVAC equipment: **Contract:** Black and McDonald	March 26, 2021 Sept 20. 2021
Quarterly maintenance on Rig & Bulk stack units: **Contract:** Black and McDonald	March 26, 2021 June 14, 2021 Sept 20, 2021 Dec 21, 2021
Annual stack verification by a third party on Rig & Bulk stack units: **Contract:** Tab Inspection	Sept 29, 2021
Sprinkler System quarterly maintenance by a third party: **Contract:** Drapeau Automatic Sprinkler Corp	March 19, 2021 June 25, 2021 Oct 8, 2021 Dec 21, 2021
Emergency Lighting & Fire Extinguisher annual inspection by a third party: **Contract:** Layman Fire and Safety	March 15, 2021
Sprinkler System inspection by SRBT:	Weekly
Fire Alarm Components inspection by SRBT:	Weekly
Fire Separation doors inspection by SRBT:	Weekly
Fire Extinguisher inspection by SRBT:	Monthly
Emergency Lights inspection by SRBT:	Monthly
Exit Doors inspected by SRBT:	Weekly
Quarterly maintenance carried out on the compressor: **Contract:** Valley Compressor	Jan 5, 2021 April 1, 2021 June 28, 2021 Sept 29, 2021
Fume Hood Inspections by SRBT:	Monthly
Tritium-in-Air Sample Collector Bubblers maintenance:	Bi-monthly
Tritium-in-Air Sample Collector Bubblers third party annual verification: **Contract:** Canadian Nuclear Laboratories	Feb 9, 2021
Liquid Scintillation Counters third party annual maintenance: **Contract:** PerkinElmer	Aug 17, 2021
Real-time Stack Monitoring system verification by SRBT:	March 3, 2021 June 14, 2021 Sept 2, 2021 Dec 9, 2021

Equipment Maintenance Information

Monitoring well inspection by SRBT:	Feb 2, 2021 June 2, 2021 Sept 8, 2021
Annual IT maintenance inspection by SRBT:	Sept 28, 2021
Non-active air filter inspection by SRBT:	Monthly
Annual Zone Differential Pressure Test by SRBT:	Dec 22, 2021
UV printer maintenance by SRBT:	Monthly
Molding machine maintenance by SRBT:	March 30, 2021 July 8, 2021 Sept, 29 2021 Dec 22, 2021
3D printer maintenance by SRBT:	March 30, 2021 June 22, 2021 Sept 29, 2021 Dec 22, 2021
Fork-crane maintenance by SRBT:	May 17, 2021
Forklift maintenance by a third party: **Contract: Hyster**	May 4, 2021
Report of any weakening or possible major failure of any components:	None

All ventilation systems were maintained at a high fitness for service. Corrective maintenance was performed as required. Ventilation equipment maintenance was performed under contract with a fully licensed maintenance and TSSA certified local HVAC contract provider.

All process equipment is serviced and maintained by qualified staff and through contract with companies that specialize in process control systems. All process equipment has been maintained in fully operational condition.

Corrective maintenance is performed on equipment as required, and recorded and tracked over time.

APPENDIX C

Ventilation Maintenance Information

Ventilation Maintenance Information

#	TYPE	ZONE SERVICED	LOCATION OF UNIT
1	Gas Furnace	1	Front office / server hallway
1	Mid efficient gas furnace	1	Receiving area
1	Mid efficient gas furnace & central air	1	Stores
1	Mid efficient gas furnace	1	Back bay
1	Heat Recovery unit	1	Receiving area
1	HRV with reheat	2	Coating
2	Makeup air units	1 & 2	Coating room
3	Unit heaters	1 & 3	Rig room, Glass shop, Receiving area
1	A/C wall unit	1	Glass shop
4	Exhaust fans	1 & 2	Coating, Assembly, Glass room, Paint Booth
1	Electric furnace with central air	1	Front office
1	Bulk stack air handling unit	3	Compound
1	Rig stack air handling unit	3	Compound
2	Rig and Bulk stack air handling unit pitot tubes	3	Compound
1	Gas furnace with central air	1	Milling / molding

APPENDIX D

Radiological Dose Data

Radiological Dose Data

Rolling five-year effective dose data (2017 - 2021)

ANNUAL DOSE (mSv)	2017	2018	2019	2020	2021	FIVE YEAR AVERAGE
Maximum Dose	0.46	0.48	0.57	0.43	0.36	**0.46**
Average Dose (all records)	0.045	0.044	0.065	0.077	0.056	**0.057**
Average Dose (excluding <0.01))	0.113	0.130	0.115	0.093	0.090	**0.108**
Collective Dose	1.96	2.06	2.95	3.30	2.35	**2.52**

EFFECTIVE DOSE RANGE (mSv)	2017	2018	2019	2020	2021	FIVE YEAR AVERAGE
< 0.01 ('zero dose')	28	32	20	8	16	**21**
0.01 – 0.05	8	7	10	18	16	**12**
0.05 – 0.10	4	1	6	7	3	**4**
0.10 – 0.25	2	5	5	6	3	**4**
0.25 – 0.50	3	2	3	4	4	**3**
0.50 – 1.00	0	0	1	0	0	**0**
>1.00	0	0	0	0	0	**0**
Number of Workers Monitored	45	47	45	43	42	**44**

APPENDIX E

Contamination Assessment Data

Contamination Assessment Data

Q1 2021 Routine Contamination Assessment Summary - Zone 3

Zone 3 Areas	Assessments	Pass	Pass Rate
Rig 7 Floor	62	61	98.39%
Rig 7	62	62	100.00%
Rig 1 Floor	62	57	91.94%
Rig 1	62	62	100.00%
Flr @ Rig 6	62	59	95.16%
Rig 6	62	62	100.00%
Floor @ Rig 8	62	60	96.77%
Rig 8	62	61	98.39%
Floor @ Rig 5	62	61	98.39%
Rig 5	62	62	100.00%
Waste Room Wall	59	58	98.31%
Computer Area	59	58	98.31%
Low-Level Waste Canister	62	60	96.77%
Flr @ Barrier	62	60	96.77%
Laser Room Floor	62	60	96.77%
EIP Area	62	62	100.00%
Laser Rm F/H	62	59	95.16%
Trit Lab Storage	59	55	93.22%
Trit Lab Flr random	62	59	95.16%
Shoe Covers	62	58	93.55%
Disassembly Fumehood	62	54	87.10%
Bulk Fume Hood	62	60	96.77%
Glove Dispensers	59	58	98.31%
Heat Control Pannel	59	58	98.31%
Waste Room Floor	3	3	100.00%
Porthole	3	3	100.00%
Trit Lab Desk	3	3	100.00%
Wash Fume Hood	3	3	100.00%
Wash Fume Hood Tap	3	3	100.00%
TOTAL	1,488	1,441	96.84%

Q1 2021 Routine Contamination Assessment Summary - Zone 2

Zone 2 Areas	Assessments	Pass	Pass Rate
Floor at Barrier	37	36	97.30%
Work Area Floors	37	33	89.19%
Work Counters	37	37	100.00%
Shoe Storage	35	35	100.00%
Storage Cabinets	37	36	97.30%
Drying Area	37	37	100.00%
Floor Beside Disassambly	37	37	100.00%
Disassembly Bins	37	37	100.00%
Supply Cabinet	35	35	100.00%
Photometer Room	35	35	100.00%
Inspection Room Table	37	35	94.59%
Insp. Prep. Counter	37	36	97.30%
Cart at Barrier	2	2	100.00%
Silk Screening Floor	2	2	100.00%
Bubbler Fume Hood	2	2	100.00%
TOTAL	444	435	97.97%

Q1 2021 Routine Contamination Assessment Summary - Zone 1

Zone 1 Areas	Assessments	Pass	Pass Rate
Lunch Room	13	13	100.00%
LSC Room	13	13	100.00%
RR Ante Rm	13	13	100.00%
RR Barrier	13	12	92.31%
Assy Barrier	13	13	100.00%
Disassembly Table	13	11	84.62%
Disassembly Cart	13	13	100.00%
Office Door Knobs	12	12	100.00%
Disassembly Cabinet	13	13	100.00%
Entrance Door	12	12	100.00%
Mail Box	12	12	100.00%
Shipping Floor	13	13	100.00%
Disassembly Storage Area	1	1	100.00%
Disassembly Floor	1	1	100.00%
Zone 2 Barrier Supply Cabinet	1	1	100.00%
TOTAL	156	153	98.08%

Q2 2021 Routine Contamination Assessment Summary - Zone 3

Zone 3 Areas	Assessments	Pass	Pass Rate
Rig 7 Floor	62	50	80.65%
Rig 7	62	61	98.39%
Rig 1 Floor	62	50	80.65%
Rig 1	62	61	98.39%
Flr @ Rig 6	62	57	91.94%
Rig 6	62	62	100.00%
Floor @ Rig 8	62	59	95.16%
Rig 8	62	62	100.00%
Floor @ Rig 5	62	55	88.71%
Rig 5	62	61	98.39%
Waste Room Door	58	58	100.00%
Disassembly Cabinet	58	56	96.55%
Laser Room desk	58	57	98.28%
Flr @ Barrier	62	58	93.55%
Laser Room Floor	62	55	88.71%
EIP Area	62	61	98.39%
Laser Rm F/H	62	54	87.10%
Trit Lab Storage	62	58	93.55%
Trit Lab Flr random	62	57	91.94%
Shoe Covers	62	57	91.94%
Disassembly Fumehood	62	54	87.10%
Bulk Fume Hood	62	58	93.55%
Table at Barrier	58	54	93.10%
Trit Lab desk	58	53	91.38%
Waste Room Wall	4	4	100.00%
Computer Area	4	4	100.00%
Low-Level Waste Canister	4	4	100.00%
Glove Dispensers	4	4	100.00%
Heat Control Pannel	4	4	100.00%
TOTAL	1,488	1,388	93.28%

Q2 2021 Routine Contamination Assessment Summary - Zone 2

Zone 2 Areas	Assessments	Pass	Pass Rate
Floor at Barrier	36	36	100.00%
Work Area Floors	36	36	100.00%
Work Counters	36	36	100.00%
Shoe Storage	36	36	100.00%
WIP Cabinets	36	36	100.00%
Computer Parts	35	35	100.00%
Air Hose	35	34	97.14%
Disassembly Bins	36	36	100.00%
Stock Cabinet	35	35	100.00%
Photometer Room	36	36	100.00%
Inspection Room Table	36	36	100.00%
Insp. Prep. Counter	36	34	94.44%
Drying Area	1	1	100.00%
Floor Beside Disassambly	1	1	100.00%
Supply Cabinet	1	1	100.00%
TOTAL	433	430	99.31%

Q2 2021 Routine Contamination Assessment Summary - Zone 1

Zone 1 Areas	Assessments	Pass	Pass Rate
Lunch Room	14	14	100.00%
LSC Room	14	14	100.00%
RR Ante Rm	14	11	78.57%
RR Barrier	14	11	78.57%
Assy Barrier	14	14	100.00%
Disassembly Table	14	13	92.86%
Disassembly Cart	14	14	100.00%
RMA Supplies	13	13	100.00%
Disassembly Cabinet	14	13	92.86%
Conference Room	13	13	100.00%
Printers	13	12	92.31%
Shipping Floor	14	14	100.00%
Office Door Knobs	1	1	100.00%
Entrance Door	1	1	100.00%
Mail Box	1	1	100.00%
TOTAL	168	159	94.64%

Q3 2021 Routine Contamination Assessment Summary - Zone 3

Zone 3 Areas	Assessments	Pass	Pass Rate
Rig 7 Floor	61	53	86.89%
Rig 7	61	59	96.72%
Rig 1 Floor	61	57	93.44%
Rig 1	61	61	100.00%
Flr @ Rig 6	61	60	98.36%
Rig 6	61	61	100.00%
Floor @ Rig 8	61	57	93.44%
Rig 8	61	61	100.00%
Floor @ Rig 5	61	59	96.72%
Rig 5	61	60	98.36%
Waste Room Floor	58	56	96.55%
Log Book Area	58	54	93.10%
Liquid Effluent Barrel	58	54	93.10%
Flr @ Barrier	61	61	100.00%
Laser Room Floor	61	60	98.36%
EIP Area	61	59	96.72%
Laser Rm F/H	61	58	95.08%
Light Switches	58	58	100.00%
Trit Lab Flr random	61	59	96.72%
Shoe Covers	61	61	100.00%
Disassembly Fumehood	61	41	67.21%
Bulk Sash	58	56	96.55%
Table at Barrier	61	60	98.36%
Trit Lab desk	61	53	86.89%
Waste Room Door	3	3	100.00%
Disassembly Cabinet	3	3	100.00%
Laser Room desk	3	3	100.00%
Trit Lab Storage	3	3	100.00%
Bulk Fume Hood	3	3	100.00%
TOTAL	1,464	1,393	95.15%

Q3 2021 Routine Contamination Assessment Summary - Zone 2

Zone 2 Areas	Assessments	Pass	Pass Rate
Floor at Barrier	36	35	97.22%
Work Area Floors	36	29	80.56%
Work Counters	36	36	100.00%
Shoe Storage	36	36	100.00%
WIP Cabinets	36	34	94.44%
Freezer	34	33	97.06%
Air Hose	36	36	100.00%
Paint Booth	34	33	97.06%
Stock Cabinet	36	36	100.00%
Photometer Room	36	36	100.00%
Liquid Effluent Barrel	34	32	94.12%
Insp. Prep. Counter	36	35	97.22%
Computer Parts	2	2	100.00%
Disassembly Bins	2	2	100.00%
Inspection Room Table	2	2	100.00%
TOTAL	432	417	96.53%

Q3 2021 Routine Contamination Assessment Summary - Zone 1

Zone 1 Areas	Assessments	Pass	Pass Rate
Lunch Room	13	13	100.00%
LSC Room	13	13	100.00%
RR Ante Rm	13	13	100.00%
RR Barrier	13	13	100.00%
Assy Barrier	13	13	100.00%
Disassembly Table	13	11	84.62%
LSC Waste Drum	12	12	100.00%
EMP Cart	12	12	100.00%
Disassembly Cabinet	13	13	100.00%
Employee Lockers	12	12	100.00%
Printers	13	13	100.00%
Shipping Floor	13	13	100.00%
Disassembly Cart	1	1	100.00%
RMA Supplies	1	1	100.00%
Conference Room	1	1	100.00%
TOTAL	156	154	98.72%

Q4 2021 Routine Contamination Assessment Summary - Zone 3

Zone 3 Areas	Assessments	Pass	Pass Rate
Rig 7 Floor	57	56	98.25%
Rig 7	57	57	100.00%
Rig 1 Floor	57	56	98.25%
Rig 1	57	57	100.00%
Flr @ Rig 6	57	52	91.23%
Rig 6	57	57	100.00%
Floor @ Rig 8	57	56	98.25%
Rig 8	57	57	100.00%
Floor @ Rig 5	57	56	98.25%
Rig 5	57	57	100.00%
Waste Room Shelves	56	56	100.00%
Log Book Area	57	57	100.00%
Liquid Effluent Barrel	57	56	98.25%
Flr @ Barrier	57	51	89.47%
Laser Room Floor	57	56	98.25%
EIP Area	57	57	100.00%
Laser Rm F/H	57	51	89.47%
Scint Table	56	56	100.00%
Trit Lab Flr random	57	54	94.74%
Wash Faucet	56	56	100.00%
Disassembly Fumehood	57	50	87.72%
Bulk Cabinet	56	55	98.21%
Disassembly Sash	56	55	98.21%
Trit Lab desk	57	55	96.49%
Waste Room Floor	1	1	100.00%
Light Switches	1	1	100.00%
Shoe Covers	1	1	100.00%
Bulk Sash	1	1	100.00%
Table at Barrier	1	1	100.00%
TOTAL	1,368	1,331	97.30%

Q4 2021 Routine Contamination Assessment Summary - Zone 2

Zone 2 Areas	Assessments	Pass	Pass Rate
Floor at Barrier	35	34	97.14%
Work Area Floors	35	31	88.57%
Work Counters	35	34	97.14%
Work Area Floor #2	35	32	91.43%
WIP Cabinets	35	34	97.14%
Freezer	35	35	100.00%
Blue Bins	35	35	100.00%
Paint Booth	35	34	97.14%
Dark Room	35	34	97.14%
Photometer Room	35	35	100.00%
Liquid Effluent Barrel	35	33	94.29%
Insp. Prep. Counter	35	33	94.29%
TOTAL	420	404	96.19%

Q4 2021 Routine Contamination Assessment Summary - Zone 1

Zone 1 Areas	Assessments	Pass	Pass Rate
Lunch Room	12	12	100.00%
LSC Room	12	12	100.00%
RR Ante Rm	12	12	100.00%
RR Barrier	12	11	91.67%
Assy Barrier	12	12	100.00%
Disassembly Table	12	11	91.67%
LSC Waste Drum	12	12	100.00%
Liquid Effluent Barrel	12	11	91.67%
Disassembly Cabinet	12	11	91.67%
Transition Seats	12	12	100.00%
Zone 2/3 Doors	12	12	100.00%
Shipping Floor	12	12	100.00%
TOTAL	144	140	97.22%

Overall Facility Summary

Facility Zone	Assessments	Pass	Pass Rate
ZONE 3	5,808	5,553	95.61%
ZONE 2	1,729	1,686	97.51%
ZONE 1	624	606	97.12%
2021	8,161	7,845	96.13%

APPENDIX F

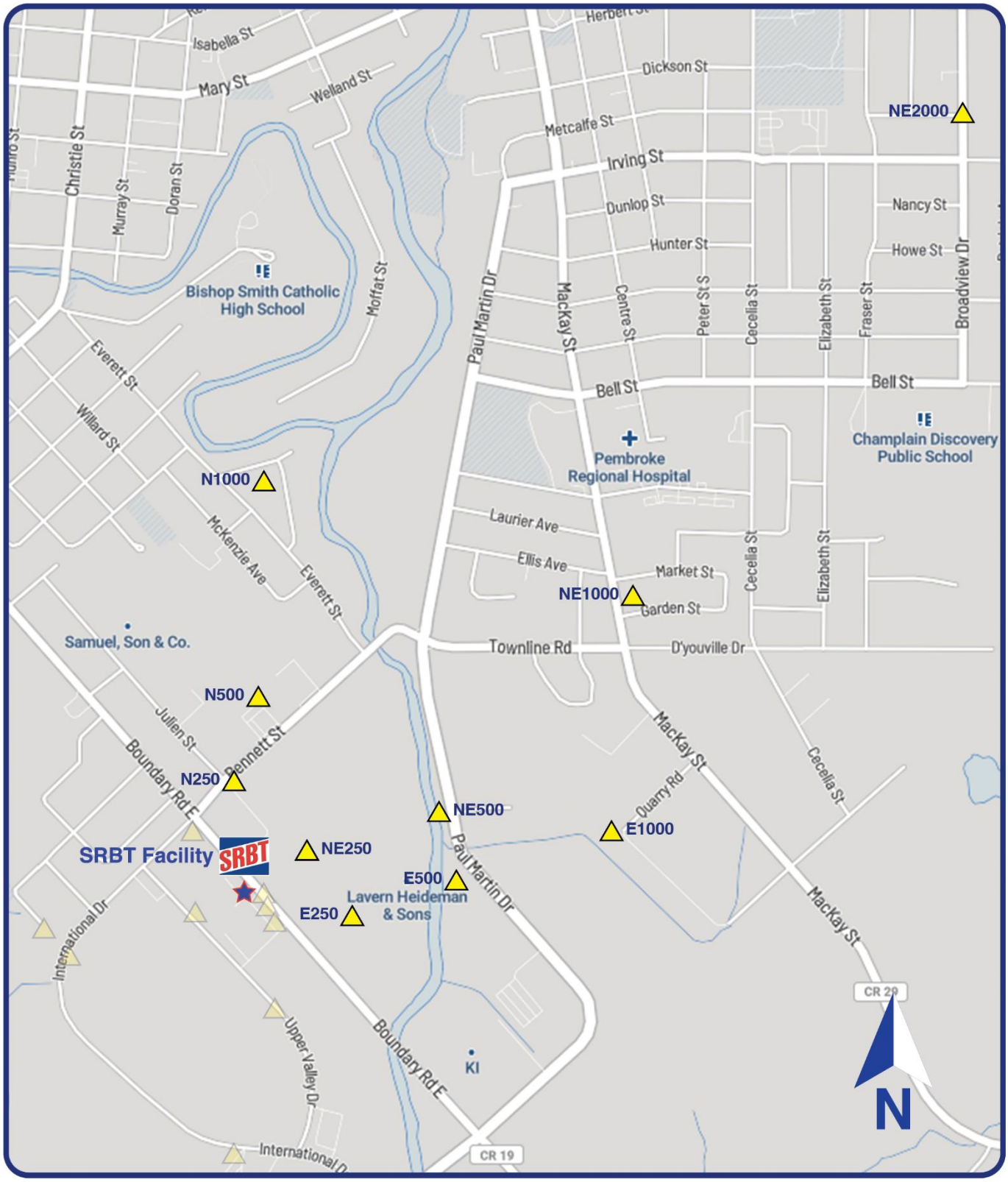
Monthly Average Concentrations of Tritium in Air in Environment

Monthly Average Concentrations of Tritium in Air in Environment

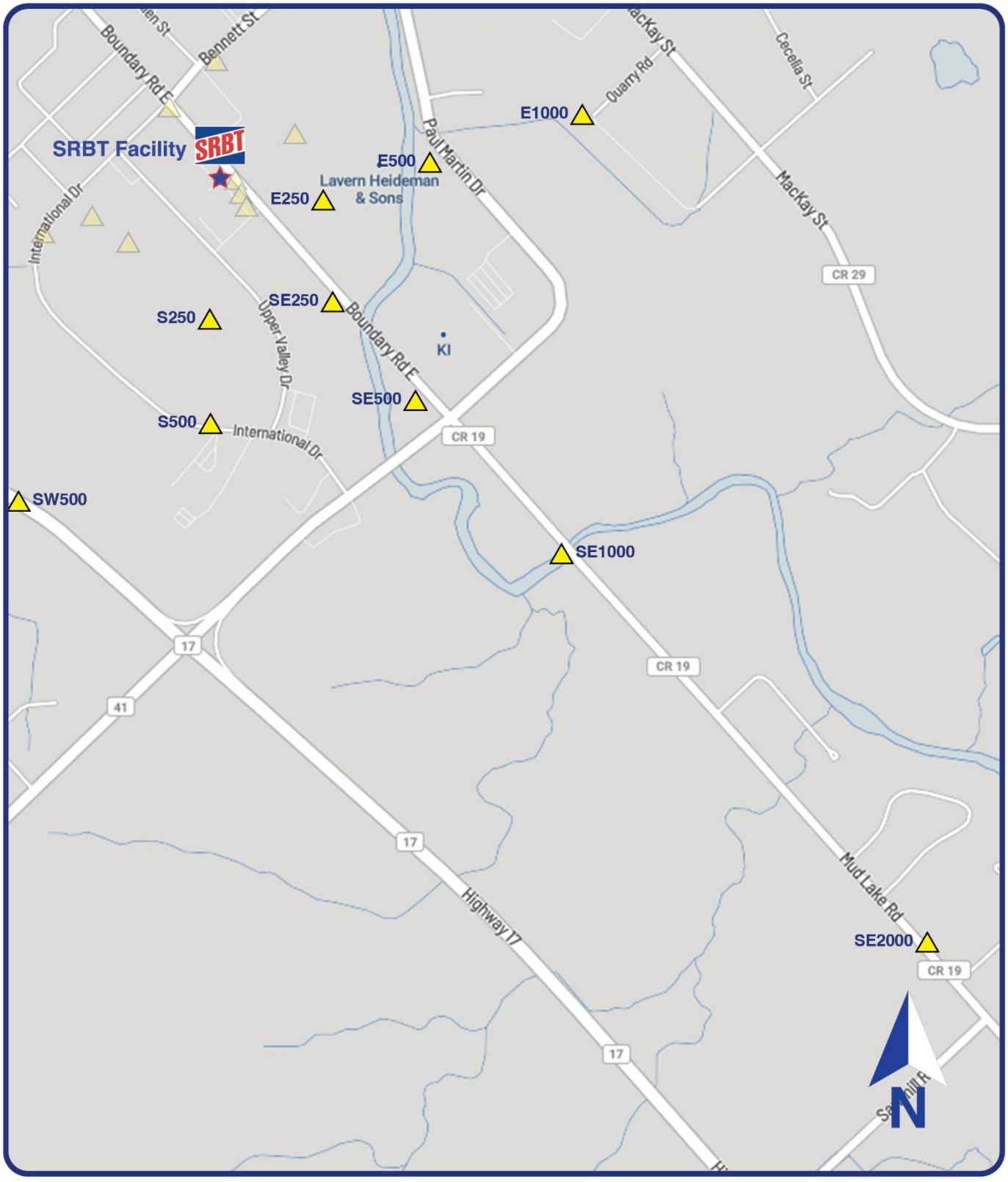
2021 Environment Monitoring Program
Passive Air Sampling System

Sampler No.	Sampler ID	Location	Dist. to SRBT	(Bq/m^3) Jan Dec. 29 - Feb. 1	Feb Feb. 1 - Mar 1	Mar Mar. 1 - Mar. 30	Apr Mar. 30 - May. 3	May May 3 - Jun. 1	Jun Jun. 1 - Jun 29	Jul Jun 29 - Jul 27	Aug Jul 27 - Sept 1	Sep Sept 1 - Sept 28	Oct Sept 28 - Nov 2	Nov Nov 2 - Dec 1	Dec Dec 1 - Dec 28	Average
		Minimum Detectable Activity (Bq/m^3)		*0.67*	*0.8*	*0.95*	*0.56*	*0.68*	*0.69*	*0.7*	*0.53*	*0.7*	*0.57*	*0.67*	*0.73*	*0.69*
1	N250	N 45º 48.486' W 077º 07.092' Elev. 137m	322m	3.47	2.36	0.95	0.56	0.68	2.21	1.79	2.75	2.96	0.57	2.62	1.74	**1.89**
2	N500	N 45º 48.572' W 077º 07.008' Elev. 134m	493m	1.91	5.96	0.95	0.56	0.68	1.11	0.75	1.56	0.96	0.57	1.55	0.78	**1.45**
3	N1000	N 45º 48.869' W 077º 06.997' Elev. 135m	1040m	2.47	0.80	0.95	0.56	0.68	1.32	0.70	0.53	0.70	0.57	1.10	1.11	**0.96**
4 (PAS #4)	NW250	N 45º 48.412' W 077º 07.189' Elev. 137m	222m	4.65	2.46	1.21	1.21	1.00	1.93	1.39	2.00	4.67	1.60	3.52	1.59	**2.27**
5	NW500	N 45º 48.577' W 077º 07.382' Elev. 134m	615m	1.15	2.50	0.95	0.56	0.68	2.21	0.79	1.72	1.67	0.66	2.76	0.73	**1.37**
6 (PAS # 8)	NW1000	N 45º 48.754' W 077º 07.599' Elev. 130m	1050m	2.32	3.31	Lost	0.56	0.68	0.69	0.70	0.53	0.70	0.57	1.48	0.74	**1.12**
7	NW2000	N 45º 49.141' W 077º 08.090' Elev. 139m	2000m	1.32	2.66	0.95	0.56	0.68	0.69	0.70	0.53	0.70	0.57	0.97	0.73	**0.92**
8	W250	N 45º 48.300' W 077º 07.323' Elev. 138m	297m	2.41	2.14	0.95	0.85	0.68	0.69	2.46	0.67	0.70	1.66	0.97	0.73	**1.24**
9	W500	N 45º 48.288' W 077º 07.393' Elev. 137m	389m	1.88	1.61	0.95	1.12	0.68	1.57	1.57	1.33	0.93	1.89	1.03	0.73	**1.27**
10	W1000	N 45º 48.306' W 077º 07.630' Elev. 134m	691m	3.65	*0.80*	*0.95*	0.56	0.68	0.69	0.70	0.64	0.74	0.83	1.45	1.63	**1.11**
11	SW250	N 45º 48.247' W 077º 07.206' Elev. 140m	183m	1.53	4.46	0.95	0.56	1.62	1.11	2.64	1.03	0.70	2.26	0.90	0.73	**1.54**
12	SW500	N 45º 47.896' W 077º 07.307' Elev. 148m	839m	1.18	0.80	0.95	0.56	0.68	0.71	0.70	0.53	0.70	0.57	0.72	0.73	**0.74**
13	SW1000	N 45º 47.599' W 077º 07.543' Elev. 149m	1470m	1.47	2.76	0.95	0.94	0.68	0.69	0.70	0.53	0.70	*0.57*	0.67	0.73	**0.95**
14	SW2000	N 45º 47.408' W 077º 07.866' Elev. 155m	2110m	1.91	4.56	1.41	3.15	0.68	Lost	0.70	0.53	0.70	0.57	0.67	0.73	**1.42**
15	S250	N 45º 48.129' W 077º 07.014' Elev. 131m	356m	2.91	0.80	0.95	0.79	1.59	2.39	1.43	1.67	1.70	2.54	1.28	0.73	**1.57**
16	S500	N 45º 48.029' W 077º 07.110' Elev. 143m	532m	1.79	3.51	0.95	0.56	0.68	0.71	0.93	2.06	0.70	0.86	1.07	0.73	**1.21**
17 (PAS # 12)	S1000	N 45º 46.466' W 077º 07.441' Elev. 158m	1450m	1.50	1.64	0.95	0.56	0.68	0.69	4.25	4.44	0.70	0.60	0.67	0.73	**1.45**
18	SE250	N 45º 48.189' W 077º 06.874' Elev. 132m	365m	12.03	4.21	2.28	2.06	1.55	2.71	5.29	1.72	3.33	2.49	5.10	3.11	**3.82**
19	SE500	N 45º 48.108' W 077º 06.783' Elev. 123m	554m	3.65	lost	1.24	0.68	1.24	1.46	2.68	1.06	1.78	2.20	4.03	1.52	**1.96**
20	SE1000	N 45º 47.894' W 077º 06.501' Elev. 120m	1090m	1.76	6.01	1.86	0.56	1.07	1.68	1.29	0.83	0.85	0.80	1.59	0.73	**1.59**
21	SE2000	N 45º 47.505' W 077º 05.978' Elev. 137m	2080m	1.53	4.16	0.95	0.56	0.68	0.69	0.70	0.53	0.70	0.57	0.67	0.73	**1.04**
22	E250	N 45º 80.564' W 077º 11.556' Elev. 131m	220m	1.76	0.80	1.62	1.79	2.48	4.57	3.79	5.36	3.19	2.54	3.41	1.96	**2.77**
23	E500	N 45º 48.333' W 077º 06.693' Elev. 132m	520m	1.91	1.71	0.95	0.56	0.76	0.71	0.89	1.17	0.70	1.29	1.90	0.78	**1.11**
24	E1000	N 45º 48.303' W 077º 06.260' Elev. 143m	1080m	1.68	2.61	0.95	0.56	0.68	0.69	0.70	0.53	0.70	0.97	1.14	0.73	**1.00**
25	NE250	N 45º 48.371' W 077º 06.964' Elev. 124m	198m	1.62	2.46	1.10	1.79	3.62	5.50	3.43	4.33	1.37	2.29	4.31	6.67	**3.21**
26	NE500	N 45º 48.421' W 077º 06.732' Elev. 131m	508m	1.41	2.61	0.95	0.65	0.72	1.54	0.70	1.17	0.70	0.86	1.62	1.33	**1.19**
27	NE1000	N 45º 48.683' W 077º 06.441' Elev. 148m	1100m	1.21	4.21	0.95	0.56	0.68	0.69	0.70	0.53	4.56	1.14	1.59	0.93	**1.48**
28	NE2000	N 45º 49.116' W 077º 05.843' Elev. 156m	2200m	1.12	2.86	0.95	0.56	0.68	0.69	0.70	0.53	0.70	0.57	0.90	0.73	**0.92**
(PAS #1)		N 45º 48.287' W 077º 07.123' Elev. 129m	94.1m	4.38	5.11	1.31	0.56	8.21	10.54	7.21	15.11	4.15	9.86	1.72	1.63	**5.82**
(PAS #2)		N 45º 48.325' W 077º 07.132' Elev. 132m	52.8m	2.85	4.96	0.95	2.68	1.62	2.18	4.54	4.44	4.04	7.14	5.28	2.63	**3.61**
(PAS #13)		N 45º 48.262' W 077º 07.093' Elev. 132m	61.5m	2.00	1.61	1.10	2.62	8.69	5.32	4.57	6.00	0.93	3.97	2.21	0.85	**3.32**
4-2	NW250	N 45º 48.412' W 077º 07.189' Elev. 137m	222m	4.12	0.89	0.95	1.12	0.83	1.54	1.36	1.50	3.96	1.34	2.86	1.59	**1.84**
11-2	SW250	N 45º 48.247' W 077º 07.206' Elev. 140m	183m	1.50	1.71	0.95	0.56	1.31	0.89	2.54	0.92	0.70	1.94	0.90	0.73	**1.22**
18-2	SE250	N 45º 48.189' W 077º 06.874' Elev. 132m	365m	4.85	lost	1.72	1.71	1.41	2.68	3.21	1.72	2.81	2.43	4.52	2.59	**2.70**
25-2	NE250	N 45º 48.371' W 077º 06.964' Elev. 124m	198m	1.47	0.80	0.95	0.82	3.38	4.93	2.79	3.47	1.30	1.80	3.55	2.52	**2.32**
Maika (PAS # 10)	SW	N 45º 46.367' W 077º 11.447' Elev. 149m	6690m	1.74	3.46	0.95	0.56	0.68	0.69	0.70	0.53	0.70	0.57	1.07	0.73	**1.03**
Maika	Duplicate	Same as above	6690m	1.26	lost	6.52	0.56	0.68	0.75	0.70	0.53	0.70	0.57	0.67	0.73	**1.24**
Fitzpatrick	SE	N 45º 44.818' W 076º 59.822' Elev. 159m	11400m	1.56	5.14	2.21	0.56	0.68	0.69	0.70	0.86	0.70	0.57	0.69	0.73	**1.26**
Petawawa	NW	N 45º 51.497' W 077º 12.828' Elev. 149m	9480m	1.74	lost	0.95	0.56	0.68	0.69	0.70	0.53	0.70	0.57	0.67	0.74	**0.78**
Farm	NE	N 45º 53.071' W 076º 56.768' Elev. 142m	16000m	1.00	12.39	1.28	0.56	0.68	3.61	2.21	0.53	0.70	0.57	0.76	0.73	**2.09**
Results shaded in blue are below minimum detectable activity			Sum	95.67	110.84	49.56	37.42	56.74	74.85	75.00	76.95	60.60	64.51	74.59	51.04	69.75

MAPS OF PAS STATIONS

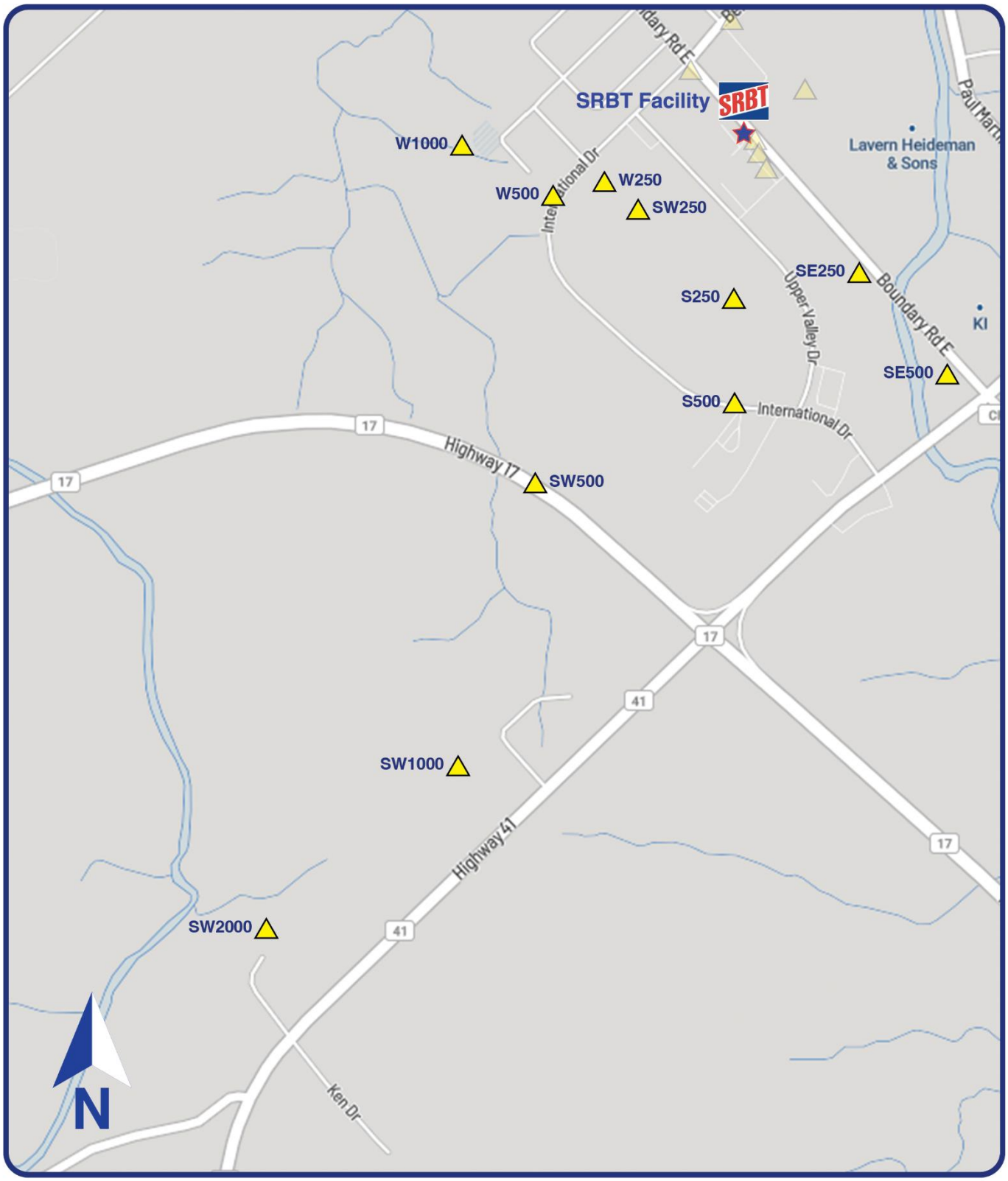


MAPS OF PAS STATIONS



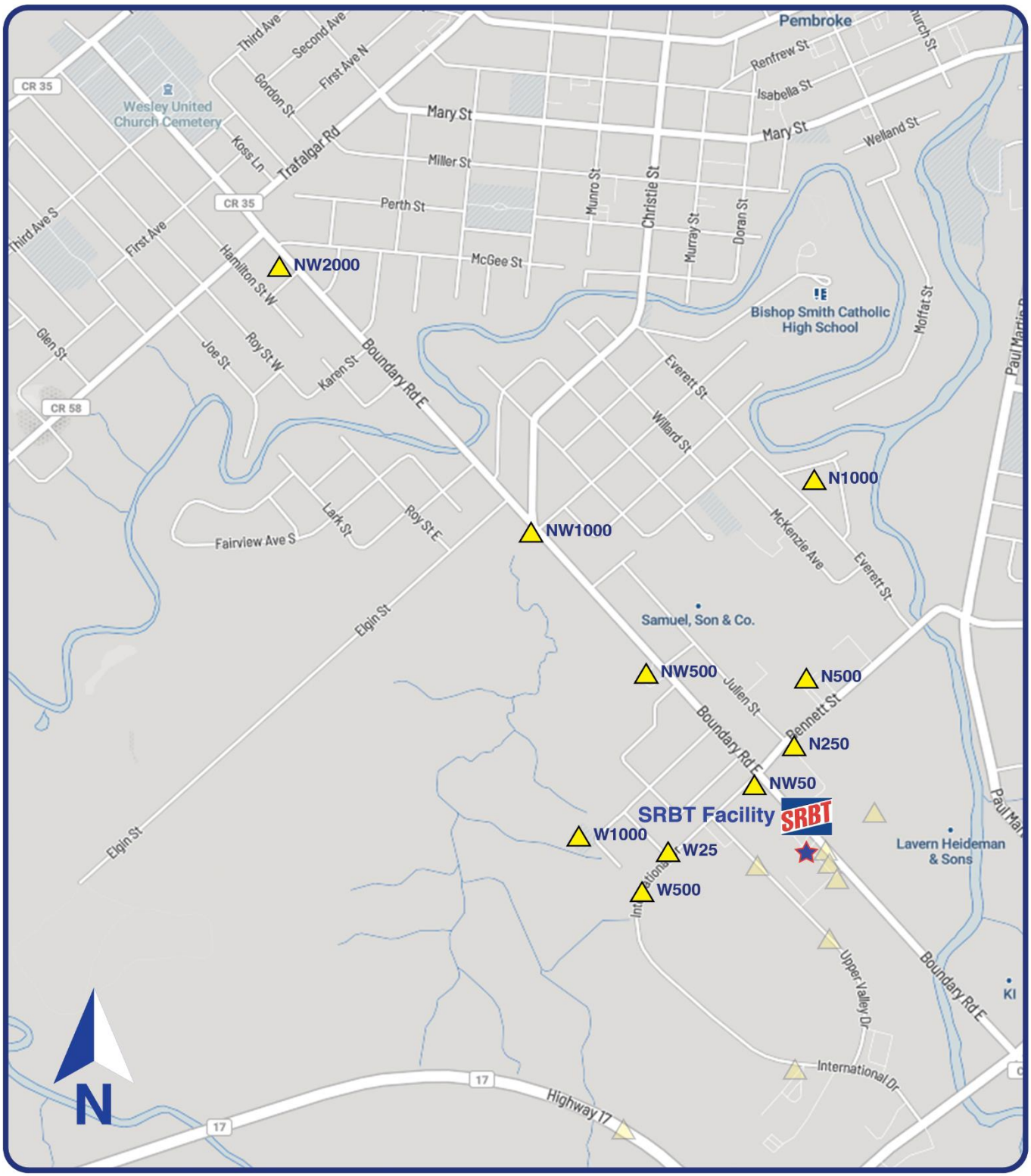
PAS Stations S / SE / E ▲

MAPS OF PAS STATIONS



PAS Stations W / SW / S ▲

MAPS OF PAS STATIONS



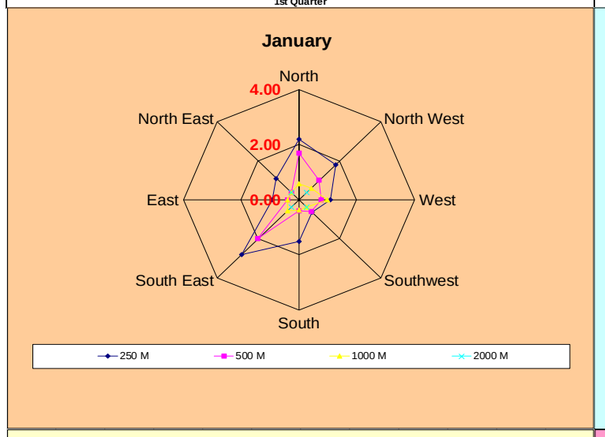
APPENDIX G

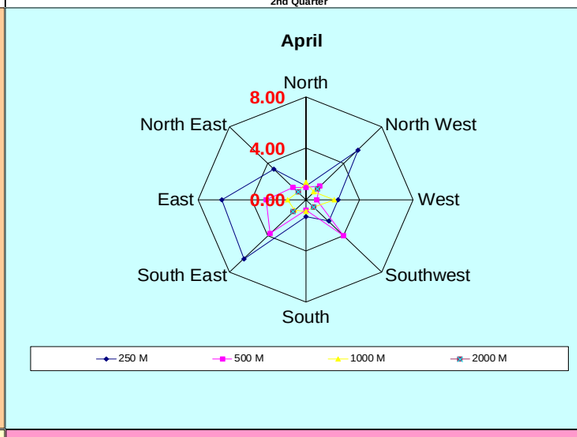
Wind Direction Information

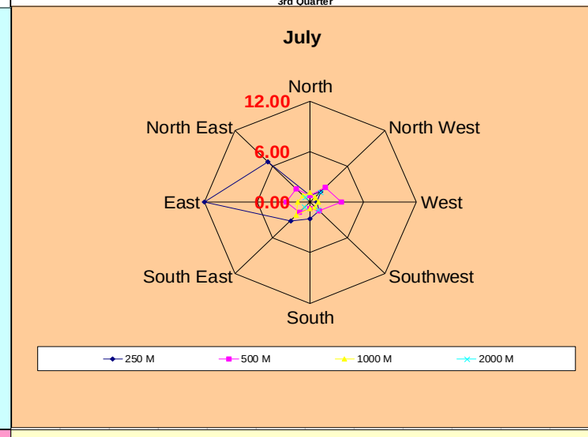
Wind Direction Information

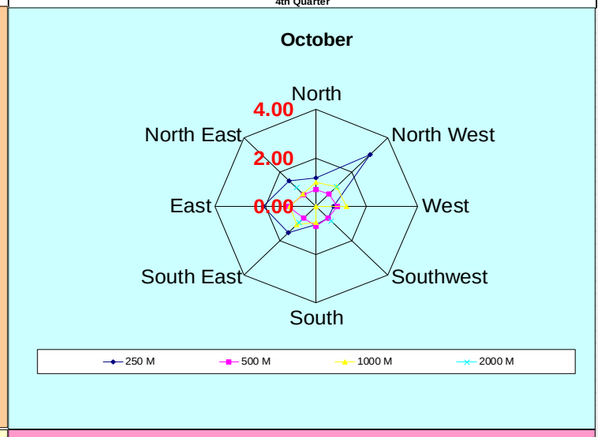
Passive Air Sampling Data (Results in Bq/m3)

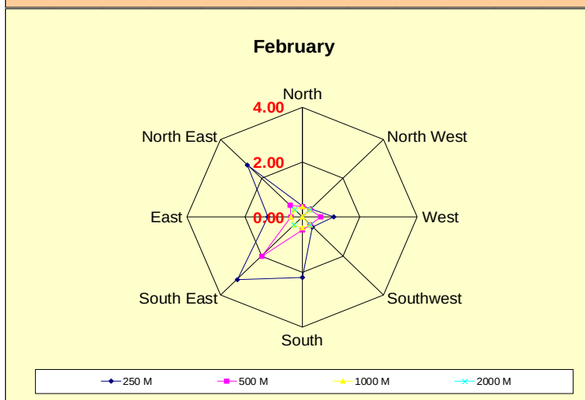
Direction	January				February				March				April				May				June				July				August				September				October				November				December			
	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M	250 M	500 M	1000 M	2000 M
North	2.20	1.70	0.58		0.41	0.39	0.39		1.42	1.55	0.84		1.07	0.93	1.33		4.45	1.55	0.82		2.64	2.14	1.93		0.79	0.79	1.13		1.79	0.79	1.45		2.97	1.39	1.06		1.18	0.68	1.00		10.13	2.70	0.76		4.56	2.63	3.59	
North West	1.80	0.99	0.59	0.38	0.43	0.40	0.39	0.40	4.00	3.61	2.19	1.03	5.47	1.47	0.82	1.20	4.52	2.13	1.48	1.03	7.79	3.21	1.71	2.57	1.73	2.47	0.79	1.67	2.09	2.15	0.79	0.79	5.42	1.61	0.71	0.94	3.03	0.73	1.15	1.15	5.07	2.10	1.80	0.76	5.33	1.85	1.30	1.22
West	1.10	0.78	0.98		1.10	0.63	No sample		3.35	2.45	No sample		2.40	0.82	2.13		1.68	2.90	0.90		3.00	4.50	2.64		0.79	3.53	0.93		14.42	2.88	0.79		0.71	1.03	0.71		0.68	0.85	1.21		7.50	1.83	0.76		7.30	1.59	2.48	
Southwest	0.65	0.60	0.38	0.38	0.50	0.39	0.39	0.39	2.45	0.84	0.84	0.84	2.40	4.00	0.82	0.82	1.74	0.84	0.82	0.82	3.64	3.14	2.07	2.93	1.40	1.40	0.80	1.27	1.42	6.45	0.79	0.79	1.58	0.87	1.35	0.71	0.68	0.68	Sample l	0.85	0.76	0.76	0.76	0.76	2.63	1.70	1.48	1.67
South	1.50	0.39	0.38		2.20	0.46	0.39		0.84	0.84	0.84		1.33	0.82	0.93		2.39	2.39	0.82		3.57	1.50	2.93		2.00	0.79	0.79		2.48	0.79	0.79		1.61	1.16	0.97		0.76	0.82	0.68		2.00	0.76	0.76		2.37	2.44	2.00	
South East	2.80	2.00	0.57	0.38	3.20	2.00	0.40	0.39	2.58	1.68	0.84	1.29	6.53	3.73	1.20	1.33	2.58	1.48	1.81	0.82	2.50	1.86	3.07	1.43	3.13	1.73	2.20	0.87	4.36	2.24	2.12	0.79	3.65	1.48	1.13	0.74	1.55	0.68	1.09	0.94	5.97	11.97	1.20	0.76	11.48	5.30	3.04	1.70
East	0.92	0.38	0.38		1.20	0.39	0.39		3.61	1.03	0.90		6.27	2.93	1.33		5.16	0.82	0.82		12.29	2.00	1.71		12.00	2.73	1.40		6.15	1.24	0.94		2.35	0.97	0.71		2.09	1.09	1.03		2.93	1.90	0.76		2.85	1.74	1.89	
North East	1.10	0.38	0.38	0.38	2.70	0.61	0.39	0.38	2.97	1.03	0.84	1.68	3.33	1.33	0.82	0.82	3.29	0.82	0.90	0.82	6.36	3.21	2.43	1.50	6.80	2.27	1.13	0.79	2.33	0.79	0.79	0.79	3.61	1.10	1.68	0.71	1.48	0.68	0.73	1.09	2.60	0.87	0.76	0.76	2.26	1.52	1.44	1.00
	1st Quarter												2nd Quarter												3rd Quarter												4th Quarter											

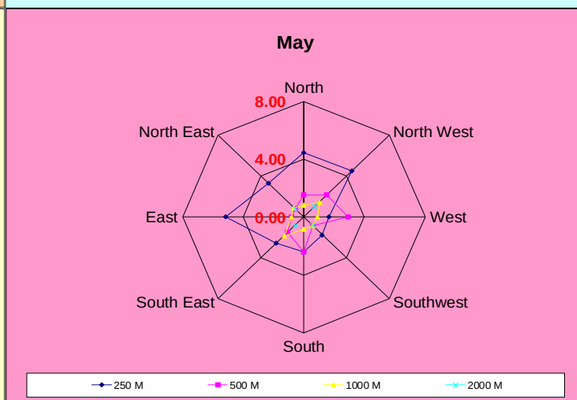


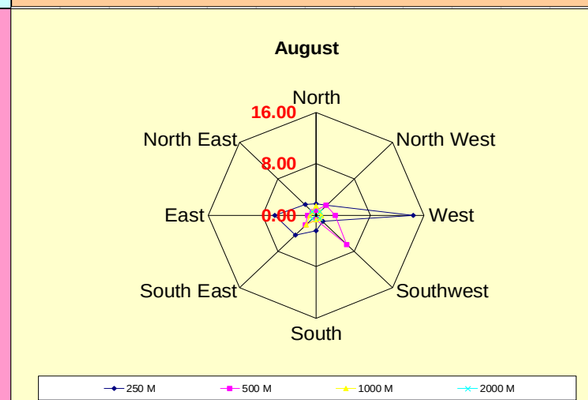


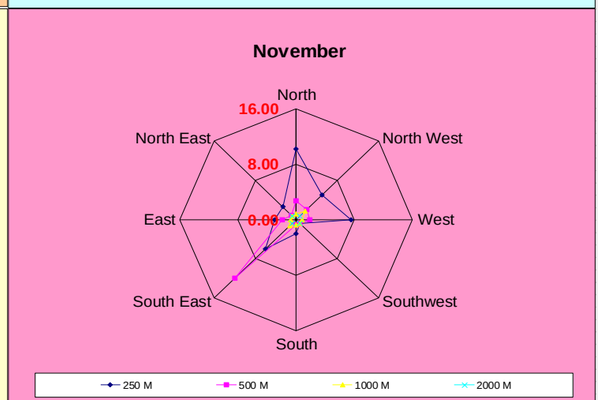


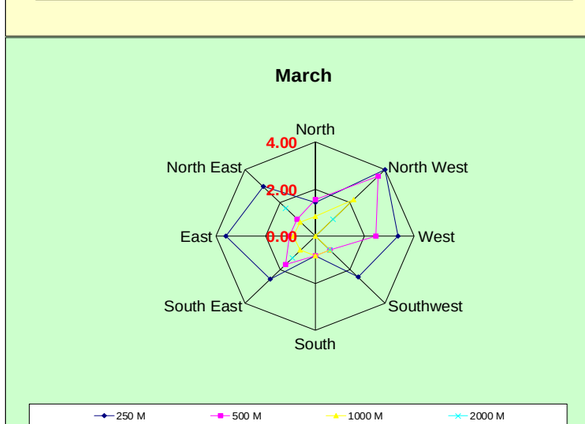


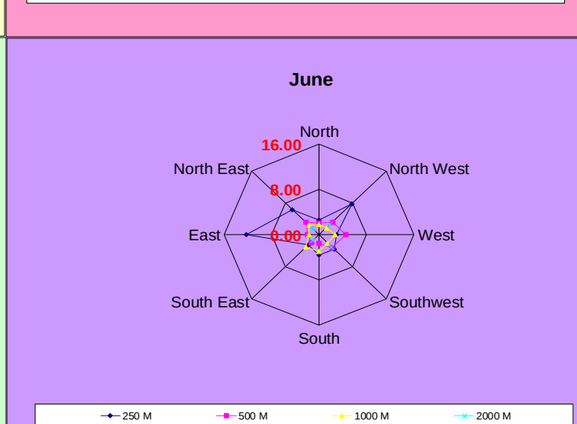


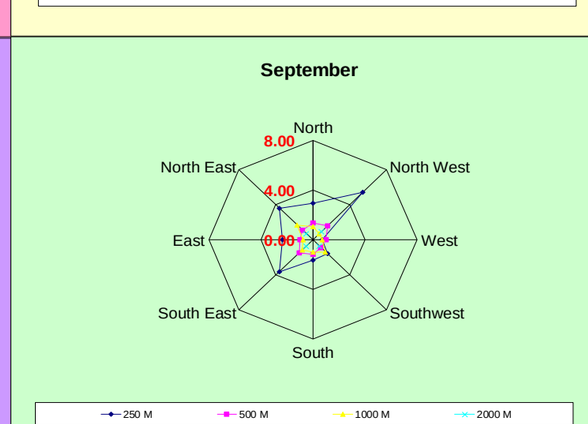


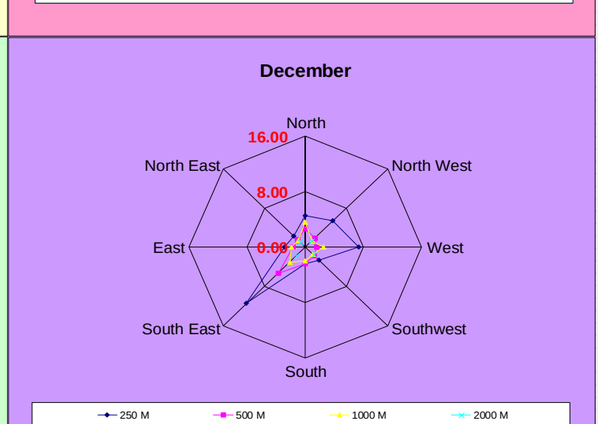












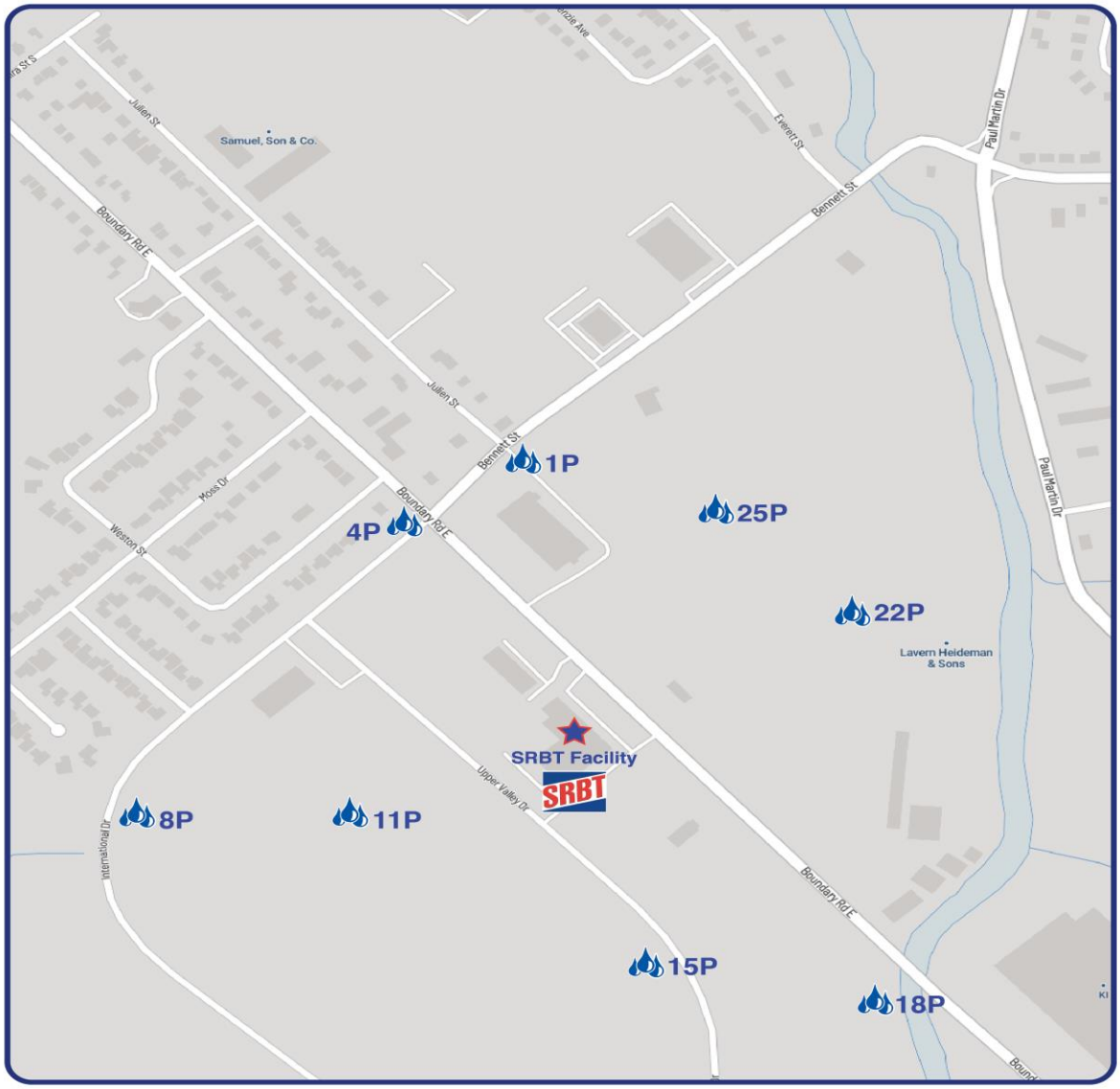
APPENDIX H

Precipitation Monitoring Data

Precipitation Monitoring Data

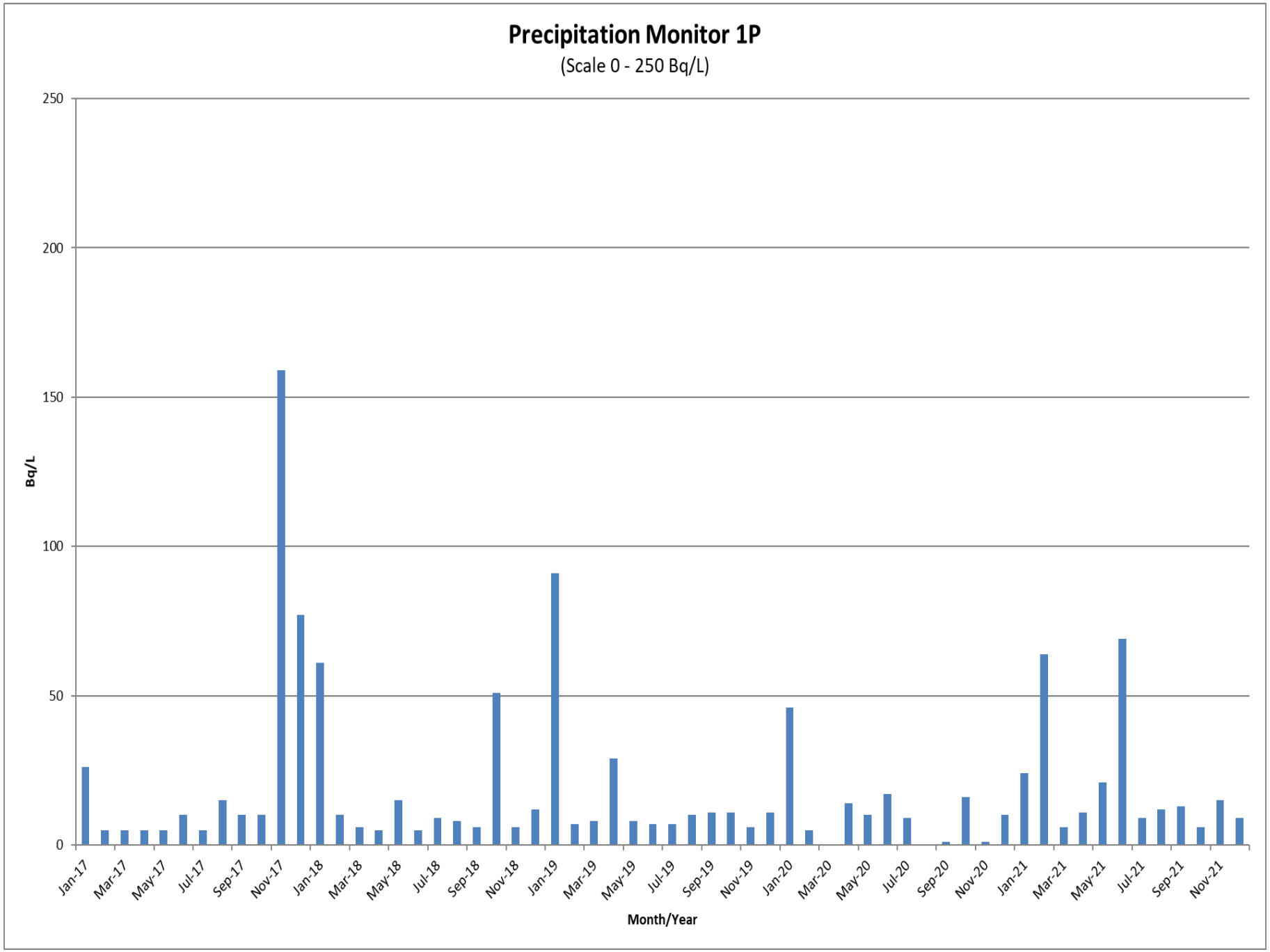
PRECIPITATION SAMPLERS									
	1P	4P	8P	11P	15P	18P	22P	25P	AVG
Date Range	Bq/L								
December 29, 2020 - February 1, 2021	30	181	30	30	30	189	30	30	69
February 1, 2021 - March 1, 2021	64	94	57	23	23	560	23	23	108
March 1, 2021 - March 30, 2021	20	20	20	90	20	20	32	20	30
March 30, 2021 - May 3, 2021	20	20	199	24	20	102	20	20	53
May 3, 2021 - June 1, 2021	21	26	94	36	No Sample	22	36	23	37
June 1, 2021 - June 29, 2021	69	42	21	22	21	21	191	33	53
June 29, 2021 - July 27, 2021	21	21	21	51	21	21	25	21	25
July 27, 2021 - September 1, 2021	20	34	20	20	20	22	22	34	24
September 1, 2021 - September 28, 202	19	27	19	19	23	22	37	20	23
September 28, 2021 - November 2, 2021	19	29	31	21	28	26	24	19	25
November 2, 2021 - December 1, 2021	22	97	24	22	22	416	23	22	81
December 1, 2021 - December 28, 2021	21	51	23	21	21	21	37	30	28
AVERAGE	29	54	47	32	23	120	42	25	46

Results shaded in blue are <minimum detectable activity (MDA)



Precipitation Sampling Stations

Precipitation Monitoring Data



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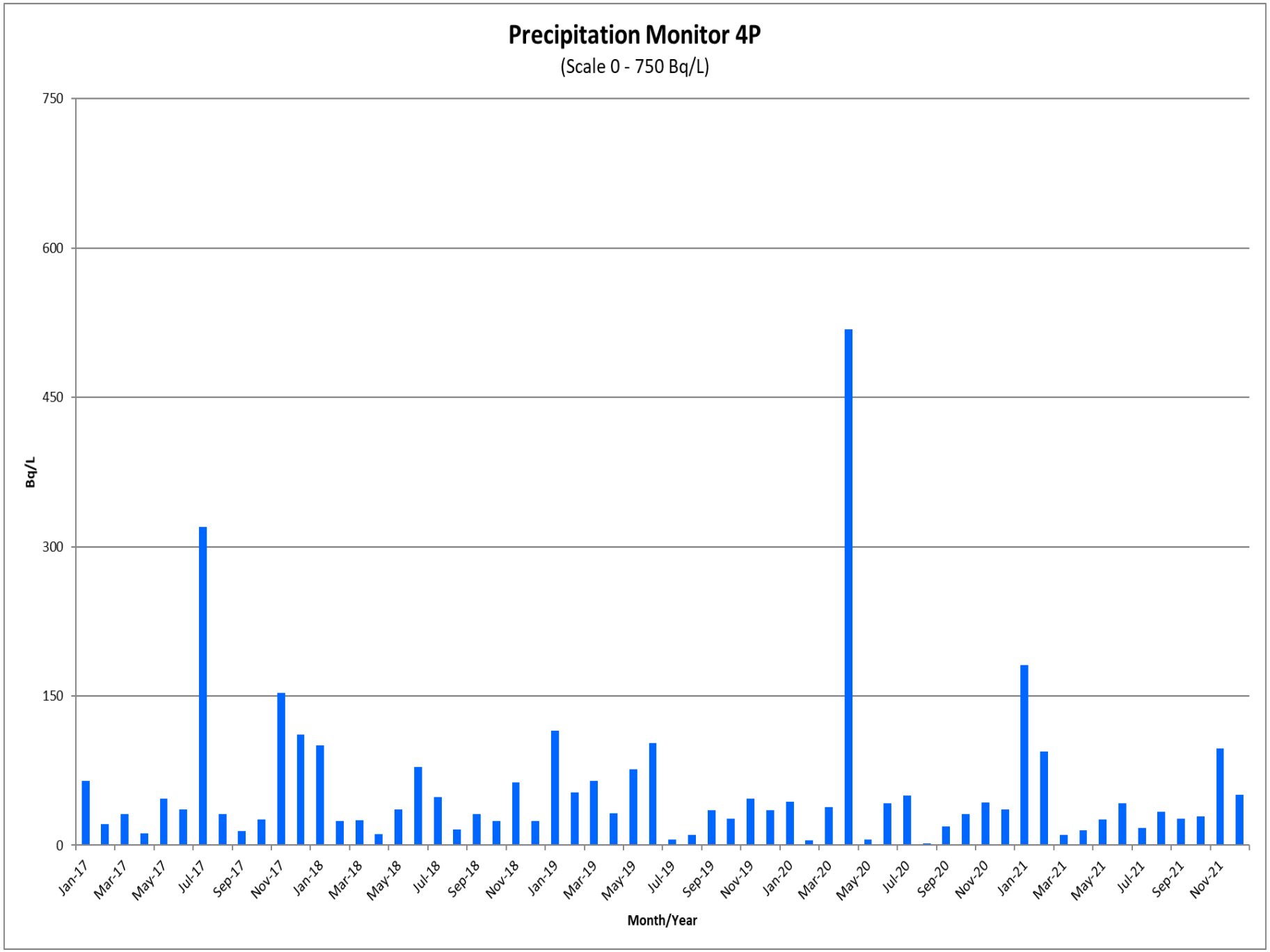
Precipitation Monitoring Data



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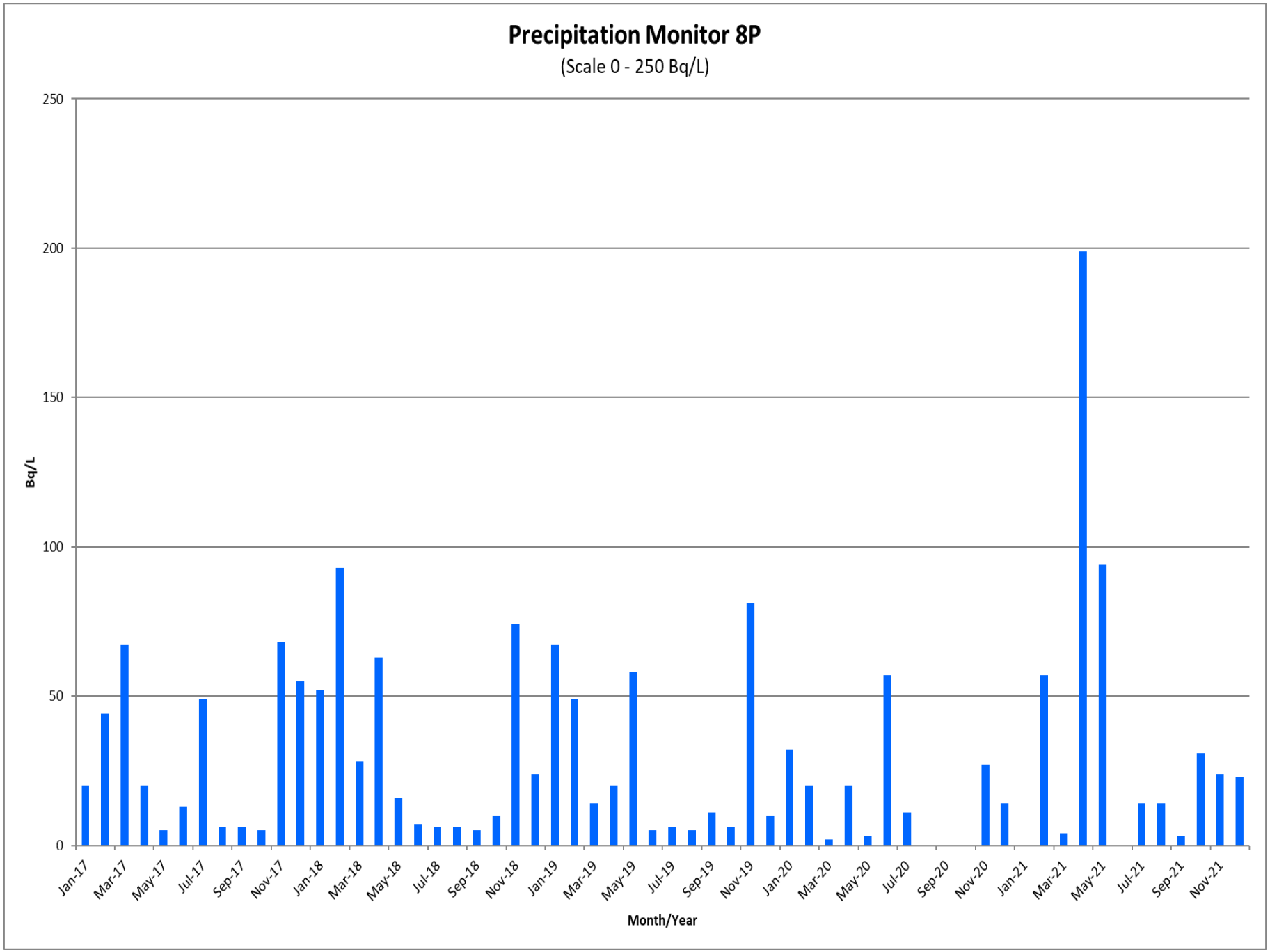
Precipitation Monitoring Data



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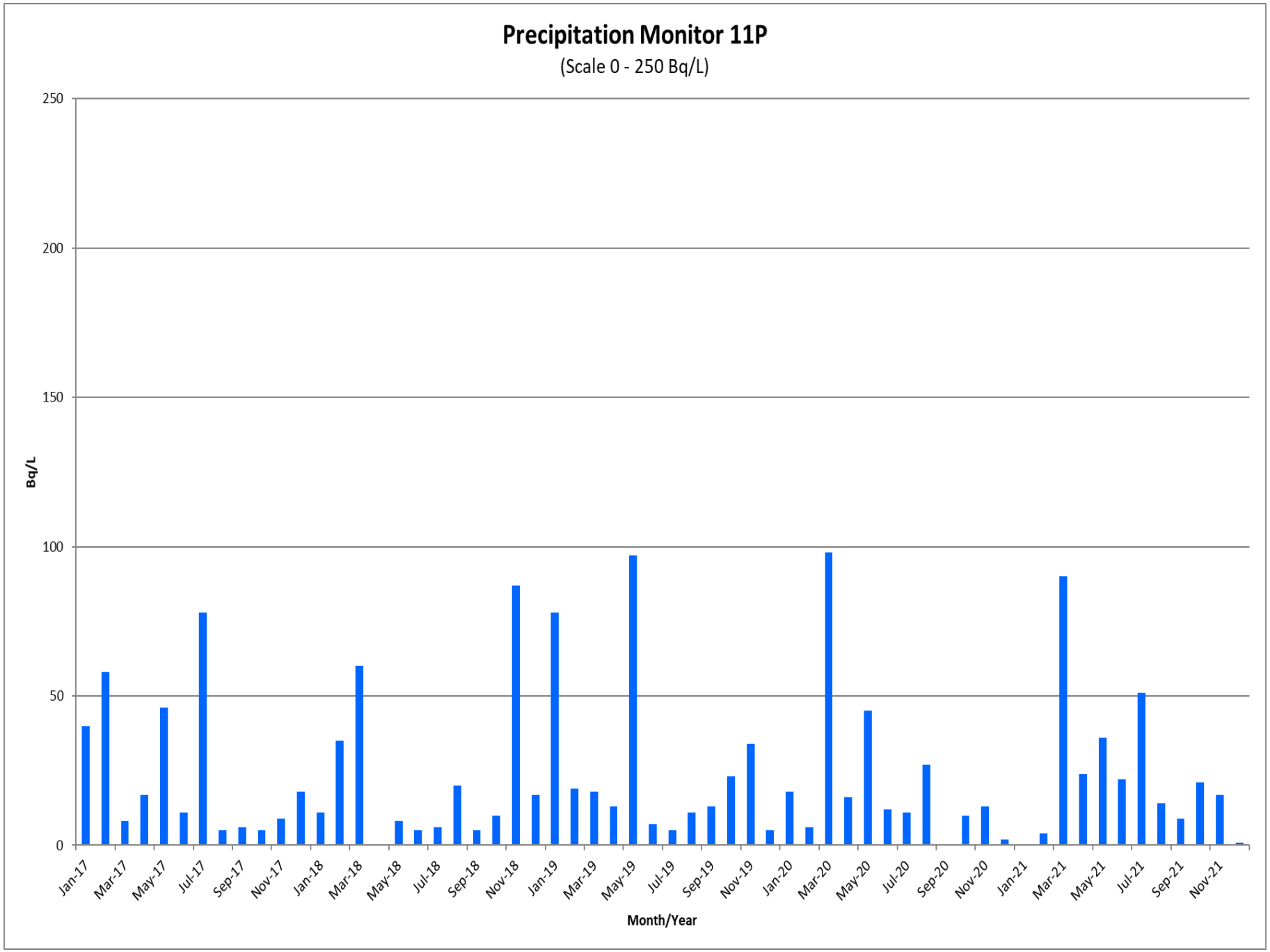
Precipitation Monitoring Data



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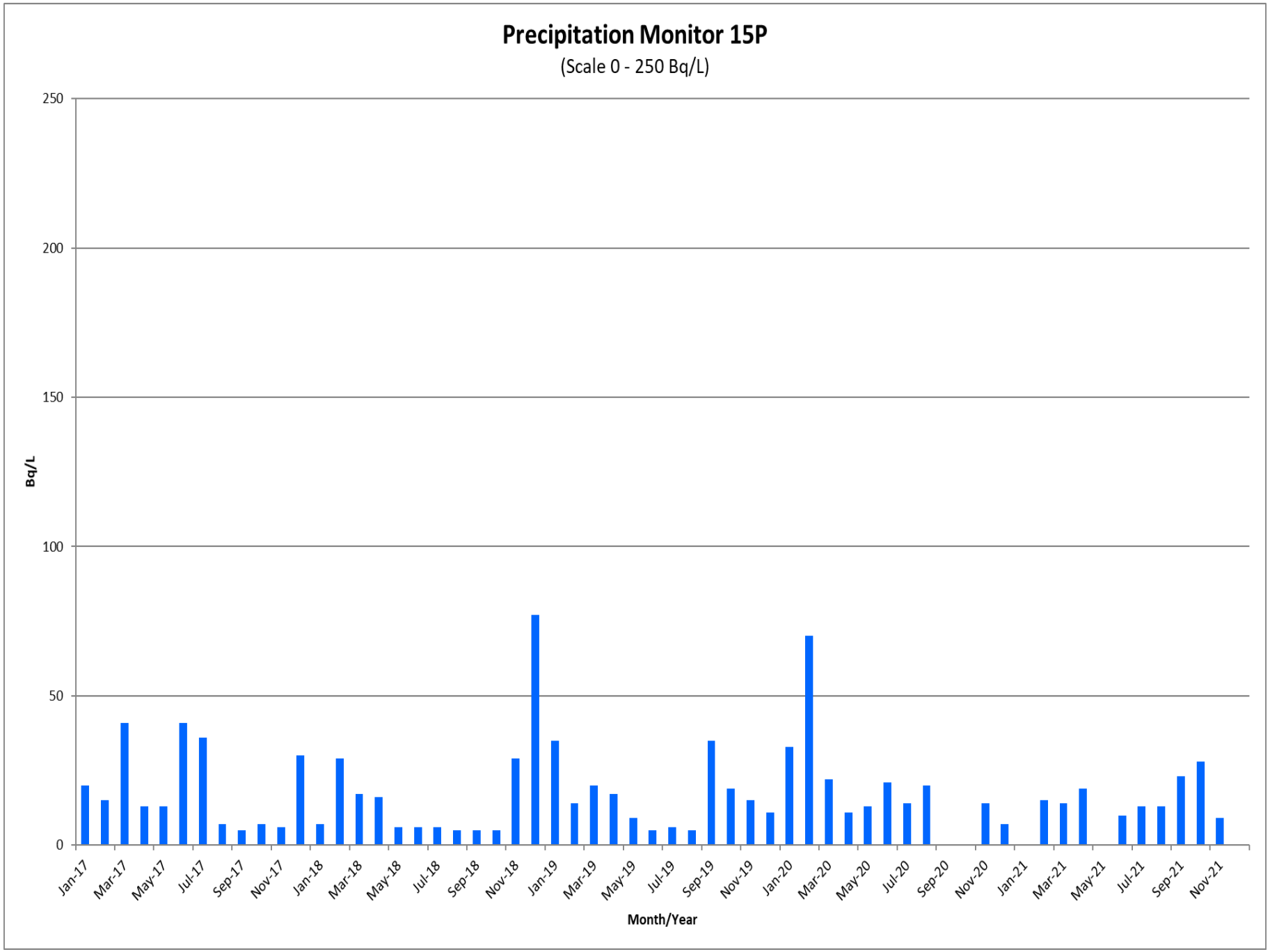
Precipitation Monitoring Data



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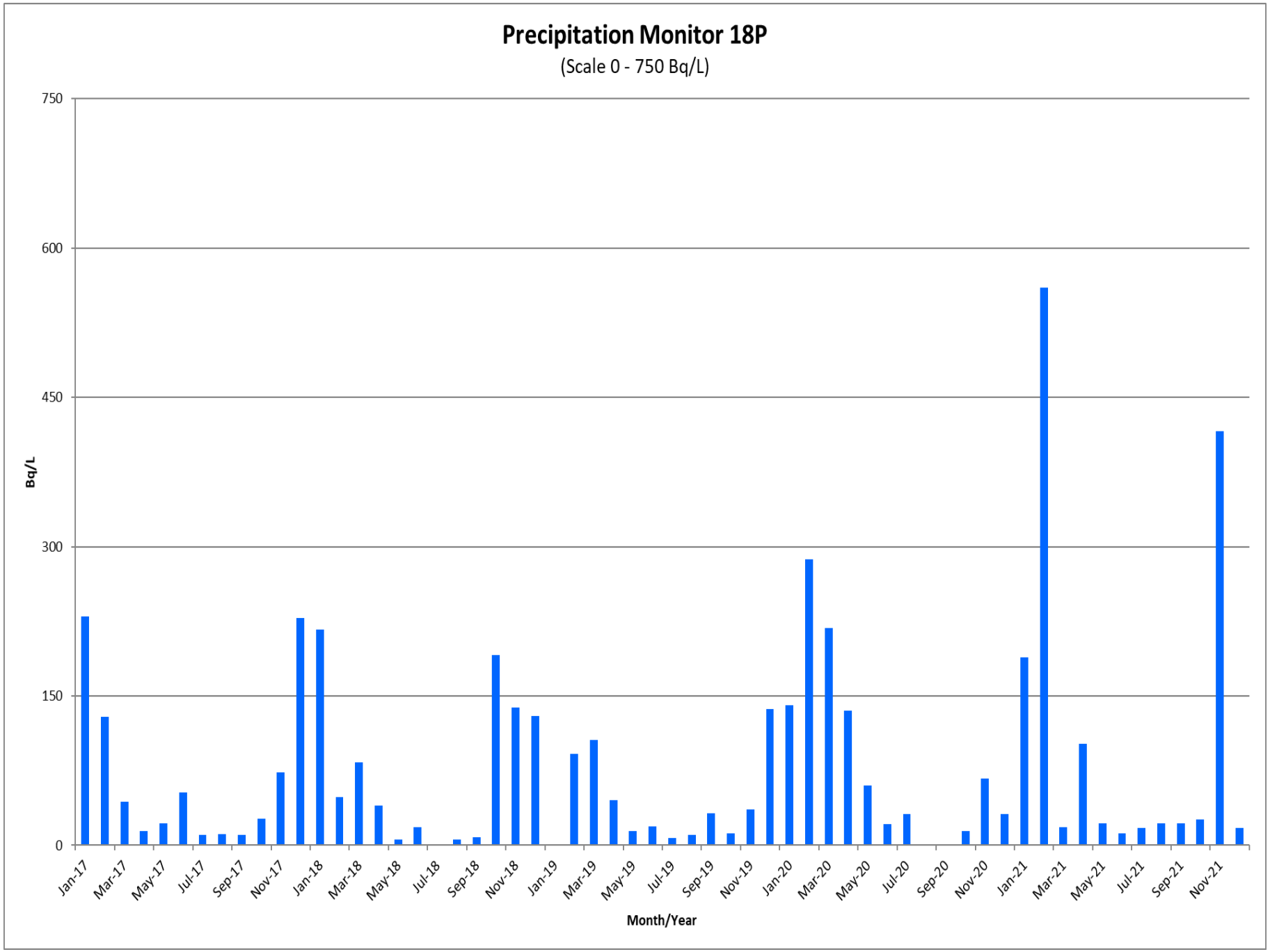
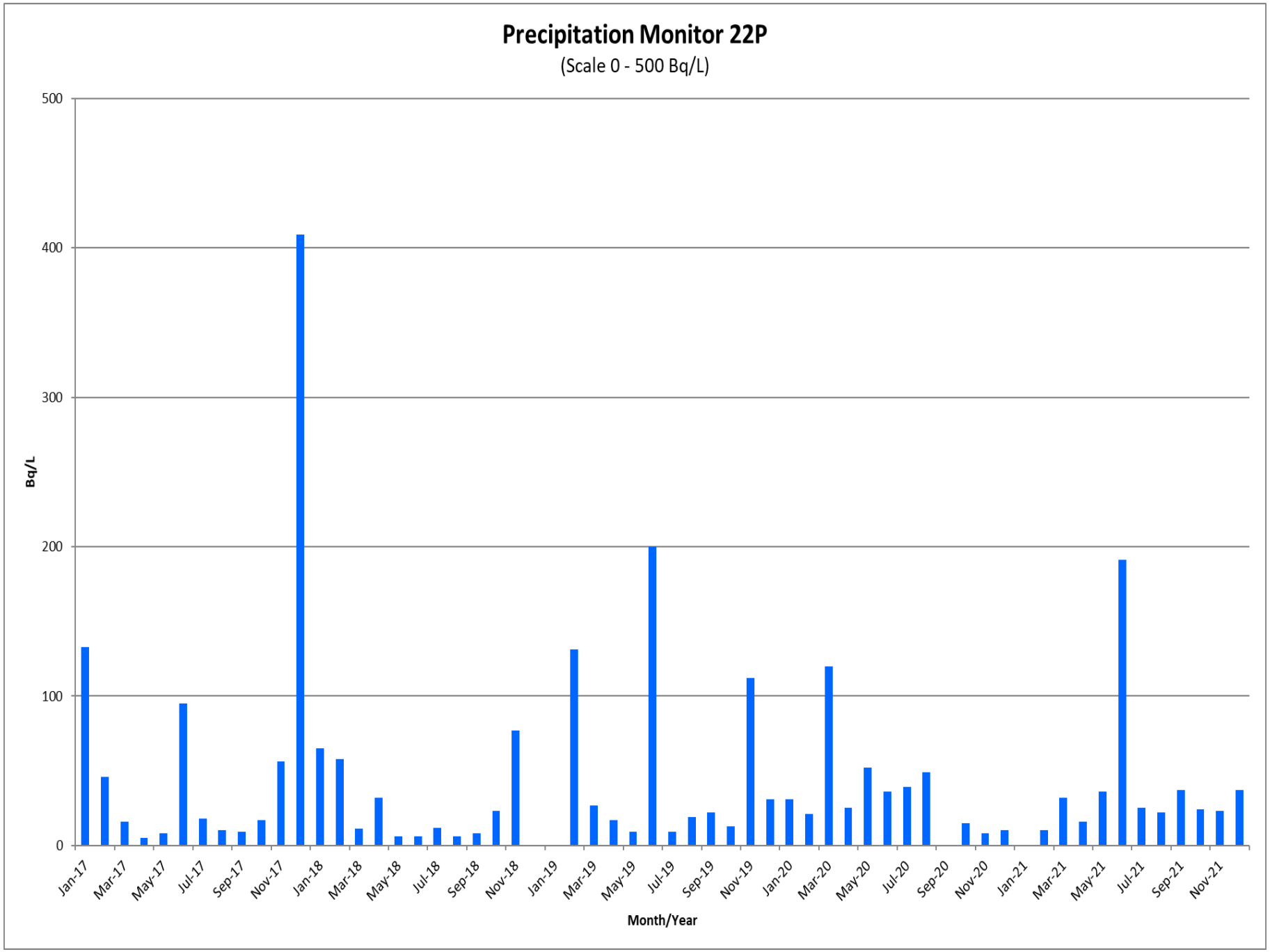
Precipitation Monitoring Data



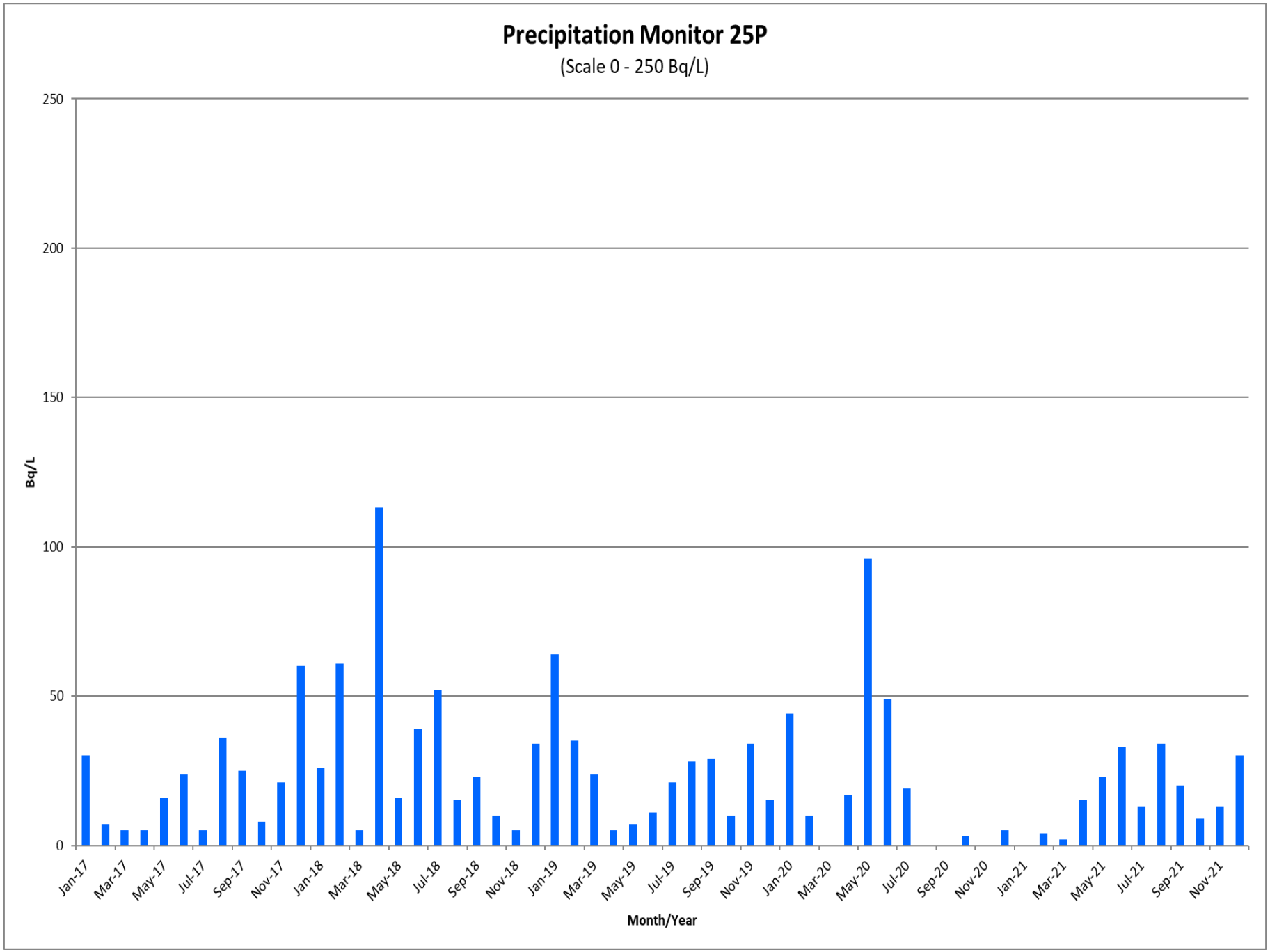
APPENDIX H

Precipitation Monitoring Data



APPENDIX H

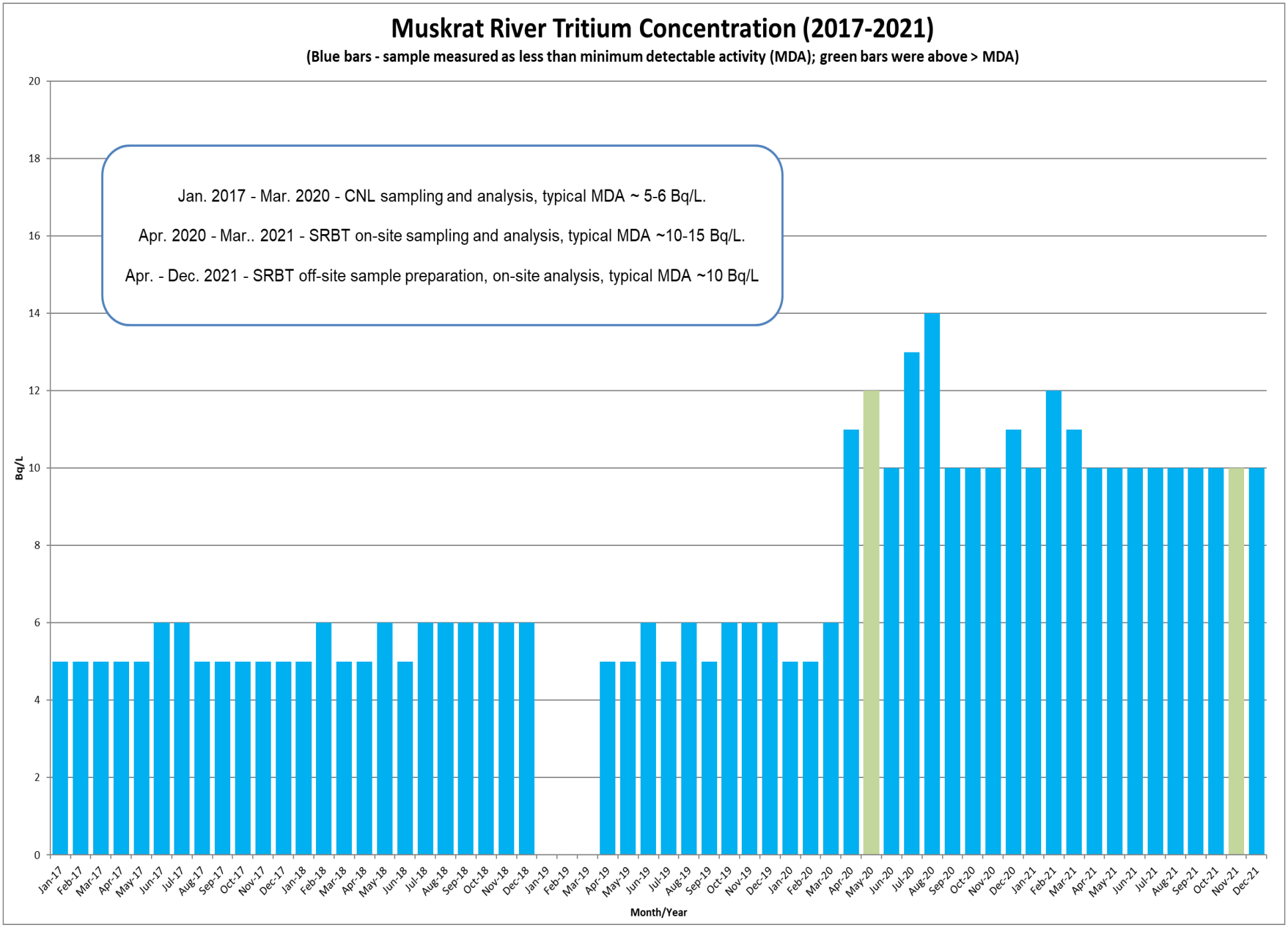
Precipitation Monitoring Data



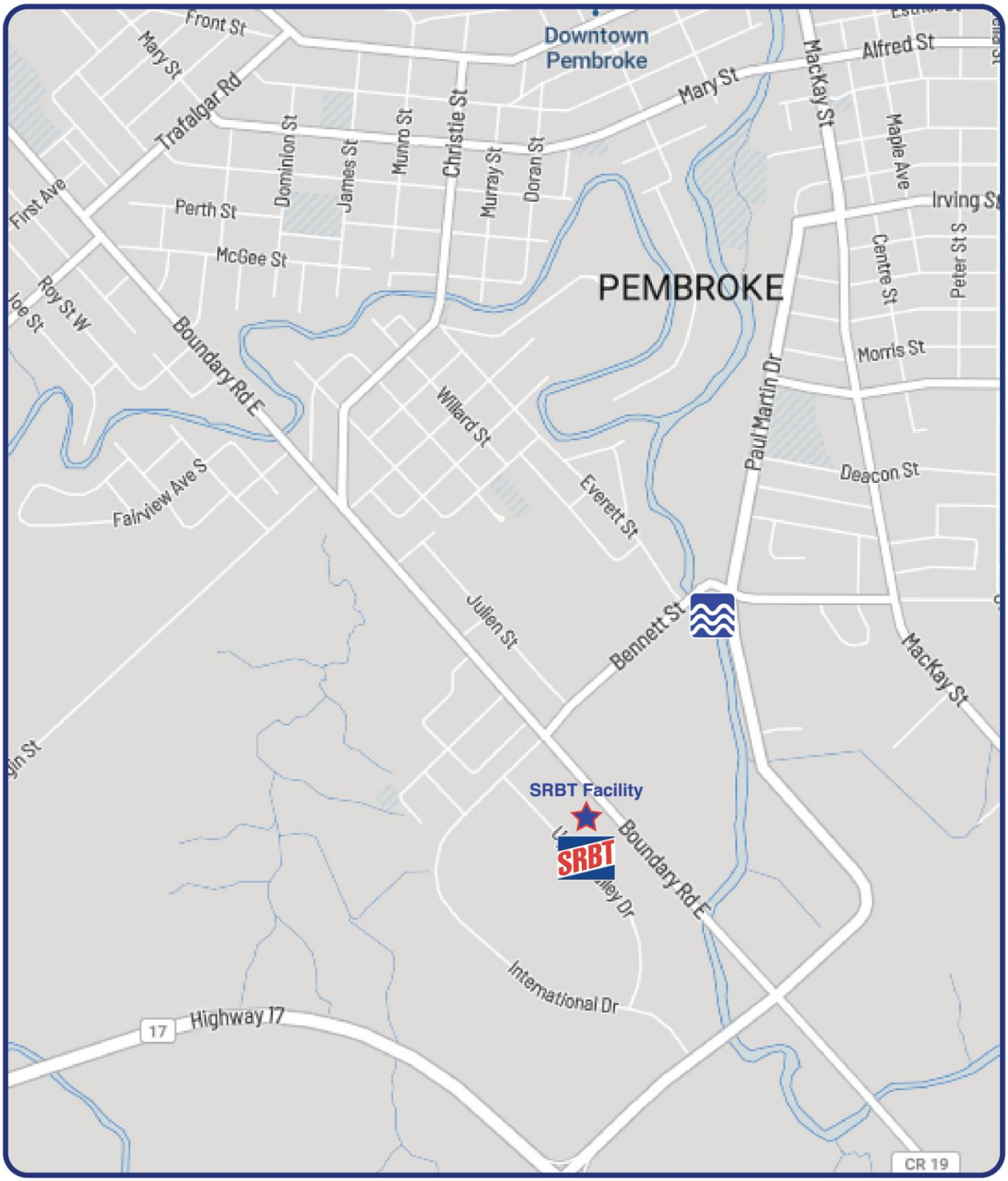
APPENDIX H

APPENDIX I

River Water Monitoring Data


Muskrat River Tritium Concentration (2017-2021)
(Blue bars - sample measured as less than minimum detectable activity (MDA); green bars were above > MDA)
Jan. 2017 - Mar. 2020 - CNL sampling and analysis, typical MDA ~ 5-6 Bq/L.
Apr. 2020 - Mar.. 2021 - SRBT on-site sampling and analysis, typical MDA ~10-15 Bq/L.
Apr. - Dec. 2021 - SRBT off-site sample preparation, on-site analysis, typical MDA ~10 Bq/L
Bq/L
0
2
4
6
8
10
12
14
16
18
20
Jan-17 Feb-17 Mar-17 Apr-17 May-17 Jun-17 Jul-17 Aug-17 Sep-17 Oct-17 Nov-17 Dec-17 Jan-18 Feb-18 Mar-18 Apr-18 May-18 Jun-18 Jul-18 Aug-18 Sep-18 Oct-18 Nov-18 Dec-18 Jan-19 Feb-19 Mar-19 Apr-19 May-19 Jun-19 Jul-19 Aug-19 Sep-19 Oct-19 Nov-19 Dec-19 Jan-20 Feb-20 Mar-20 Apr-20 May-20 Jun-20 Jul-20 Aug-20 Sep-20 Oct-20 Nov-20 Dec-20 Jan-21 Feb-21 Mar-21 Apr-21 May-21 Jun-21 Jul-21 Aug-21 Sep-21 Oct-21 Nov-21 Dec-21
Month/Year

APPENDIX I



River Water Sampling Point

APPENDIX J

Downspout / Facility Runoff Monitoring Data

Downspout / Facility Runoff Monitoring Data

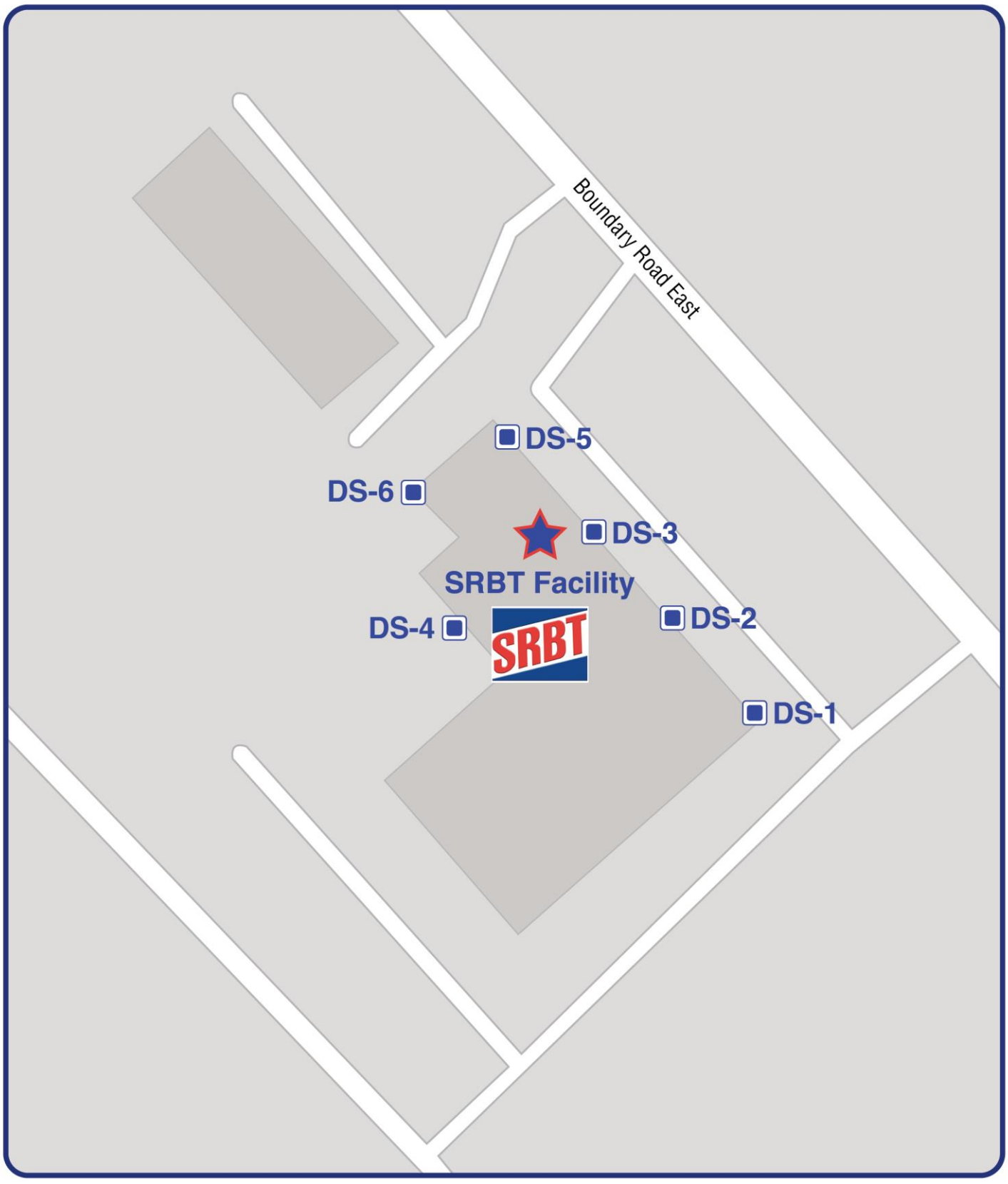
2021 - Tritium Concentration in Facility Downspout / Runoff Water (Bq/L)

Date	Time	DS-1	DS-2	DS-3	DS-4	DS-5	DS-6	MDA
Mar. 26	0830h	< MDA	< MDA	< MDA	< MDA	< MDA	< MDA	46.1
	1030h	< MDA	< MDA	< MDA	< MDA	< MDA	< MDA	
Jun. 18	0815h	No sample	79	81	118	106	678	41.2
Jul. 20	1345h	No sample	225	< MDA	< MDA	< MDA	332	38.8
	1400h	408	52	< MDA	< MDA	< MDA	59	
	1415h	295	< MDA	< MDA	< MDA	< MDA	< MDA	
	1430h	212	< MDA	< MDA	< MDA	< MDA	< MDA	
Sep. 23	0930h	< MDA	No sample	< MDA	< MDA	< MDA	< MDA	41.6
	1030h	< MDA	No sample	< MDA	222	< MDA	< MDA	
	1130h	< MDA	No sample	< MDA	310	< MDA	61	
	1900h	59	No sample	< MDA	< MDA	< MDA	< MDA	
Oct. 21	0900h	475	No sample	< MDA	< MDA	< MDA	< MDA	35.0
Average (Bq/L) (<MDA = 0)		145	51	7	54	9	94	41

Average of all samples obtained (<MDA taken to be 0)	58 Bq/L
Average of all samples obtained (<MDA taken to be MDA value)	88 Bq/L
Average of samples exceeding MDA	222 Bq/L

*MDA = Minimum Detectable Activity

Downspout / Facility Runoff Monitoring Data

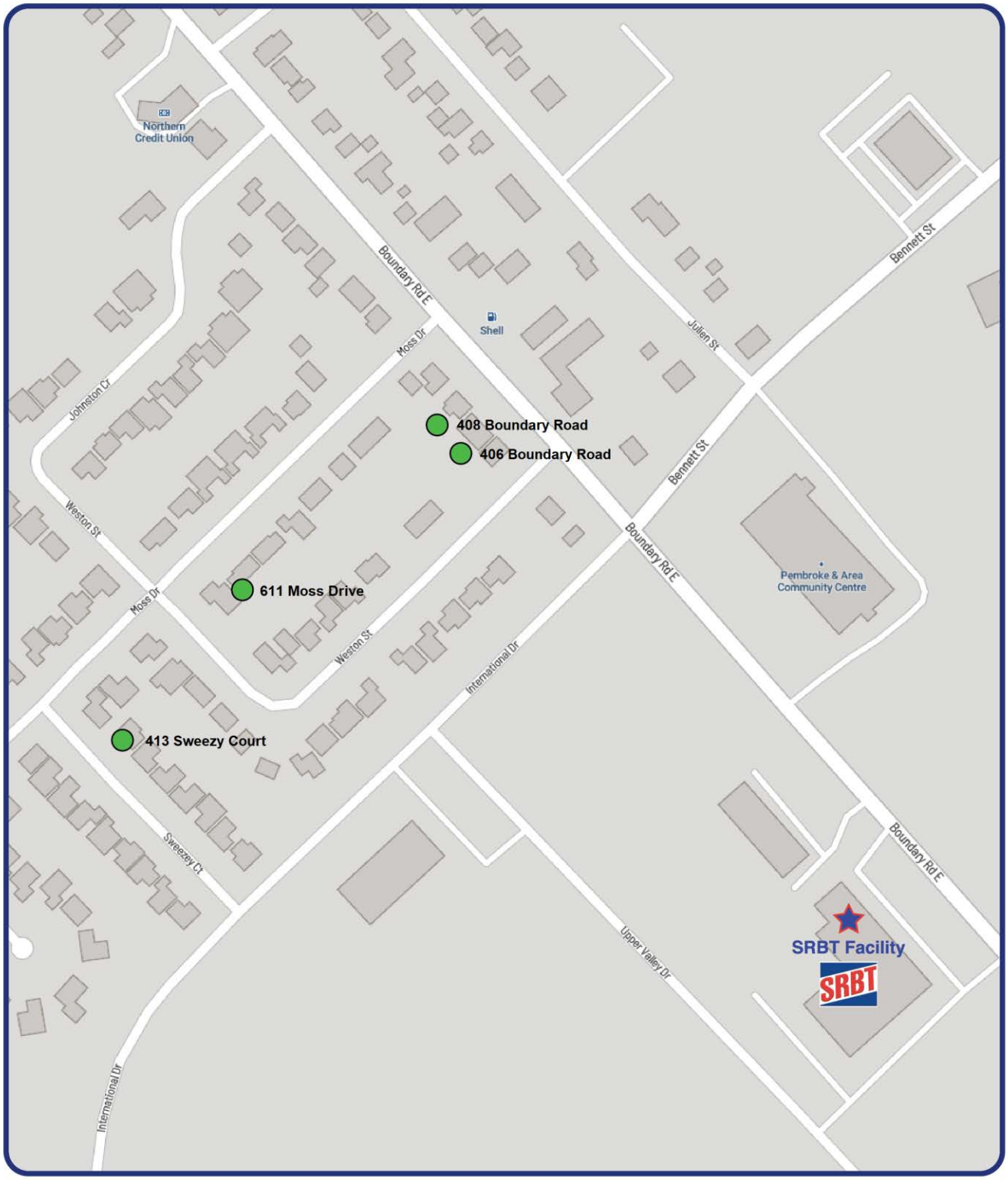


Facility Downspout Runoff Sampling Points ■

APPENDIX K

Produce Monitoring Data

Produce Monitoring Data



Produce Monitoring Sample Points ●

APPENDIX K

Produce Monitoring Data

2021 Residential Produce Sampling – Free-water Tritium Concentration

Sample	Units	Result
Apples 406 Boundary Road	Bq/kg Fresh weight	63
Tomatoes 408 Boundary Road	Bq/kg Fresh weight	117
Apples 413 Sweezey Court	Bq/kg Fresh weight	52
Peppers 413 Sweezey Court	Bq/kg Fresh weight	55
Mixed Herbs 413 Sweezey Court	Bq/kg Fresh weight	18
Tomatoes 413 Sweezy Court	Bq/kg Fresh weight	67
Tomatoes 611 Moss Drive	Bq/kg Fresh weight	53
AVERAGE	**Bq/kg Fresh weight**	**60.7**

2021 Residential Produce Sampling – Organically-bound Tritium (OBT) Concentration

Sample	Units	Result
Tomatoes 408 Boundary Road	Bq/kg Fresh weight	1

2021 Commercial Produce Sampling – Free-water Tritium Concentration
Biedermann Farm Gate – 11133 Round Lake Road

Sample	Units	Result
Pumpkin	Bq/kg Fresh weight	4
Tomatoes	Bq/kg Fresh weight	4
Carrots	Bq/kg Fresh weight	3
AVERAGE	**Bq/kg Fresh weight**	**3.7**

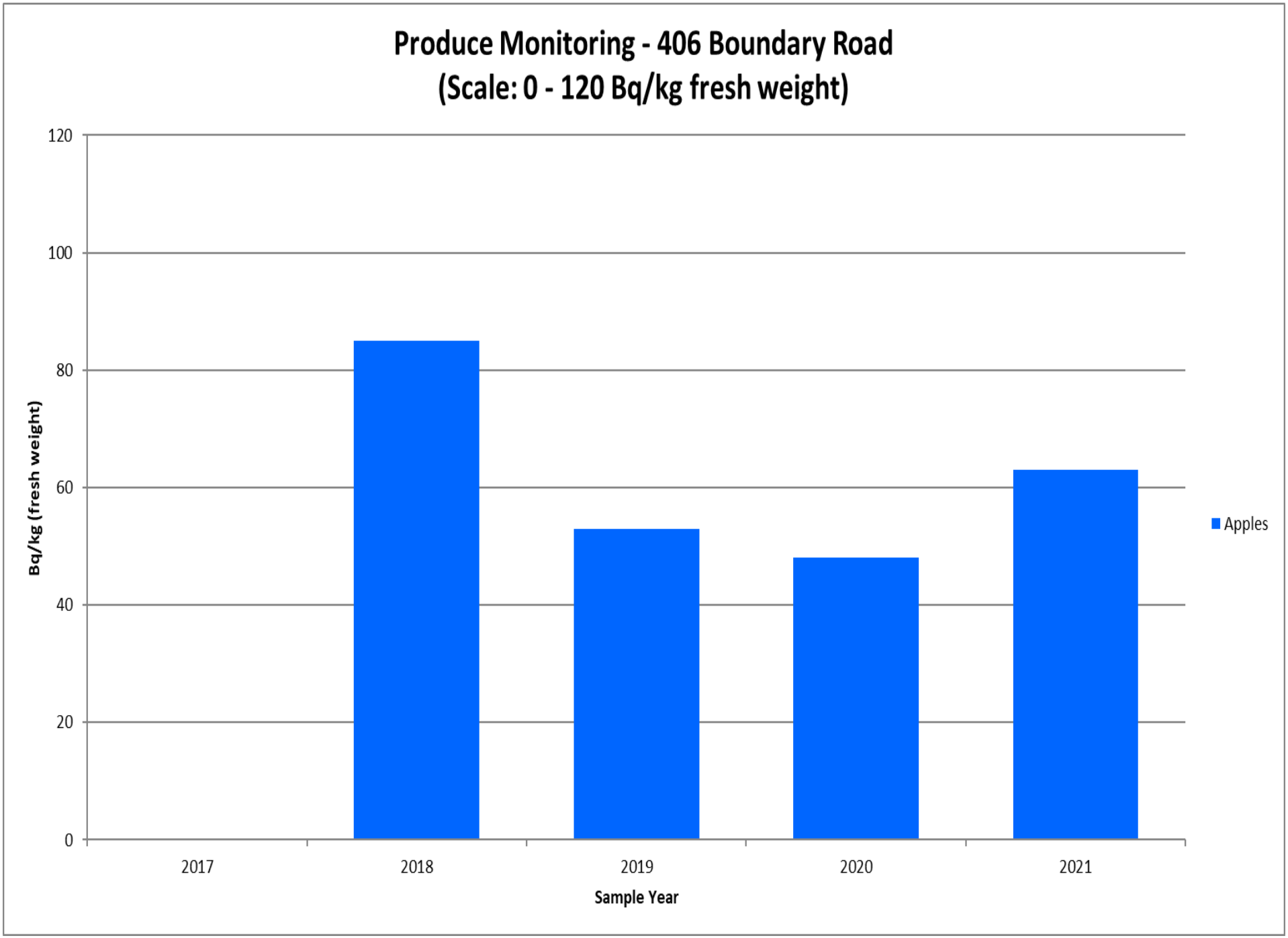
2021 Commercial Produce Sampling – Organically-bound Tritium (OBT) Concentration
Biedermann Farm Gate – 11133 Round Lake Road

Sample	Units	Result
Tomato	Bq/kg Fresh weight	4

Produce Sampling Data Trends

2017-2021

Produce Monitoring Data



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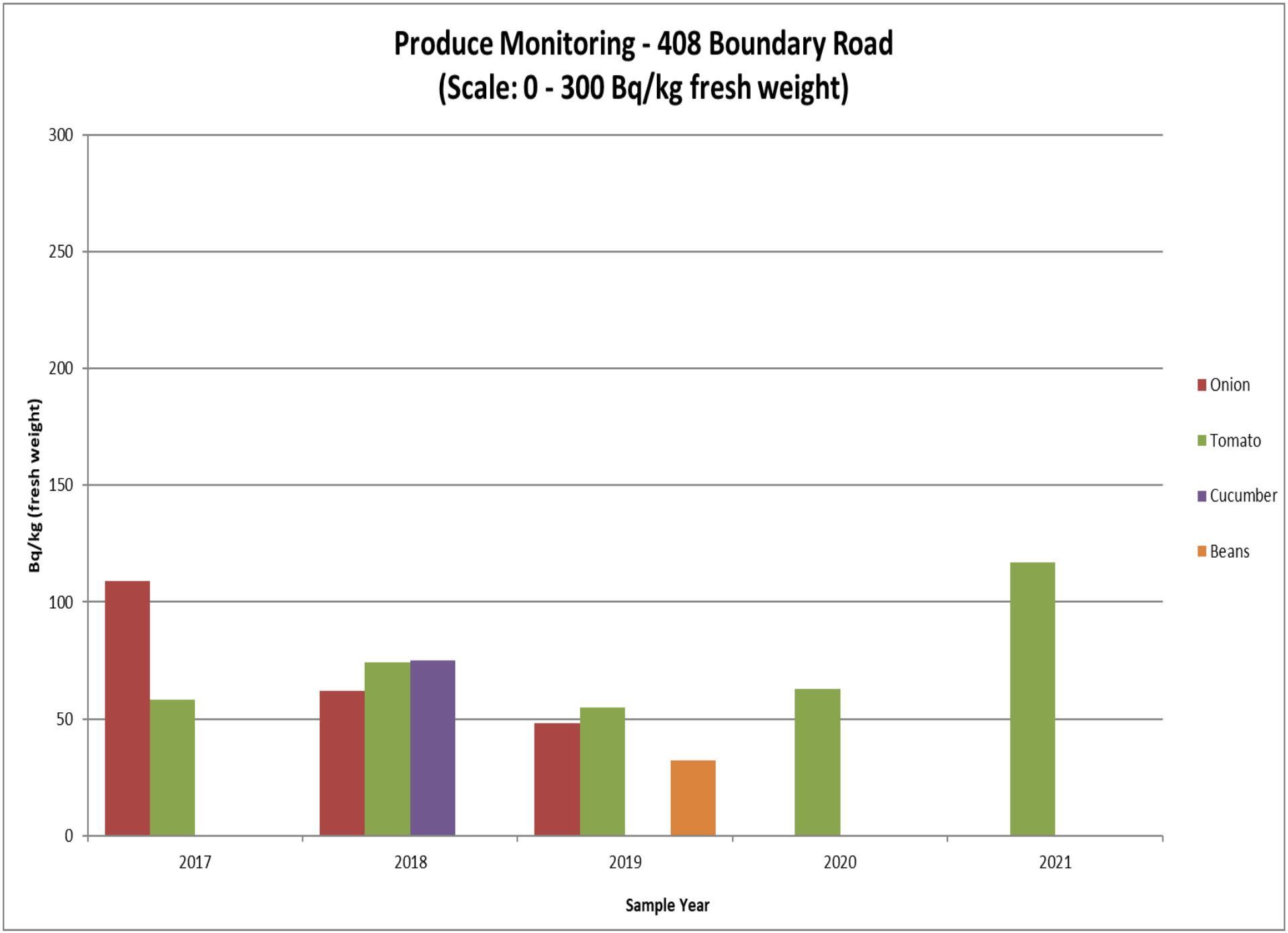

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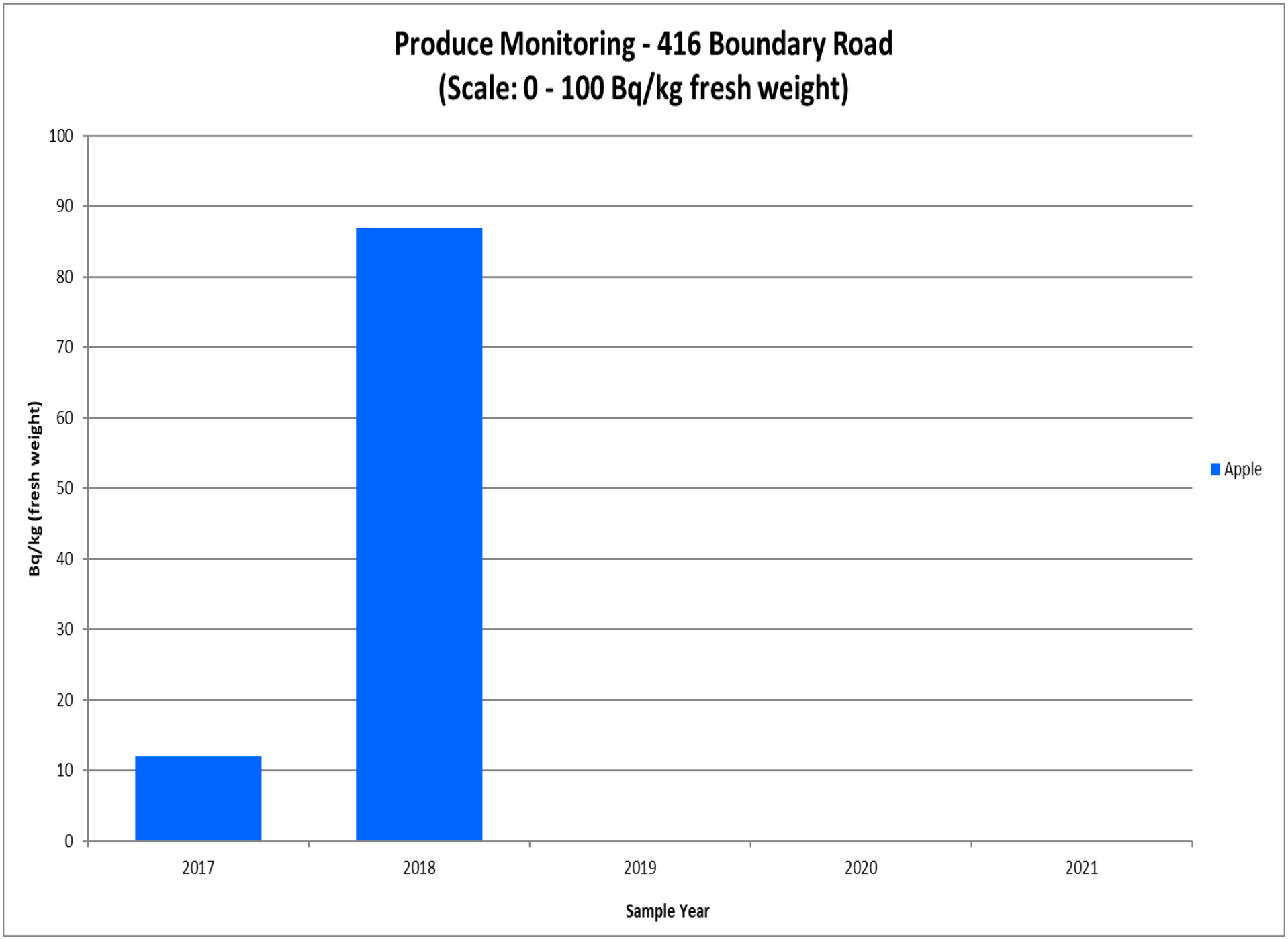
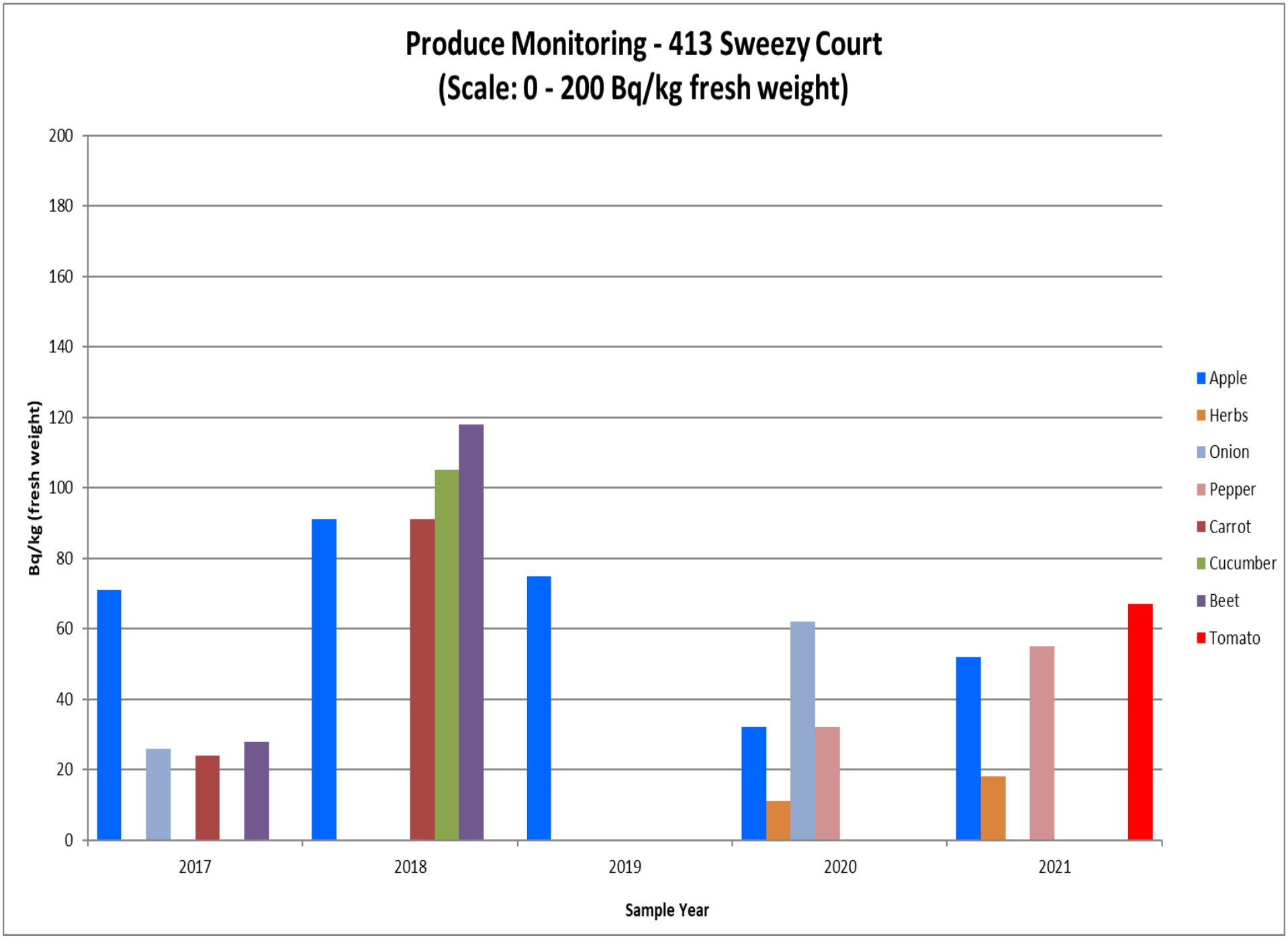


Produce Monitoring Data



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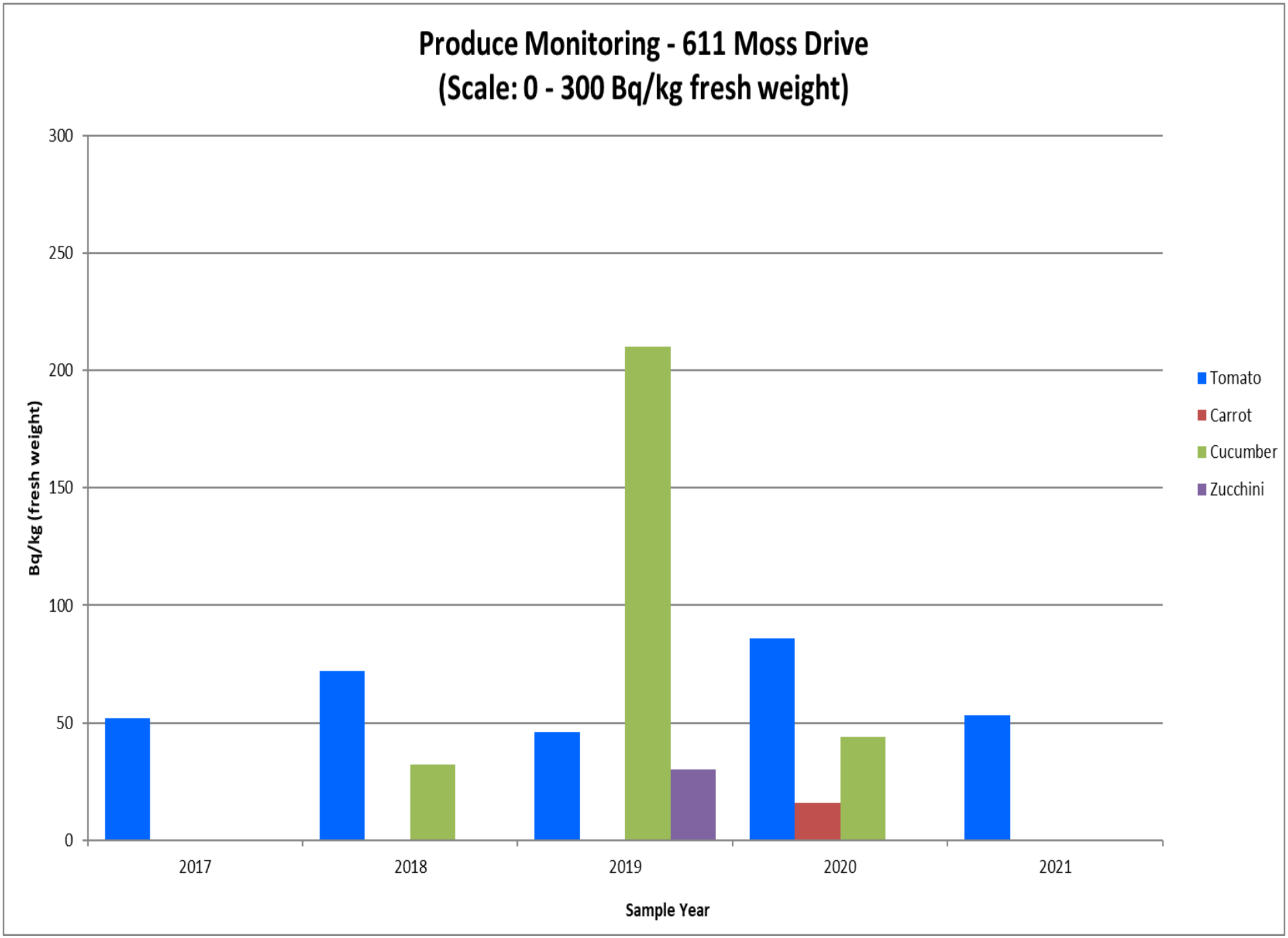
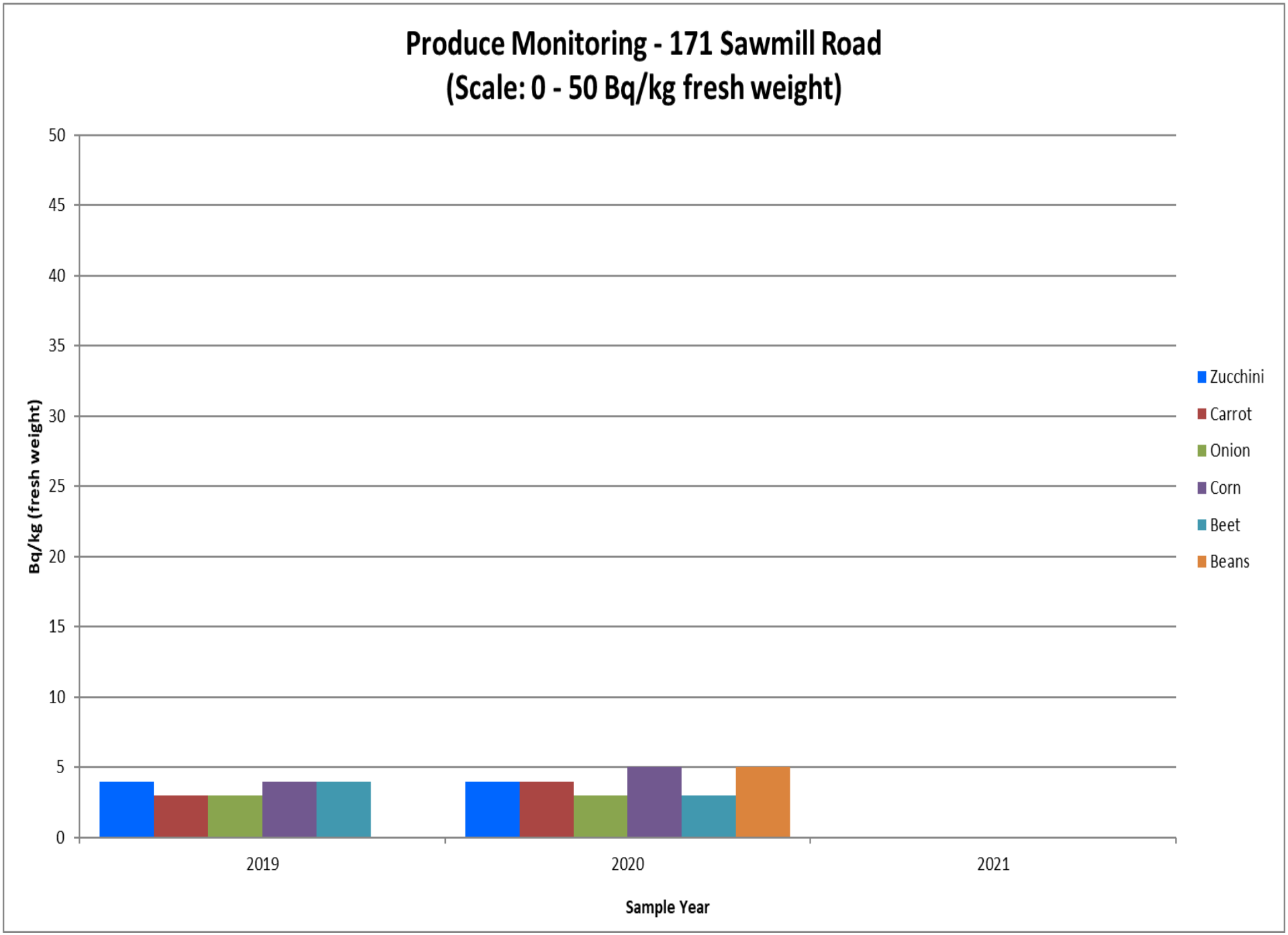


Produce Monitoring Data



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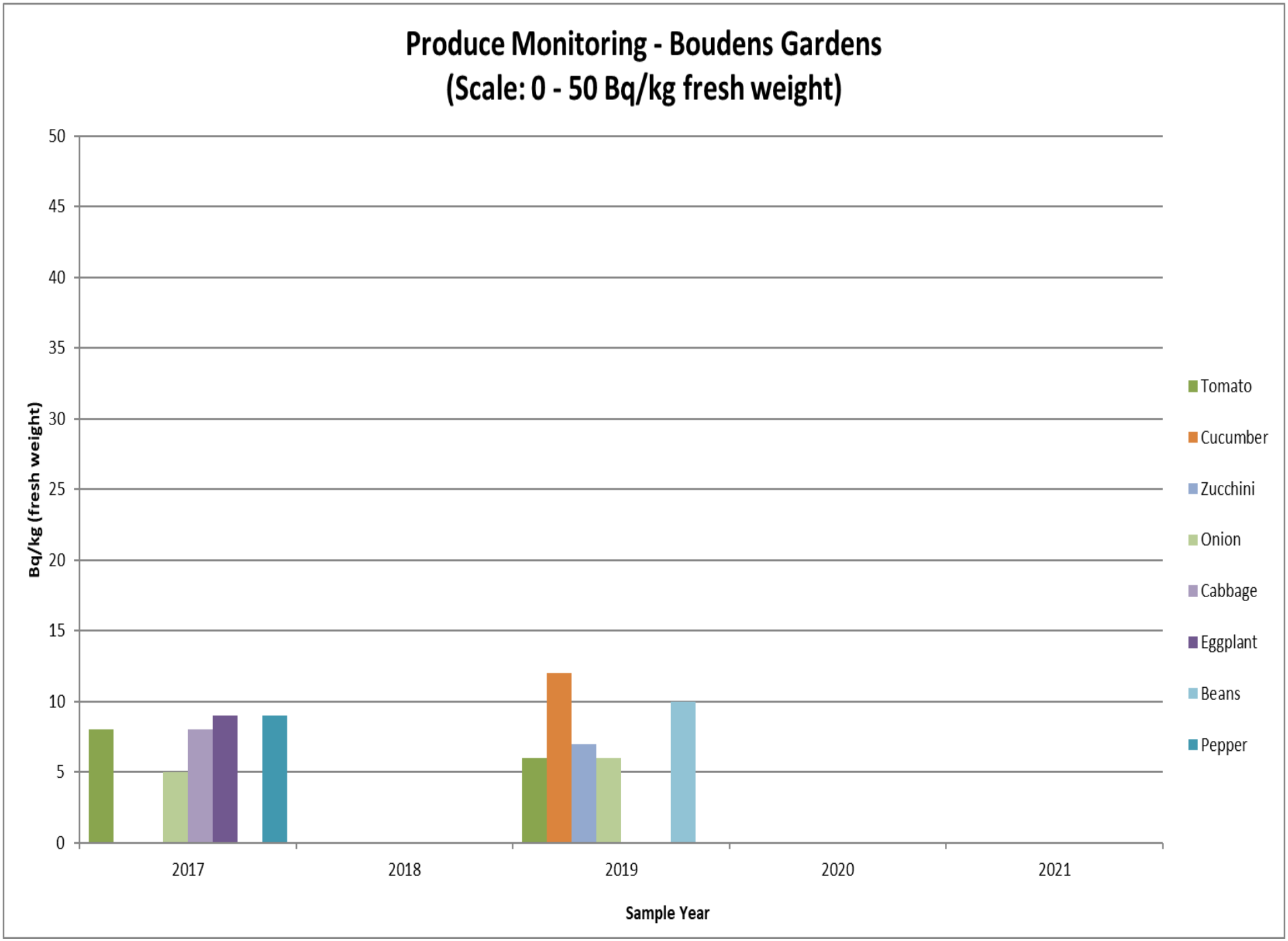
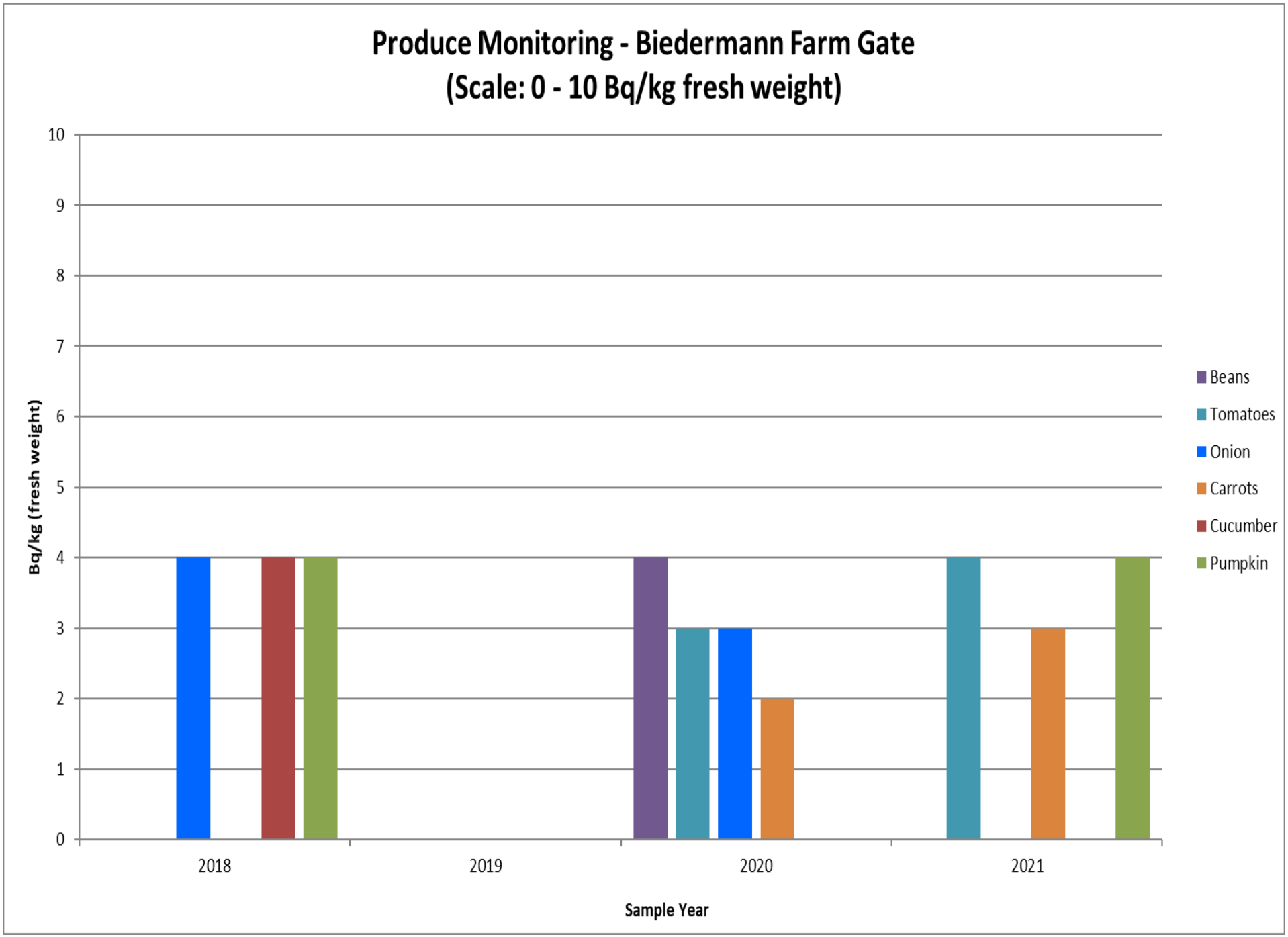


Produce Monitoring Data

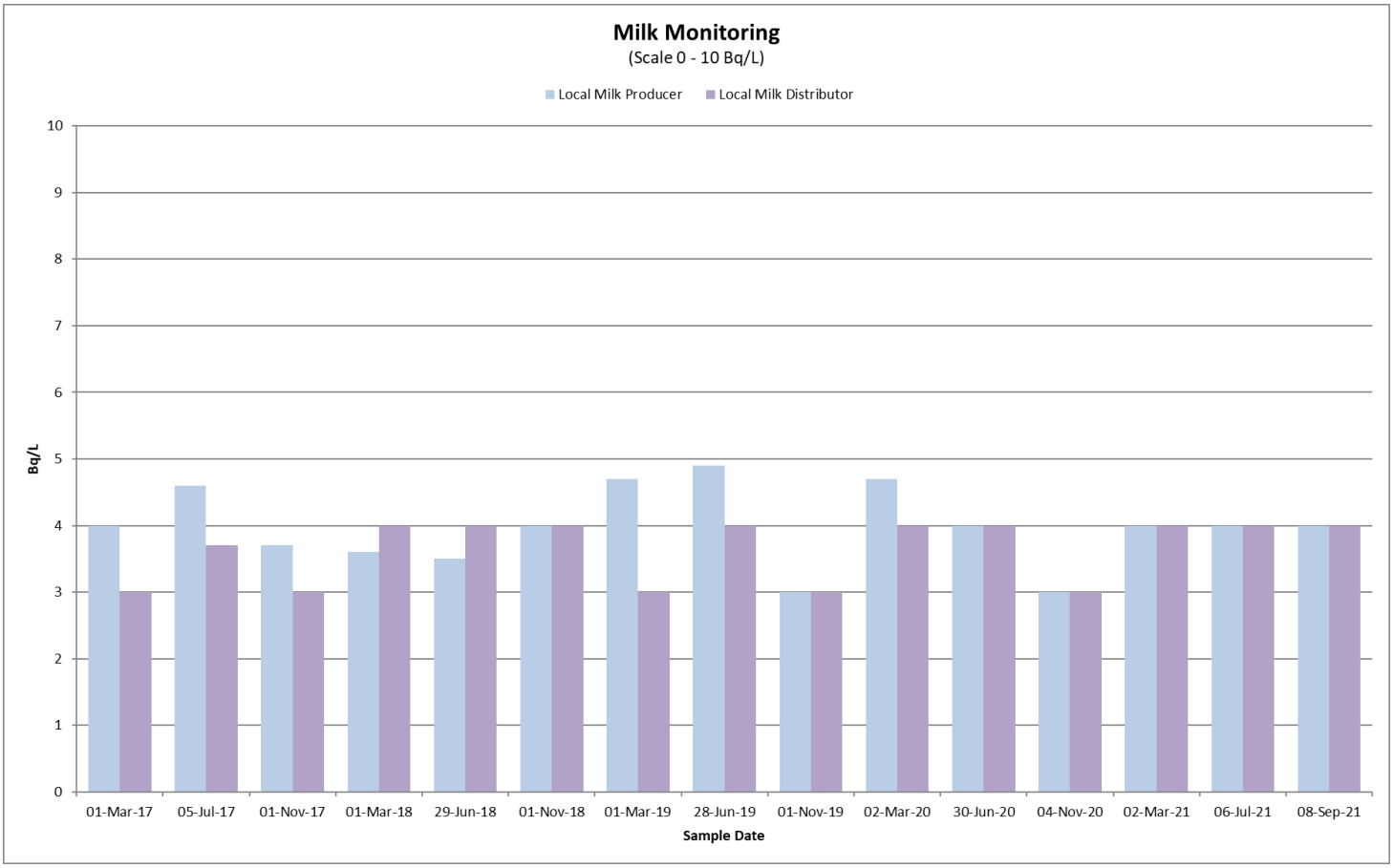


APPENDIX L

Milk Monitoring Data

Milk Monitoring Data

MILK MONITORING		
Results shaded in blue are <MDA (minimum detectable activity)		
	LOCAL MILK PRODUCER	LOCAL MILK DISTRIBUTOR
	Bq/L	Bq/L
01-Mar-17	4	3
05-Jul-17	4.6	3.7
01-Nov-17	3.7	3
01-Mar-18	3.6	4
29-Jun-18	3.5	4
01-Nov-18	4	4
01-Mar-19	4.7	3
28-Jun-19	4.9	4
01-Nov-19	3	3
02-Mar-20	4.7	4
30-Jun-20	4	4
04-Nov-20	3	3
02-Mar-21	4	4
06-Jul-21	4	4
08-Sep-21	4	4



APPENDIX M

Weather Data

WEATHER DATA SUMMARY (2017-2021)

Month	Precip Counts, # (TOTAL)	Wind Speed, m/s (AVG)	Gust Speed, m/s (AVG)	Wind Direction, ø (AVG)	Temp, °C (AVG)	RH, % (AVG)	DewPt, °C (AVG)	Wind sector (nesw)	Total rain (mm)
January-2017	113	3.0	4.4	187.5	-5.8	82.0	-8.4	SSW	22.6
February-2017	246	2.8	4.1	160.3	-5.2	79.4	-8.4	SSE	49.2
March-2017	209	2.9	4.4	227.5	-4.7	67.0	-10.3	SW	41.8
April-2017	857	2.6	4.1	179.4	6.8	75.1	2.1	SSE	171.4
May-2017	552	2.6	4.2	202.9	11.9	74.4	6.9	SSW	110.4
June-2017	1041	2.2	3.5	249.5	18.2	75.0	13.1	WSW	208.2
July-2017	712	1.7	2.8	221.6	20.0	76.0	15.2	SW	142.4
August-2017	433	2.0	3.3	241.1	17.5	79.3	13.6	WSW	86.6
September-2017	284	1.4	2.3	227.9	16.2	81.5	12.7	SW	56.8
October-2017	534	2.5	4.0	210.1	11.0	79.4	7.3	SSW	106.8
November-2017	286	3.2	4.6	162.8	-0.4	79.4	-3.7	SSE	57.2
December-2017	79	2.8	4.1	135.1	-10.9	79.2	-13.8	SE	15.8
January-2018	167	3.3	4.9	146.0	-9.7	80.2	-12.6	SE	33.4
February-2018	169	3.3	3.7	154.8	-5.6	77.9	-9.1	SSE	33.8
March-2018	158	3.9	5.1	94.1	-2.3	68.6	-7.7	ESE	31.6
April-2018	348	2.8	4.2	146.6	3.5	66.5	-3.1	SE	69.6
May-2018	276	2.4	3.9	202.6	15.1	60.7	6.4	SSW	55.2
June-2018	273	2.1	3.4	221.4	17.2	70.1	11.0	SW	54.6
July-2018	340	2.1	3.3	250.8	22.4	69.7	15.9	WSW	68
August-2018	336	1.8	2.9	213.2	21.0	78.7	16.8	SW	67.2
September-2018	352	2.1	3.3	205.2	14.5	81.1	11.1	SSW	70.4
October-2018	234	2.8	4.3	213.7	6.0	79.0	2.4	SW	46.8
November-2018	352	2.9	4.3	204.3	-2.3	85.6	-4.4	SSW	70.4
December-2018	170	2.3	3.4	195.0	-8.0	85.6	-10.0	SSW	34
January-2019	767	2.7	4.0	215.7	-13.0	79.2	-15.9	SW	153.4
February-2019	116	2.6	3.9	196.8	-9.7	74.9	-13.5	SSW	23.2
March-2019	178	3.0	4.5	231.7	-3.6	68.1	-9.2	SW	35.6
April-2019	778	3.0	4.5	204.9	4.1	73.3	-0.8	SSW	155.6
May-2019	369	2.6	4.0	212.2	10.8	72.9	5.6	SW	73.8
June-2019	493	2.3	3.7	248.4	16.8	70.5	10.7	WSW	98.6
July-2019	321	1.9	3.1	264.1	21.9	71.2	15.9	WSW	64.2
August-2019	285	2.0	3.2	239.8	19.4	71.7	13.6	SW	57
September-2019	228	2.1	3.3	246.7	14.6	78.8	10.6	WSW	45.6
October-2019	690	2.4	3.7	246.2	7.8	80.9	4.5	WSW	138
November-2019	219	2.1	3.3	249.3	14.8	78.9	10.8	WSW	43.8
December-2019	190	1.7	2.8	237.0	-5.0	84.7	-7.2	SW	38
January-2020	246	1.6	2.7	245.3	-7.4	84.1	-9.7	WSW	49.2
February-2020	165	1.9	3.4	251.2	-7.4	73.2	-11.6	WSW	33
March-2020	374	1.8	3.2	232.0	0.2	71.3	-4.9	SW	74.8
April-2020	261	2.0	3.8	*Wind Measurement Malfunction*	4.6	61.4	-3.1	*Wind Measurement Malfunction*	52.2
May-2020	375	1.2	2.8		12.1	59.4	3.2		75
June-2020	297	1.3	2.7		19.0	70.2	12.9		59.4
July-2020	358	1.0	2.2		23.2	72.5	17.4		71.6
August-2020	1131	0.6	1.3		18.6	82.1	15.1		226.2
September-2020	344	-6.9	-6.7		13.5	79.3	9.7		68.8
October-2020	296	0.0	0.2		5.9	78.1	2.2		59.2
November-2020	259	0.0	1.5		3.7	78.7	-0.9		51.8
December-2020	192	0.0	1.1		-4.6	84.9	-6.8		38.4
January-2021	66	0.1	0.9		-7.2	83.1	-9.6		13.2
February-2021	121	0.3	1.2		-8.1	75.6	-11.8		24.2
March-2021	*Weather Station taken offline for investigation, corrective maintenance and component replacement.*								
April-2021									
May-2021									
June-2021									
July-2021									
August-2021									
September-2021									
October-2021	271	2.7	4.2	201.9	10.9	83.8	8.1	SSW	54.2
November-2021	102	3.1	4.7	225.2	0.9	79.4	-2.5	SW	20.4
December-2021	253	4.0	6.1	209.2	-4.5	79.4	-7.6	SSW	50.6

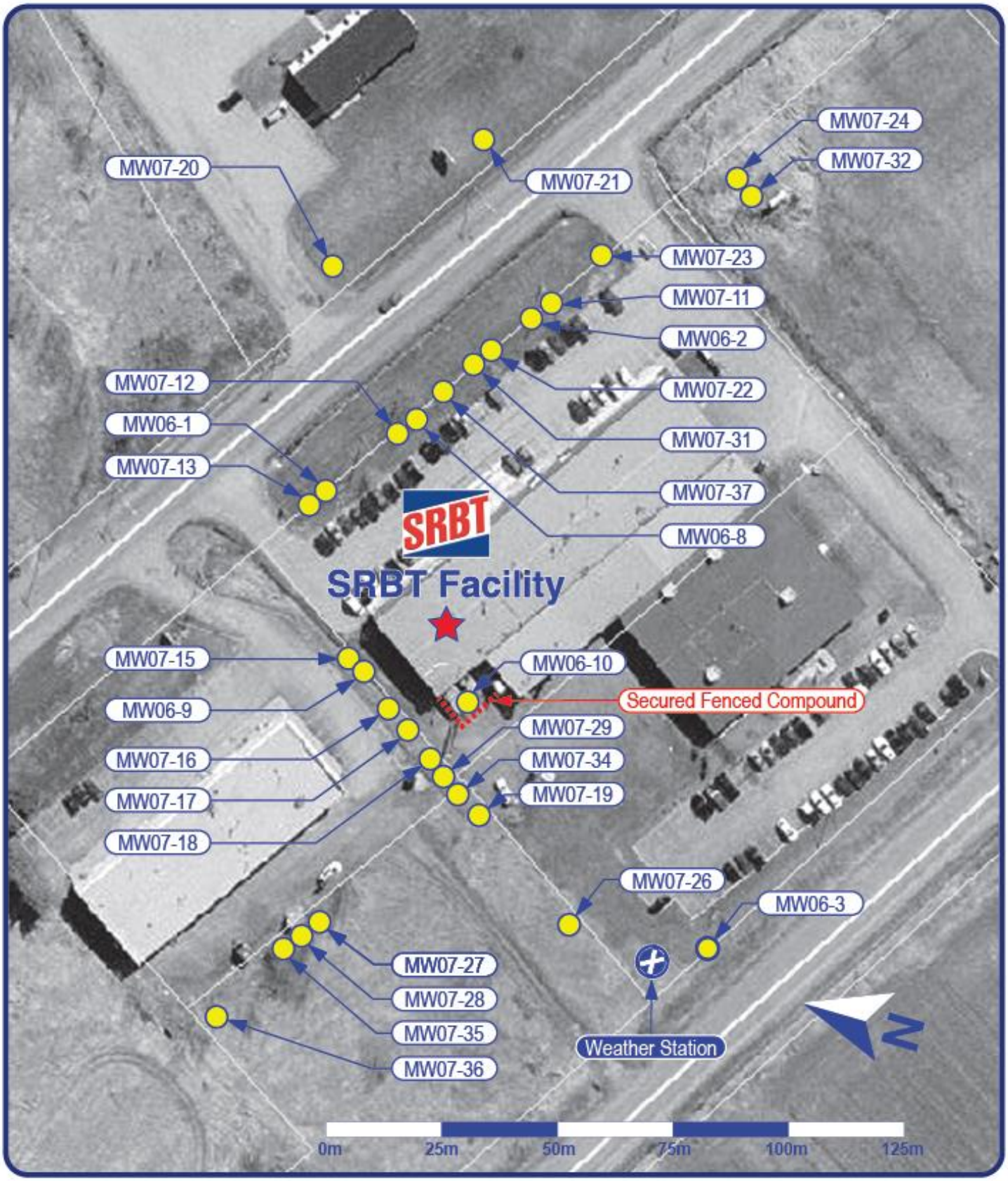
APPENDIX N

Groundwater Monitoring Data

Groundwater Monitoring Data

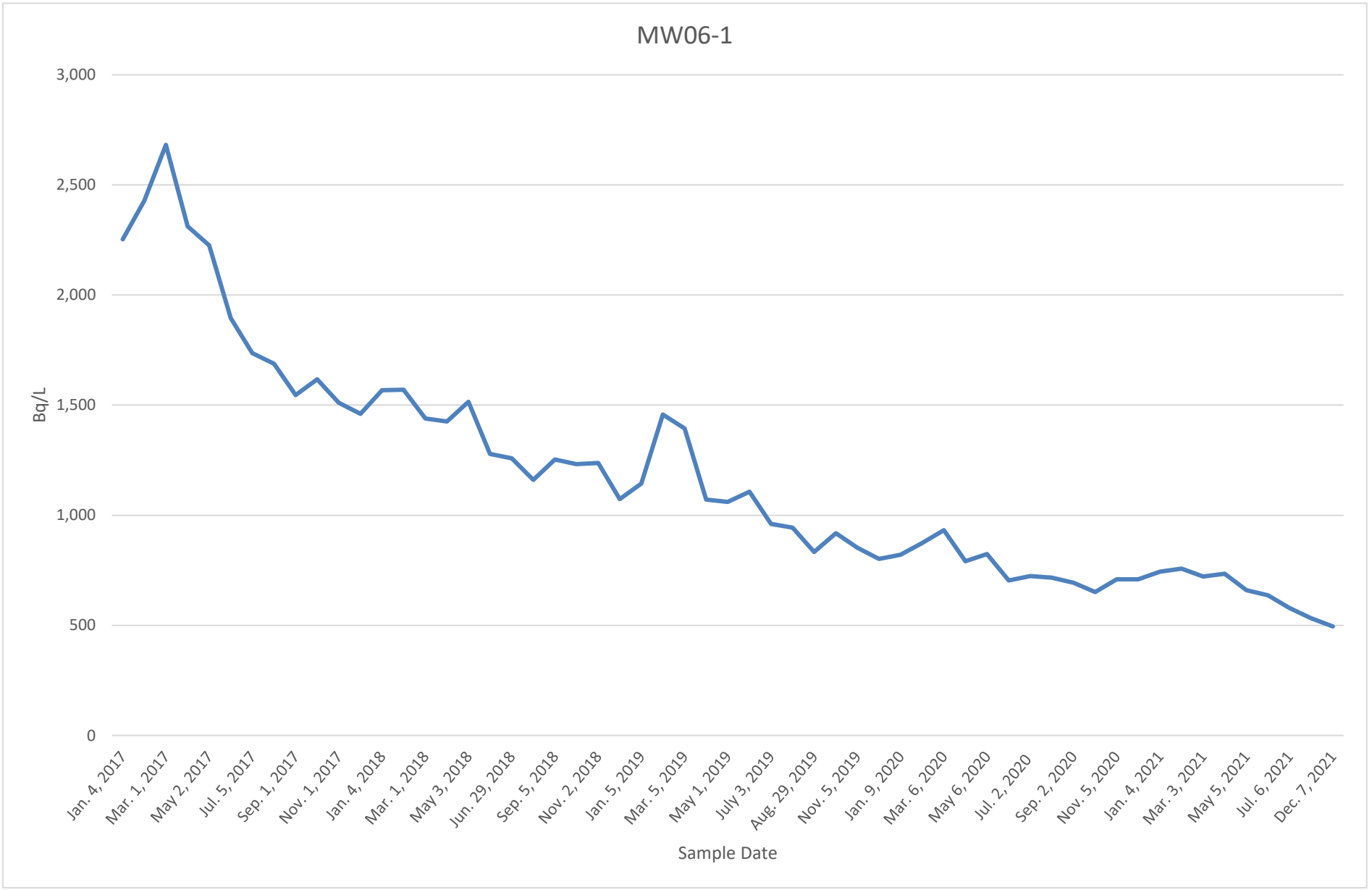
WELL I.D.	DESCRIPTION		DISTANCE FROM STACKS (m)	2021-Jan-04	2021-Feb-03	2021-Mar-03	2021-Apr-06	2021-May-05	2021-Jun-03	2021-Jul-06	2021-Sep-03	2021-Dec-07	WELL I.D.
MW06-1	SRB SITE	IN SOIL	50	744	757	722	734	660	636	579	532	495	MW06-1
MW06-2	SRB SITE	IN SOIL	75	726	709	767	749	740	714	757	739	727	MW06-2
MW06-3	SRB SITE	IN SOIL	50	247	Dry	Dry	192	186	187	190	Dry	190	MW06-3
MW06-8	SRB SITE	IN SOIL	55	575	548	542	580	547	552	550	536	519	MW06-8
MW06-9	SRB SITE	IN SOIL	25	1,460	1,418	1,489	1,342	1,397	1,391	1,338	1,243	1,216	MW06-9
MW06-10	SRB SITE	SURFACE OF BEDROCK	0	35,943	41,210	40,054	19,036	18,910	22,499	25,271	35,762	32,692	MW06-10
MW07-11	SRB SITE	SURFACE OF BEDROCK	75	1,001	952	996	807	683	670	809	880	921	MW07-11
MW07-12	SRB SITE	SURFACE OF BEDROCK	55	441	426	363	460	466	467	452	438	402	MW07-12
MW07-13	SRB SITE	SURFACE OF BEDROCK	50	3,798	3,752	3,706	3,668	3,532	3,464	3,395	3,272	3,154	MW07-13
MW07-15	SRB SITE	SURFACE OF BEDROCK	25	1,268	1,146	1,170	1,128	1,071	1,079	1,089	1,140	592	MW07-15
MW07-16	SRB SITE	SURFACE OF BEDROCK	15	1,001	943	962	902	886	873	878	831	800	MW07-16
MW07-17	SRB SITE	DEEPER BEDROCK	15	272	251	291	336	291	315	328	288	290	MW07-17
MW07-18	SRB SITE	SURFACE OF BEDROCK	10	1,203	1,388	1,416	1,017	943	948	1,004	1,007	995	MW07-18
MW07-19	SRB SITE	SURFACE OF BEDROCK	20	1,208	1,072	1,090	965	760	799	1,028	820	885	MW07-19
MW07-20	SUPERIOR PROPANE PROPERTY	SURFACE OF BEDROCK	90	319	287	347	297	296	307	298	244	266	MW07-20
MW07-21	SUPERIOR PROPANE PROPERTY	SURFACE OF BEDROCK	110	356	369	377	290	349	387	370	412	360	MW07-21
MW07-22	SRB SITE	SURFACE OF BEDROCK	70	787	740	736	733	752	727	730	725	628	MW07-22
MW07-23	SRB SITE	SURFACE OF BEDROCK	90	1,200	1,132	1,163	1,167	1,167	1,140	1,149	1,114	1,087	MW07-23
MW07-24	HARRINGTON PROPERTY	SURFACE OF BEDROCK	115	1,582	1,551	1,536	1,535	1,518	1,498	1,488	1,454	1,439	MW07-24
MW07-26	SRB SITE	SURFACE OF BEDROCK	50	446	456	413	396	398	406	428	428	419	MW07-26
MW07-27	CITY PROPERTY	SURFACE OF BEDROCK	55	1,898	2,107	2,123	882	1,378	1,490	1,648	1,840	1,897	MW07-27
MW07-28	CITY PROPERTY	DEEPER BEDROCK	55	758	638	688	678	709	742	618	643	558	MW07-28
MW07-29	SRB SITE	DEEPER BEDROCK	10	1,114	1,277	1,620	812	890	1,007	1,009	1,011	934	MW07-29
MW07-31	SRB SITE	DEEPER BEDROCK	70	200	257	291	373	363	405	370	358	308	MW07-31
MW07-32	HARRINGTON PROPERTY	DEEPER BEDROCK	115	46	<MDA (50)	<MDA (40)	82	47	54	82	50	<MDA (38)	MW07-32
MW07-34	SRB SITE	SHALLOW BEDROCK	10	1,194	1,103	1,155	1,209	1,235	1,233	1,145	1,083	1,023	MW07-34
MW07-35	CITY PROPERTY	SHALLOW BEDROCK	55	1,647	1,589	1,619	1,532	1,533	1,520	1,506	1,503	1,505	MW07-35
MW07-36	CITY PROPERTY	SHALLOW BEDROCK	80	1,340	1,738	1,031	869	839	793	1,084	1,308	1,387	MW07-36
MW07-37	SRB SITE	SHALLOW BEDROCK	60	763	746	745	723	709	702	688	685	696	MW07-37
RW-2	185 MUD LAKE ROAD		1,100			41				32	35		RW-2
RW-3	183 MUD LAKE ROAD		1,100			28				44	42		RW-3
RW-5	171 SAWMILL ROAD		2,300			7				5	5		RW-5
RW-6	40987 HWY 41		1,400			4				4	5		RW-6
RW-7	40925 HWY 41		1,600			No sample				4	5		RW-7
B-1	VALLEY POOL SERVICE OFFICE		160			804				844	940		B-1
B-2	SUPERIOR PROPANE TRUCK WASH		250			532				473	456		B-2
B-3	HEIDEMAN & SONS LUMBER		385			No sample				No sample	No sample		B-3

Groundwater Monitoring Data



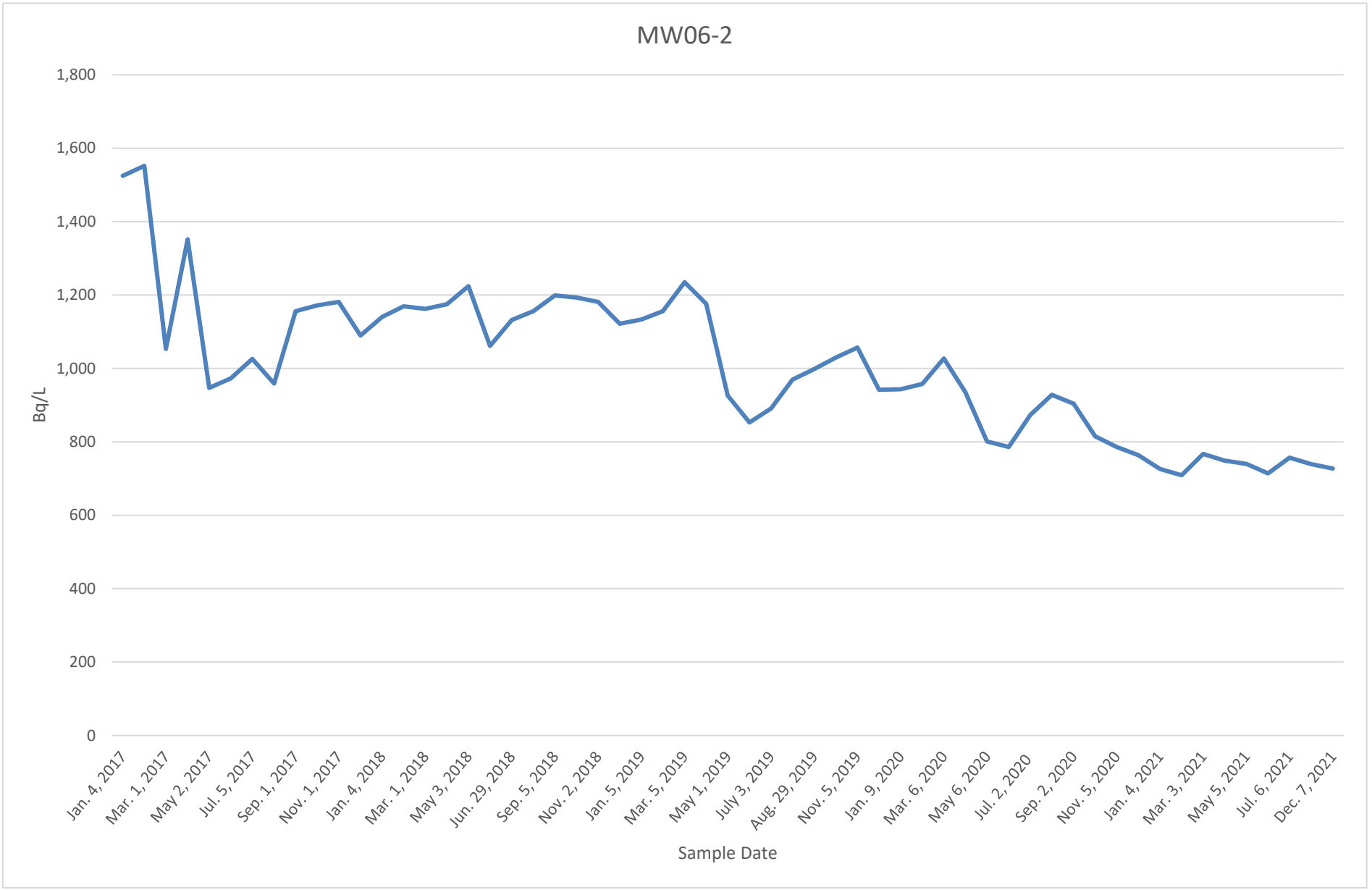
Monitoring Wells

Groundwater Monitoring Data



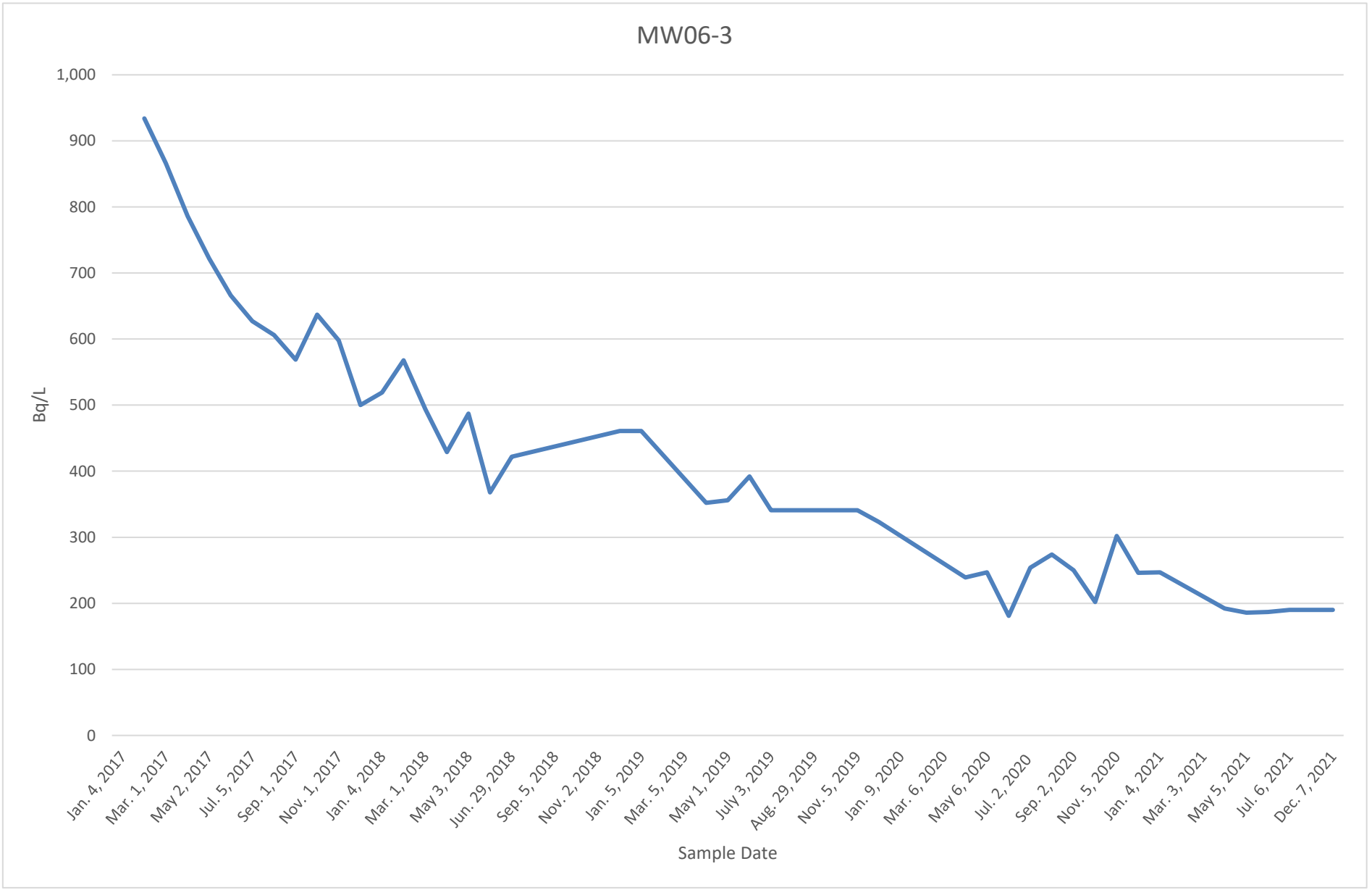
APPENDIX N

Groundwater Monitoring Data



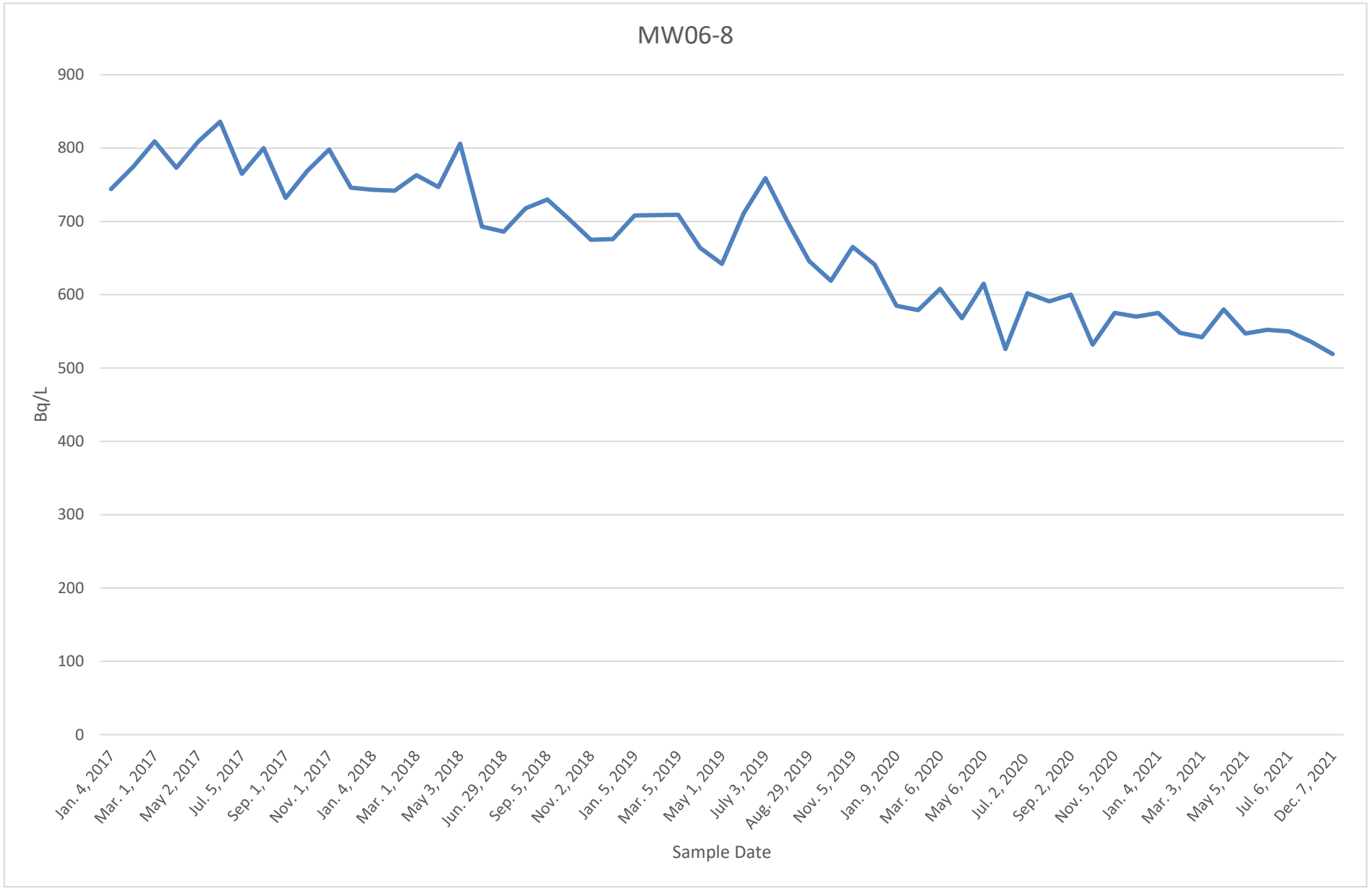
APPENDIX N

Groundwater Monitoring Data



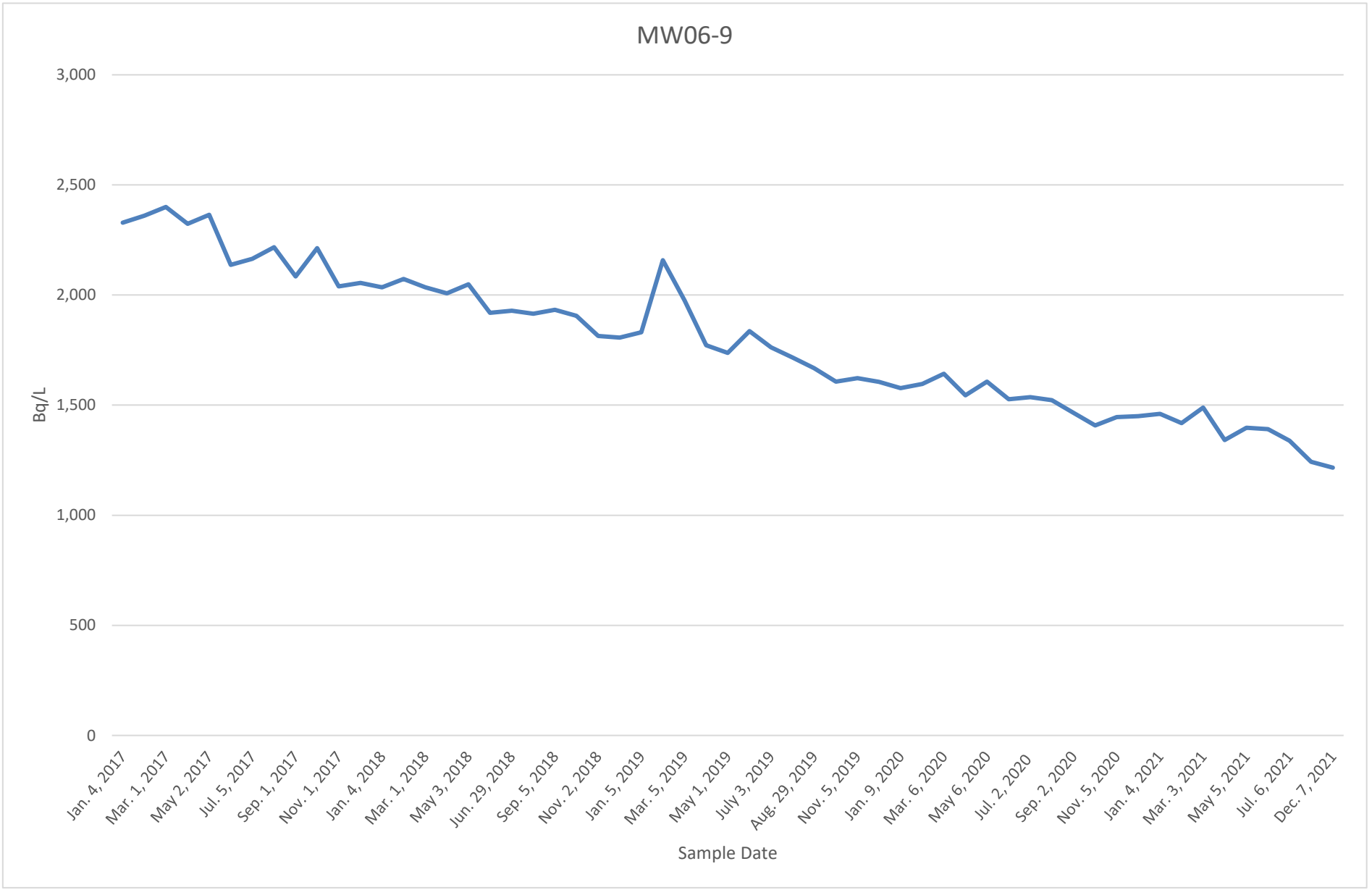
APPENDIX N

Groundwater Monitoring Data



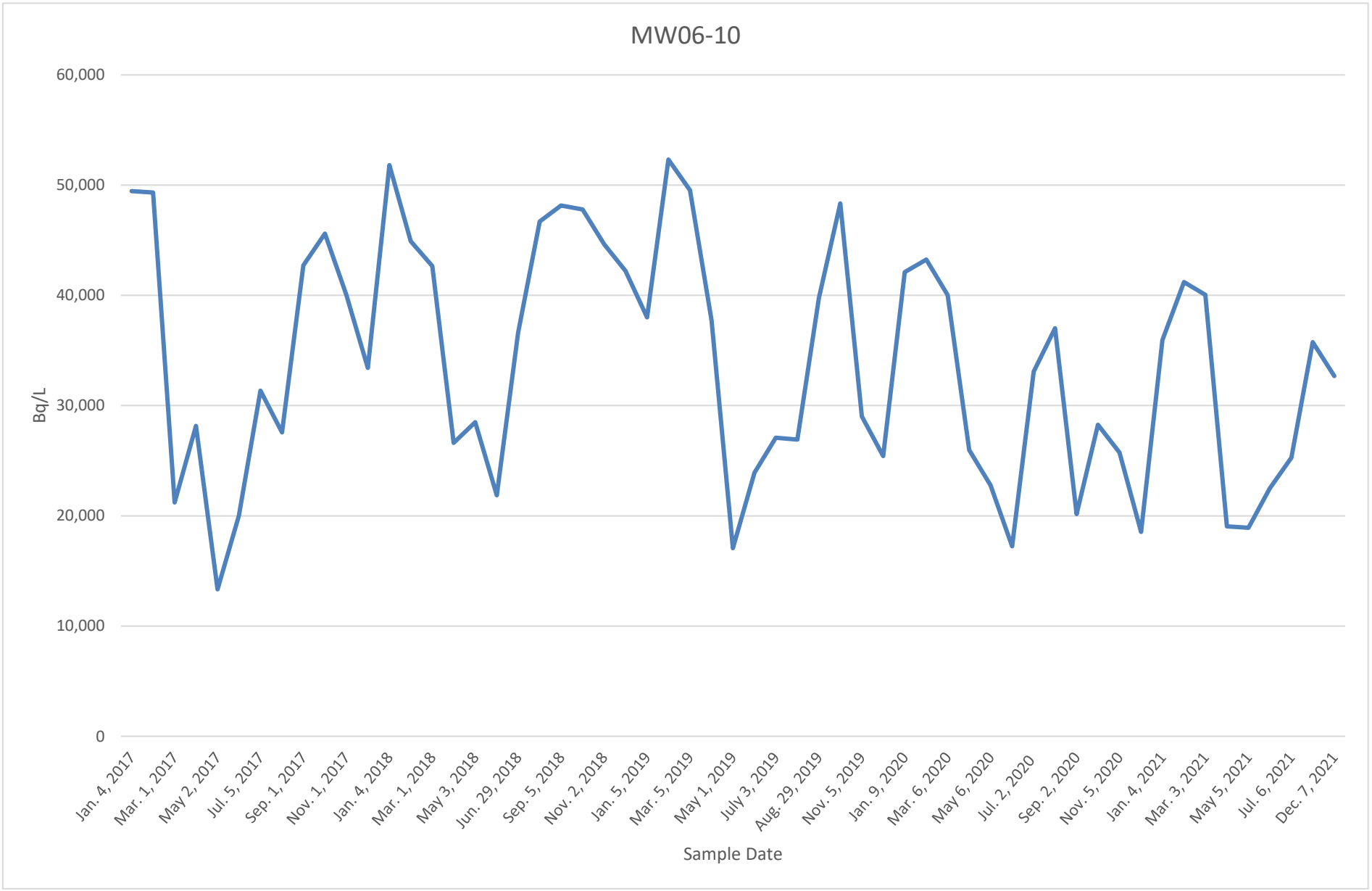
APPENDIX N

Groundwater Monitoring Data



APPENDIX N

Groundwater Monitoring Data



APPENDIX N

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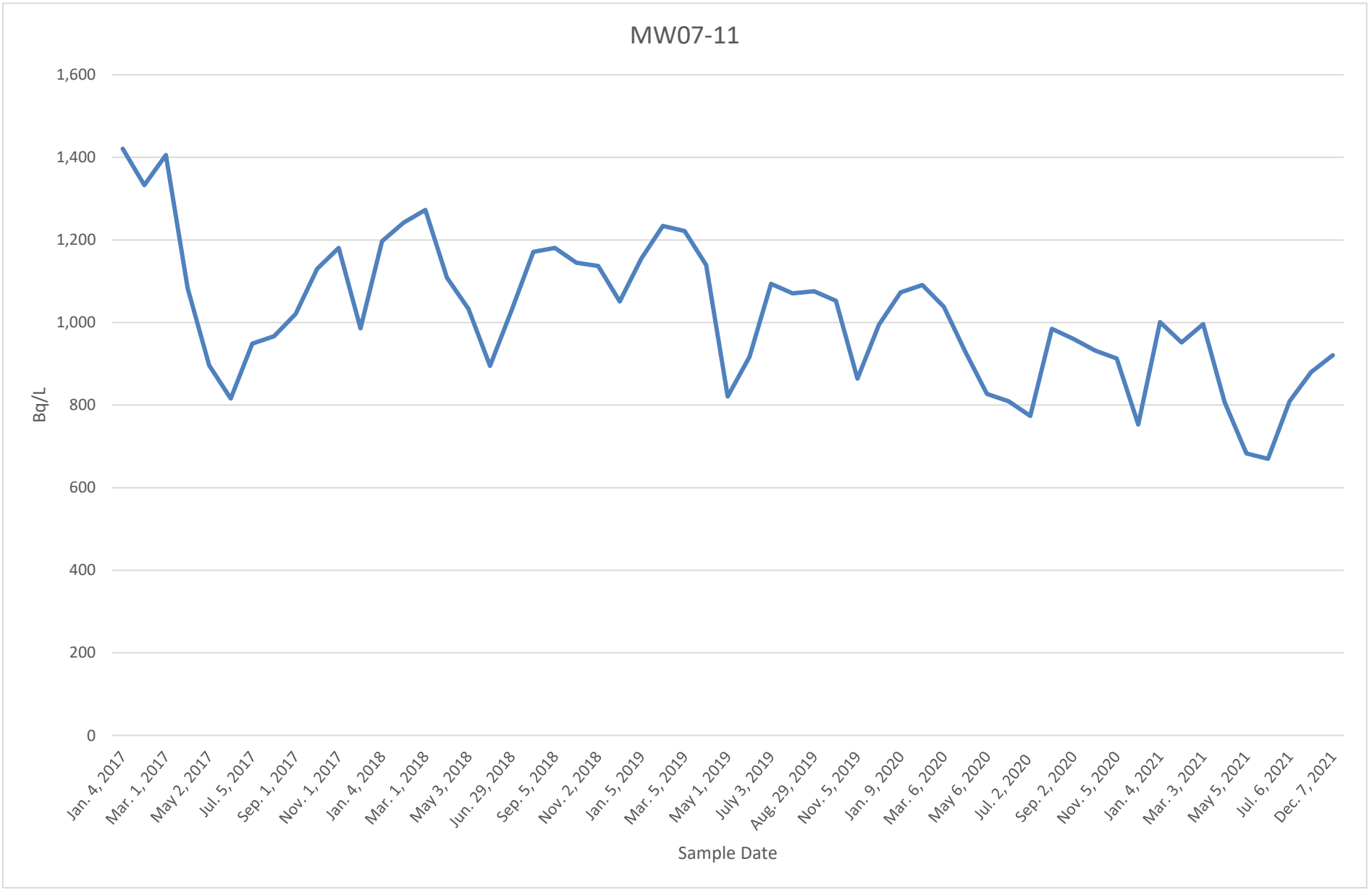

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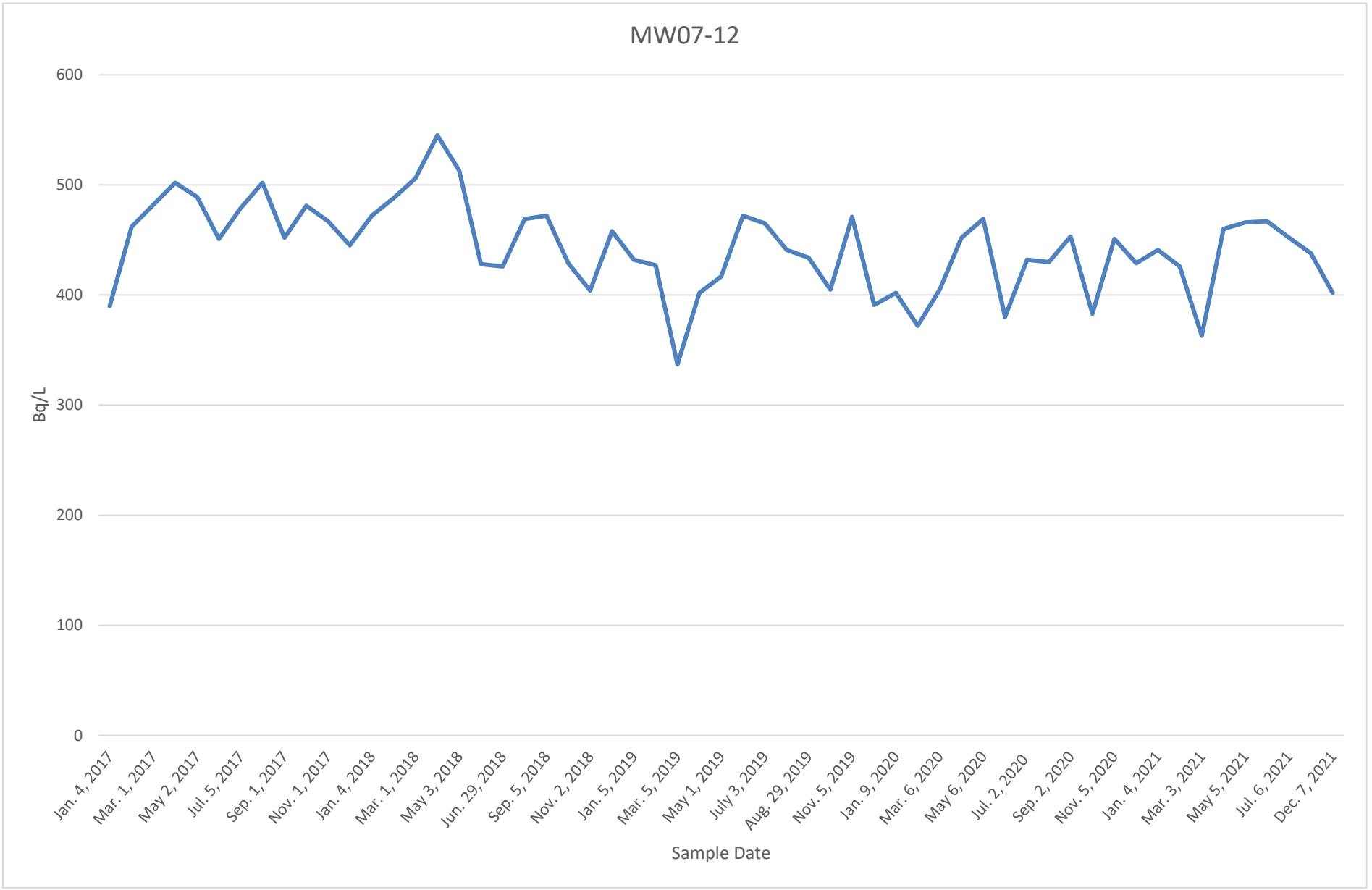
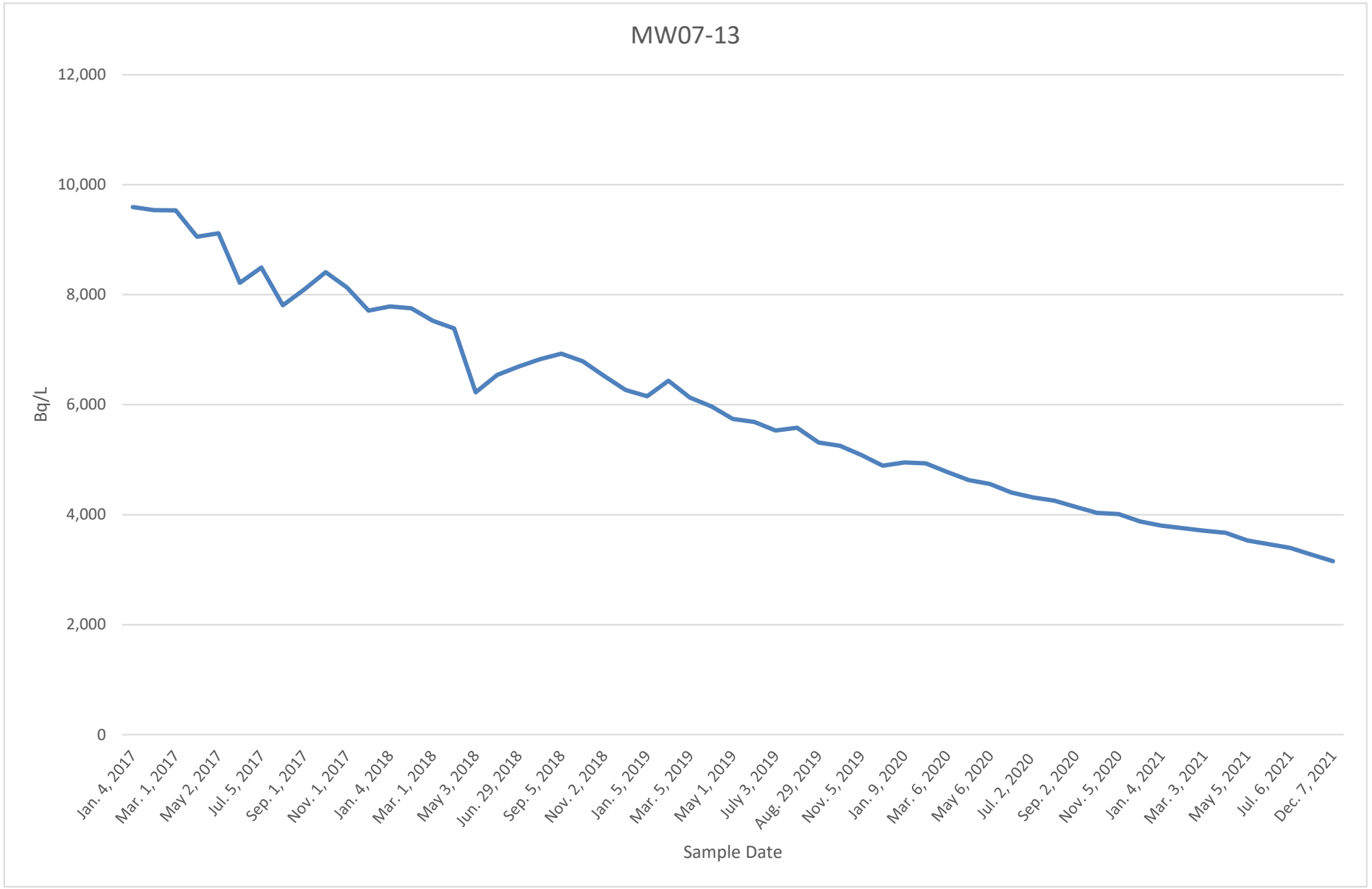


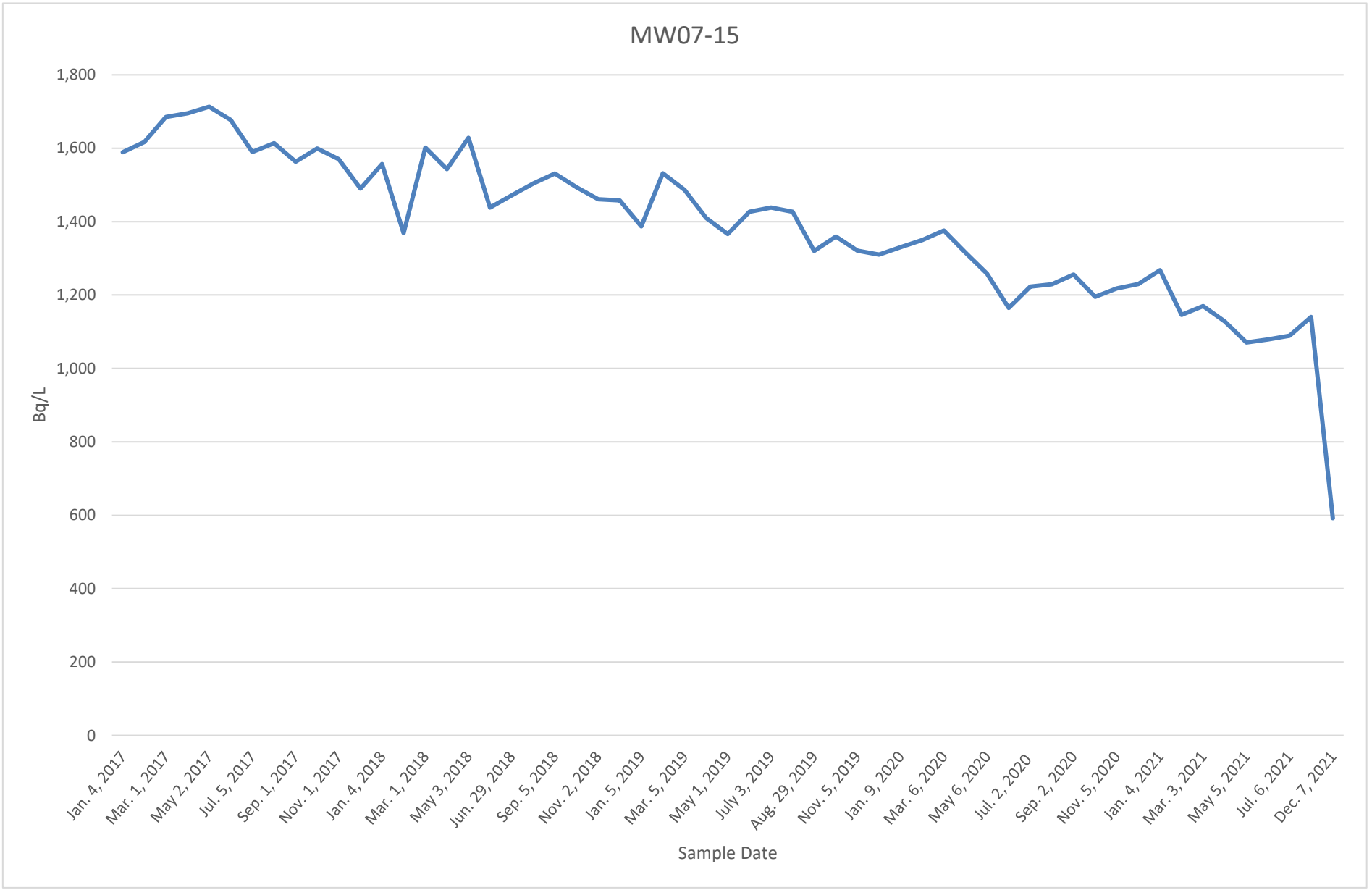
APPENDIX N

Groundwater Monitoring Data



APPENDIX N

Groundwater Monitoring Data



APPENDIX N

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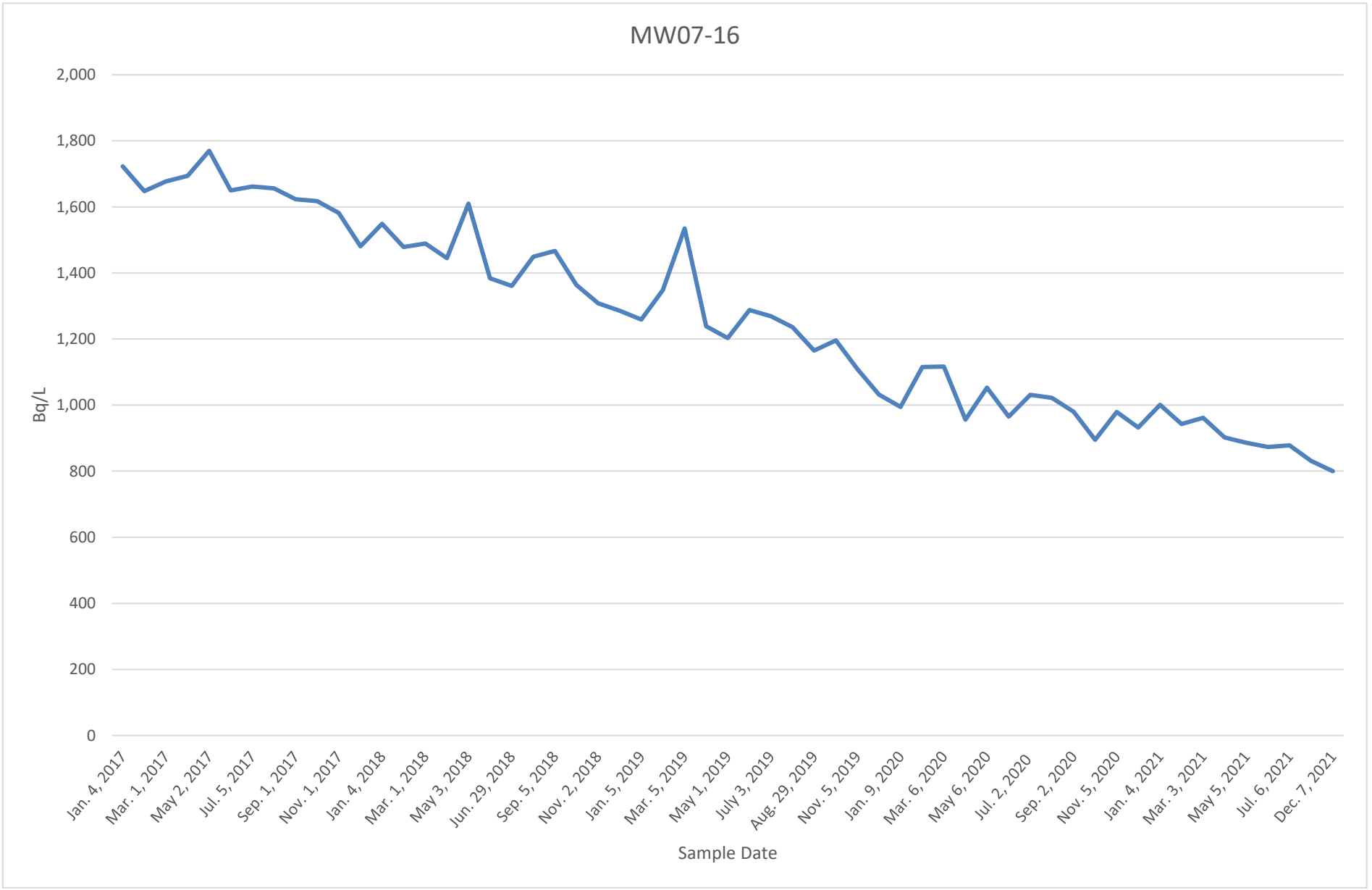

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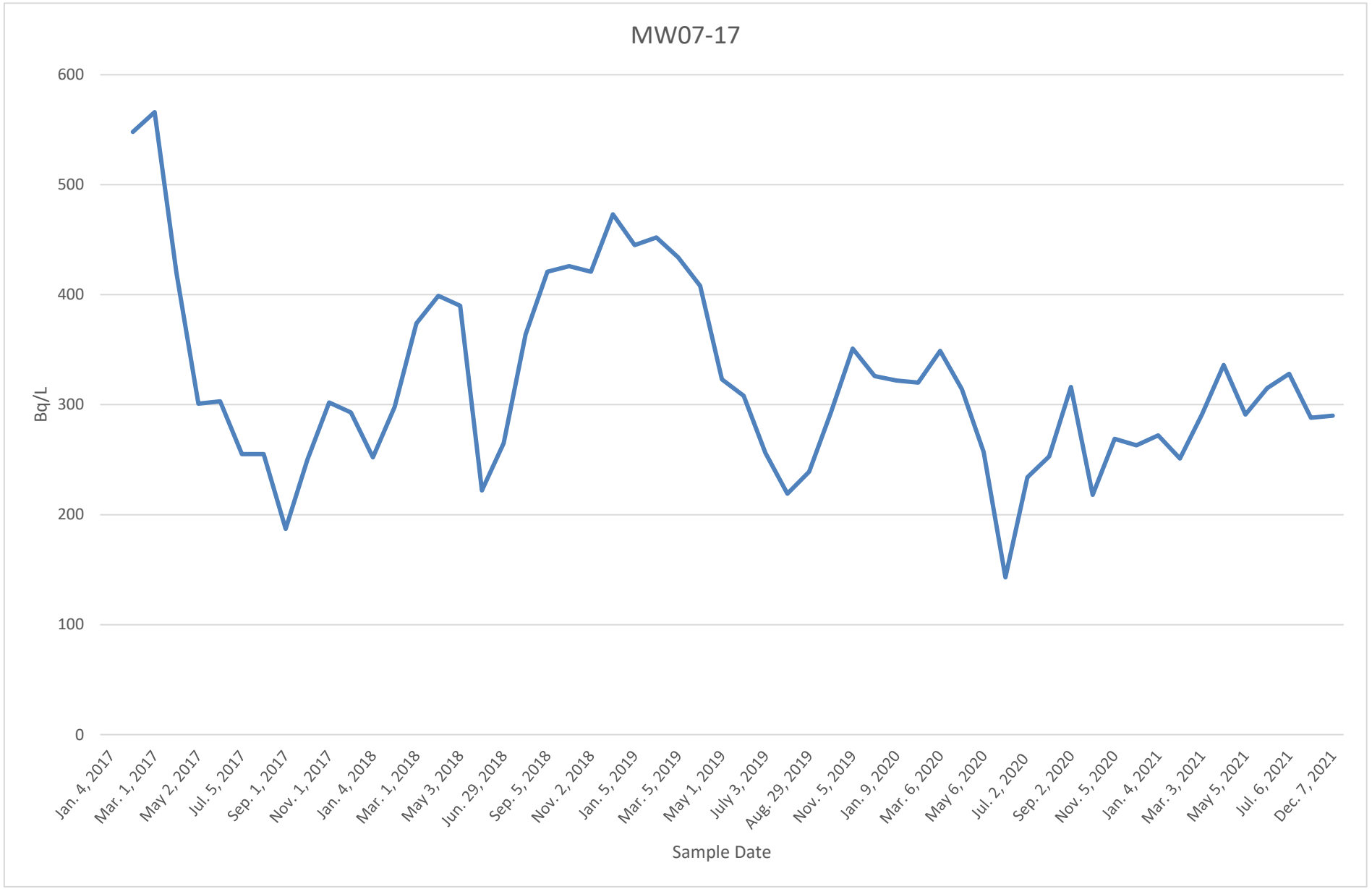

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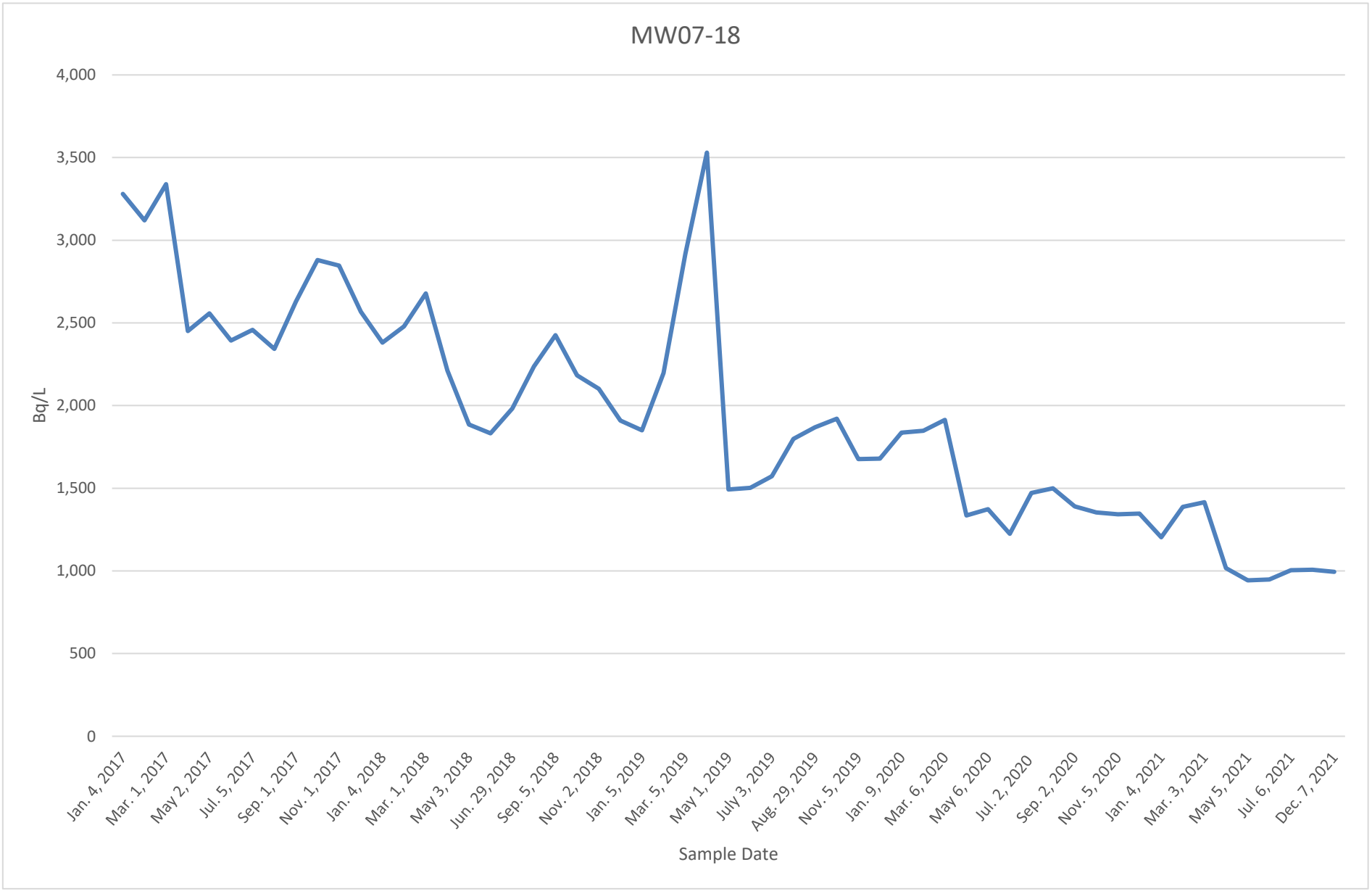

APPENDIX N

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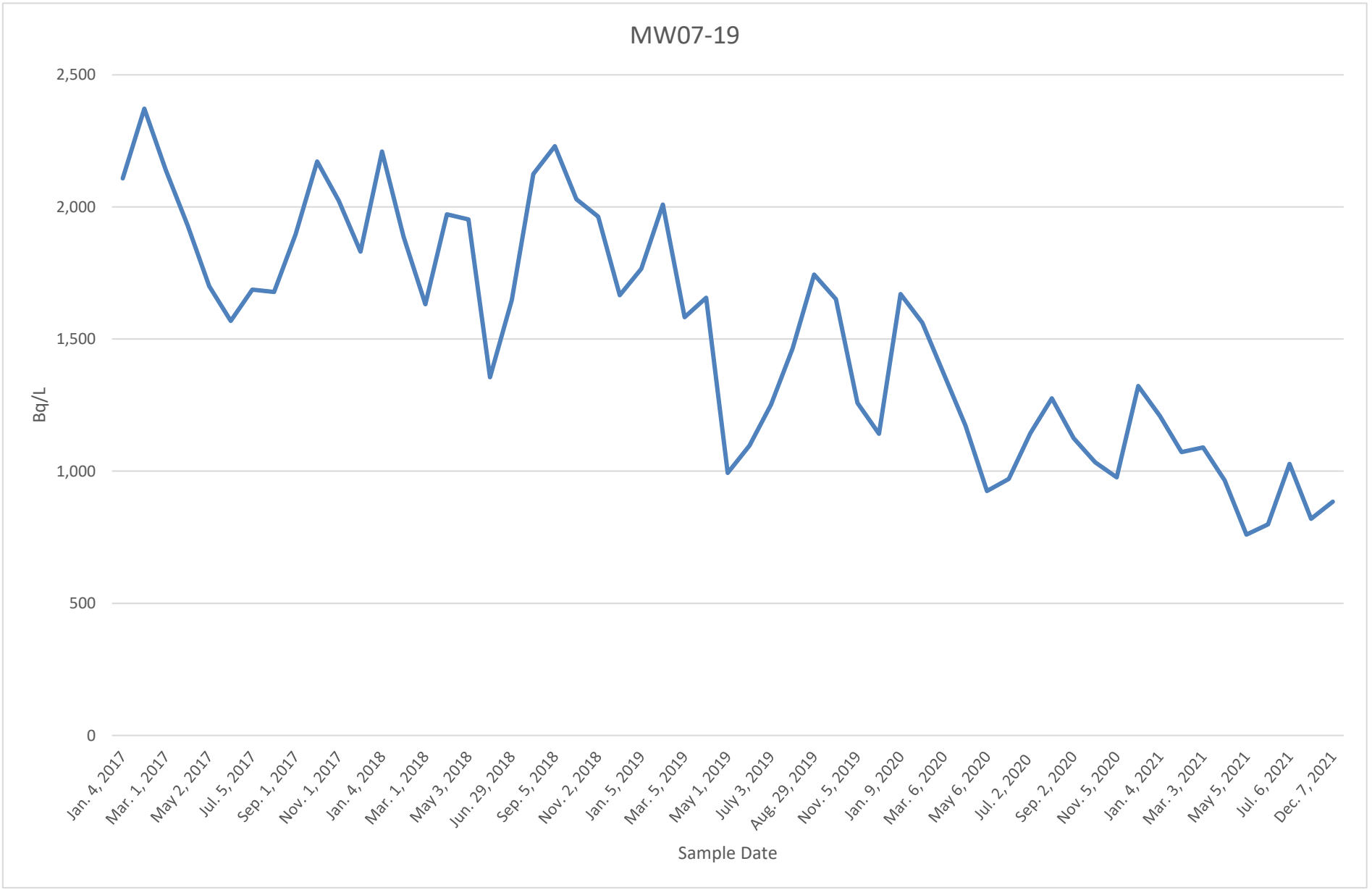

APPENDIX N

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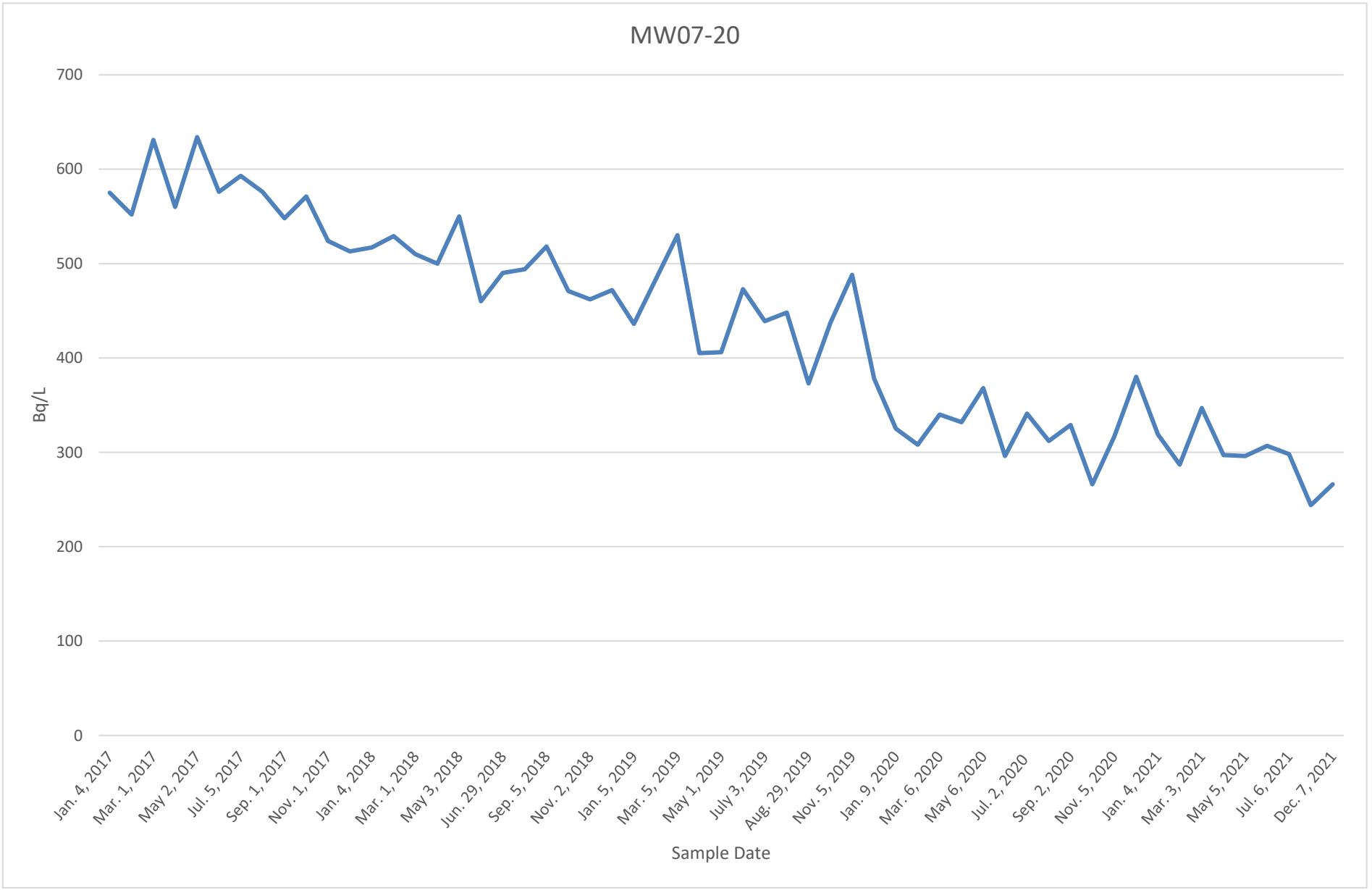

APPENDIX N

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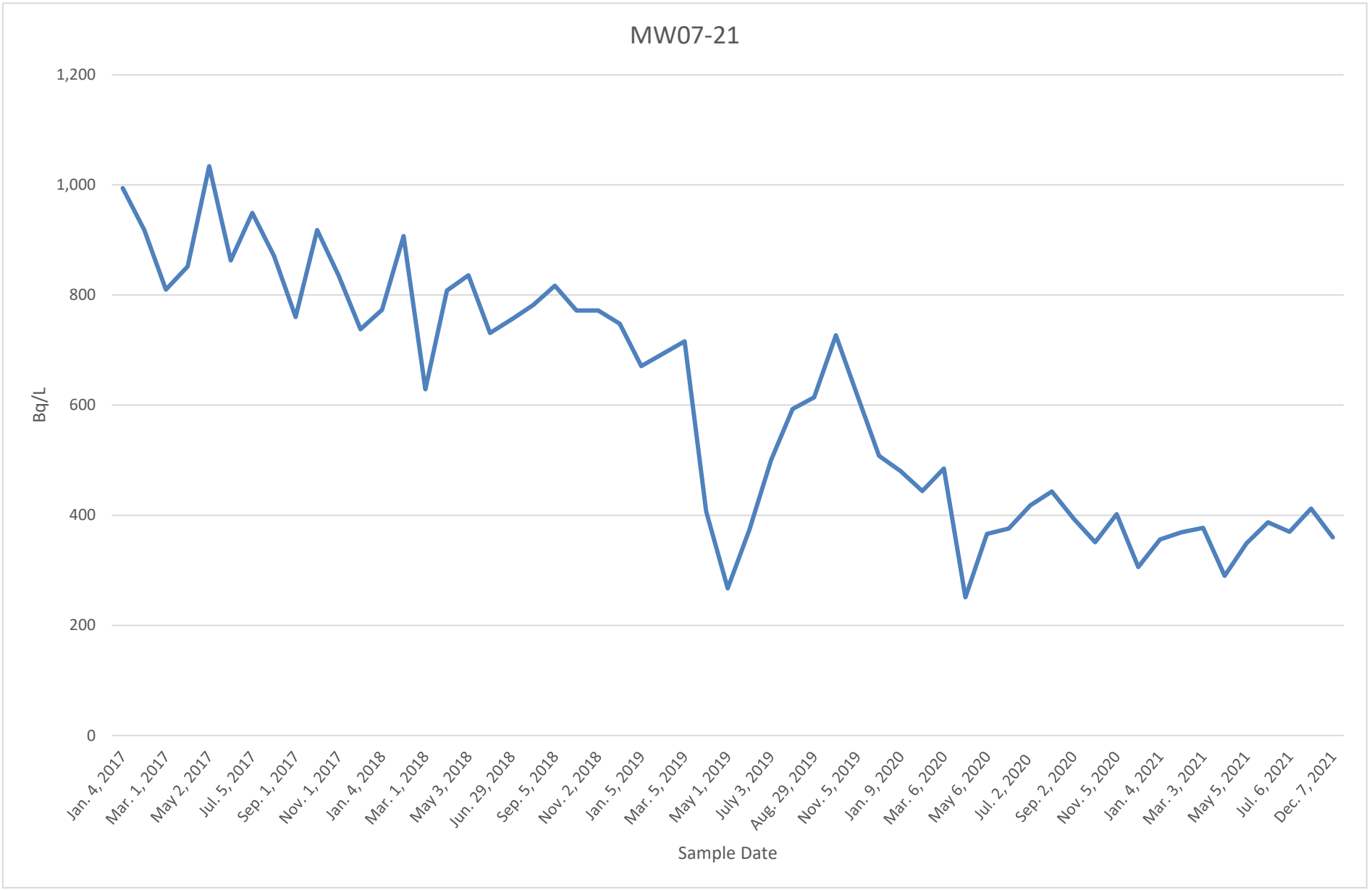
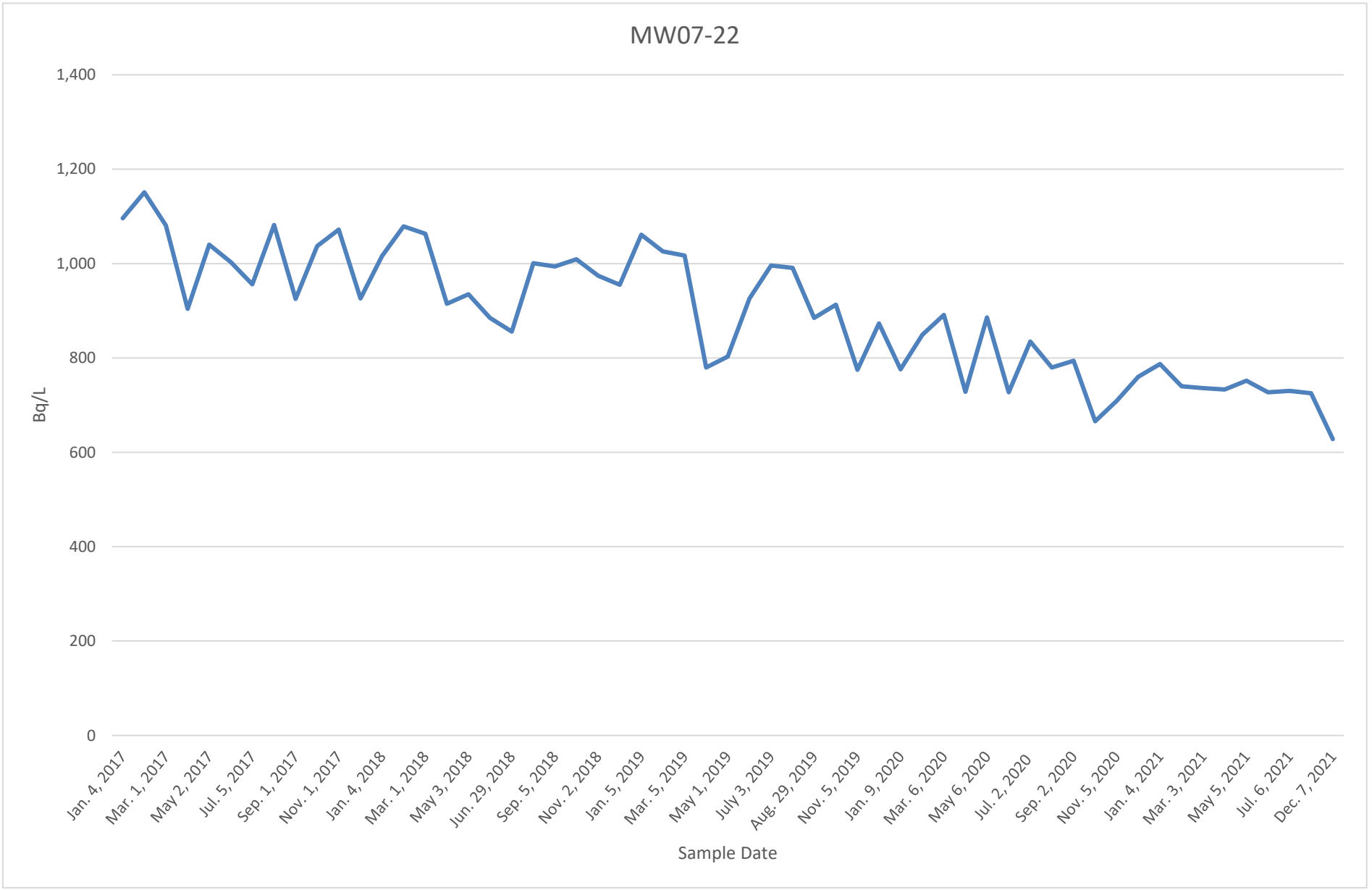


APPENDIX N

Groundwater Monitoring Data



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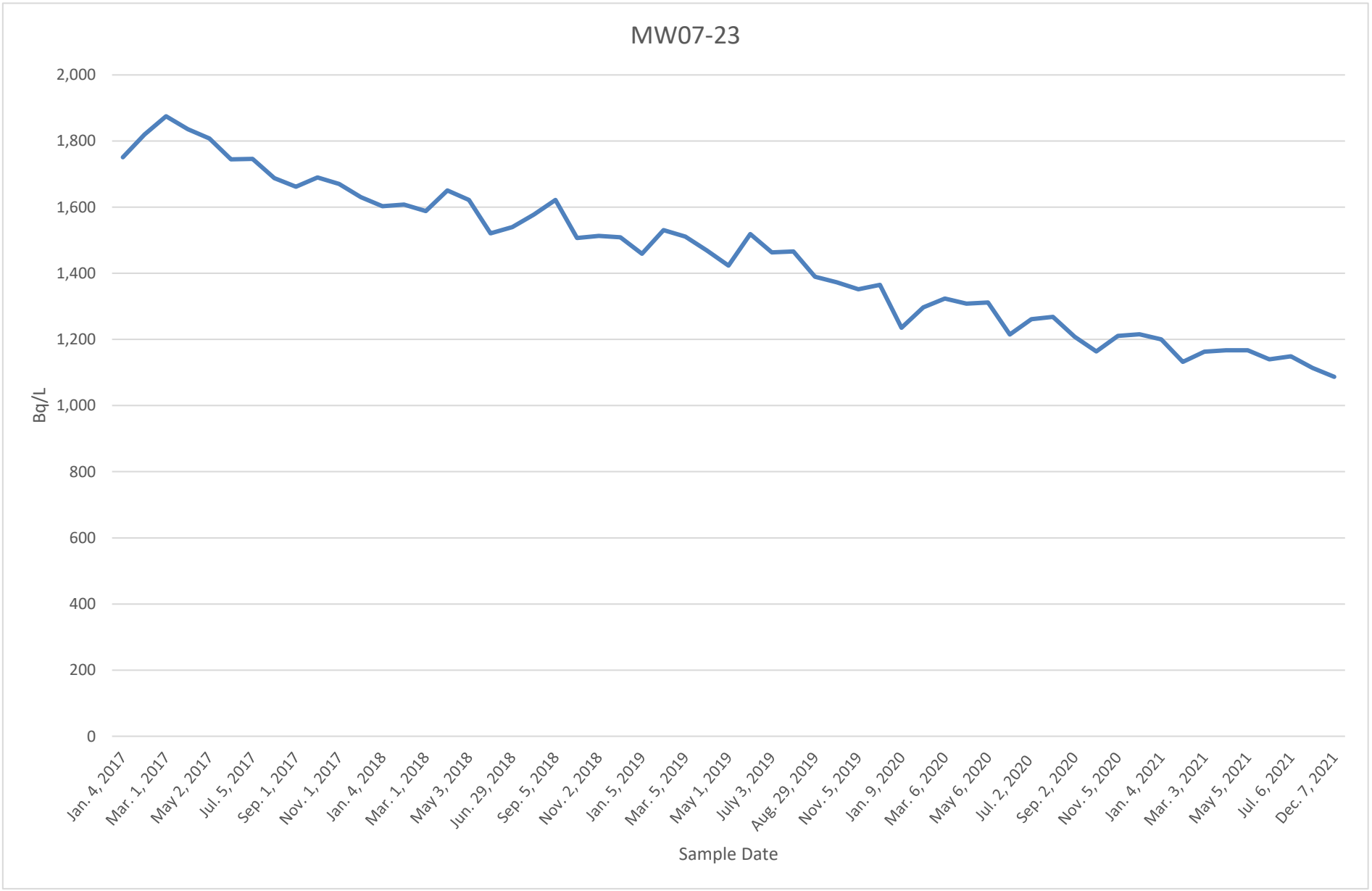
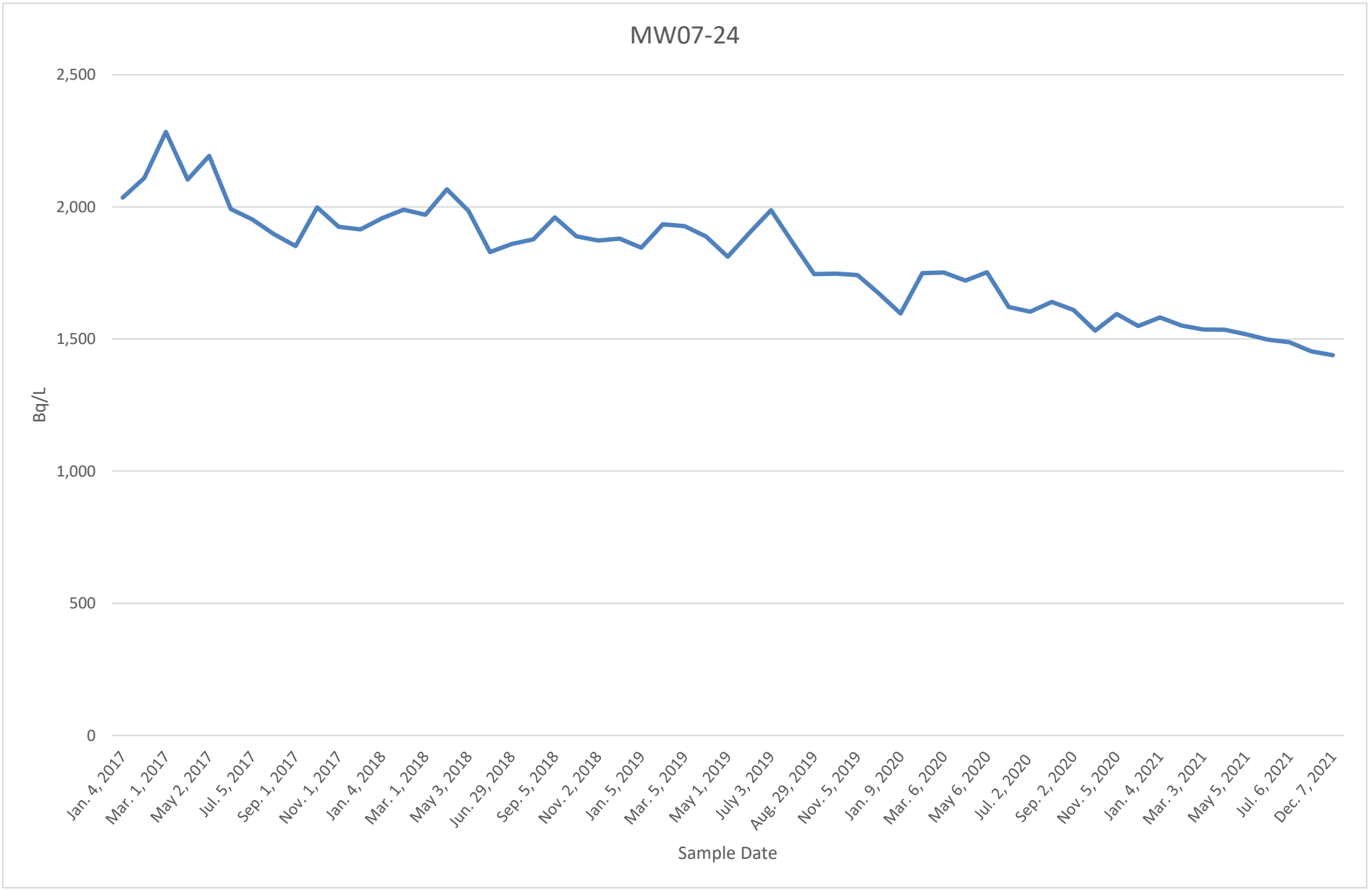


APPENDIX N

Groundwater Monitoring Data



APPENDIX N

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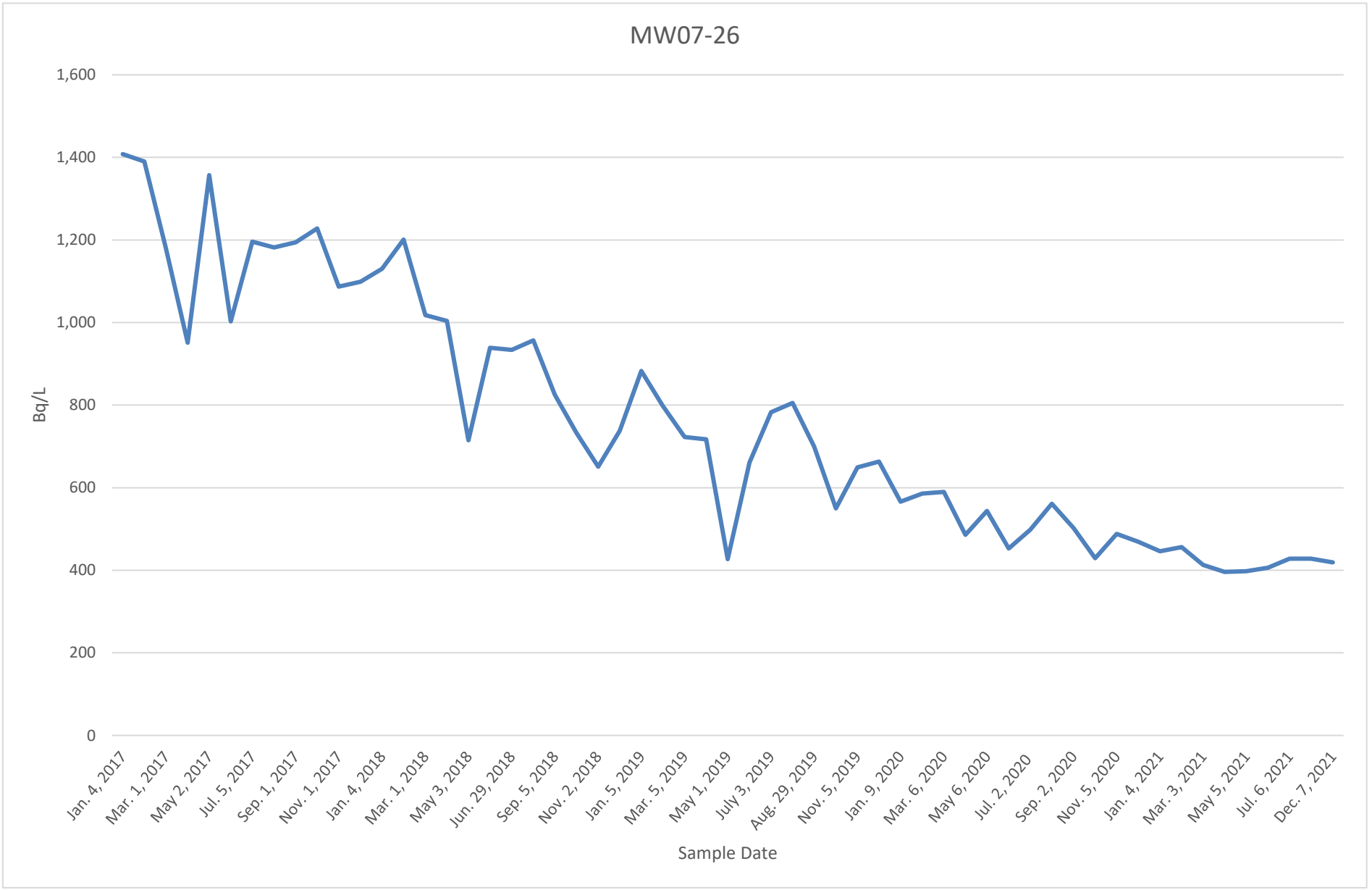

APPENDIX N

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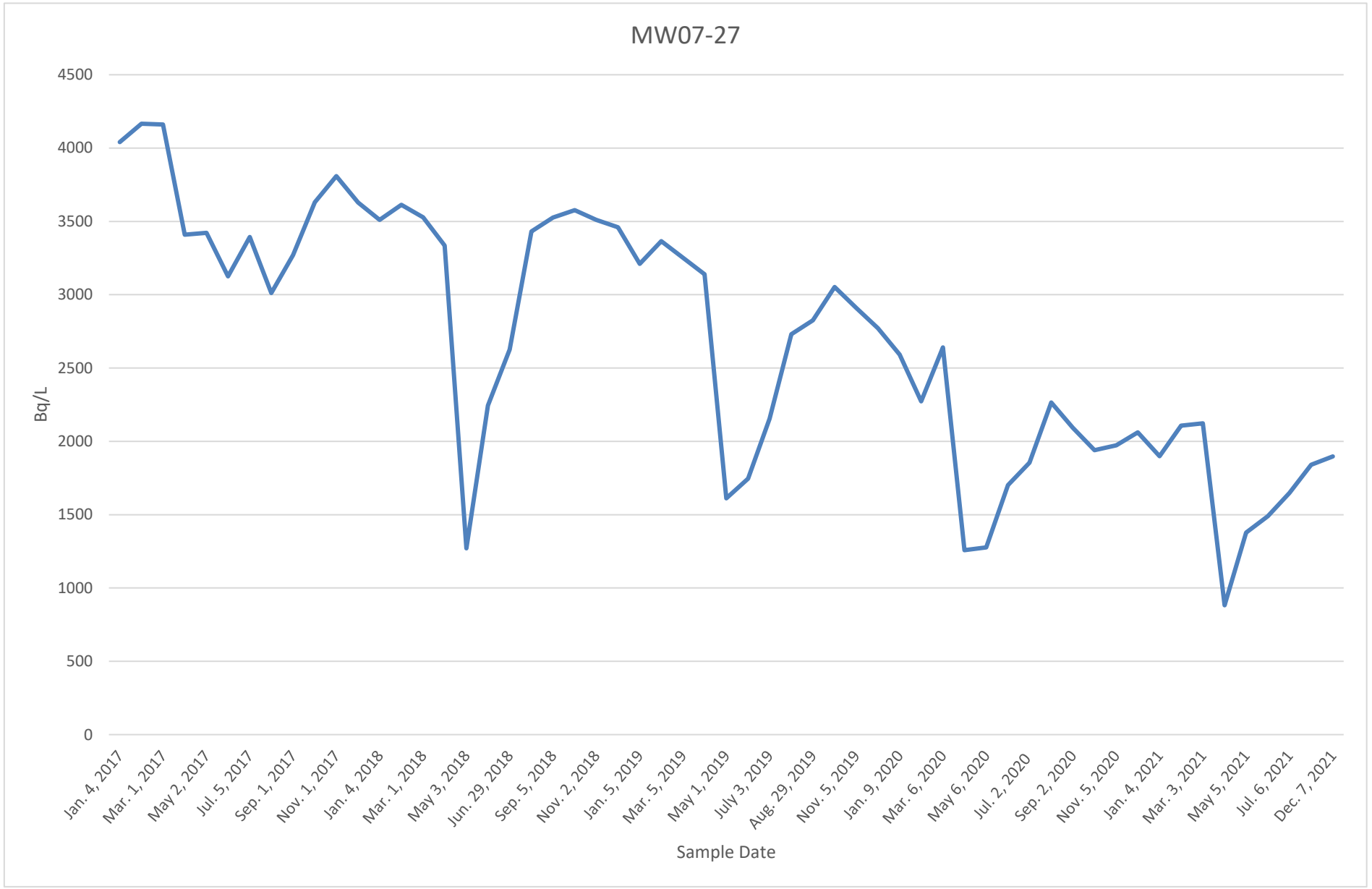
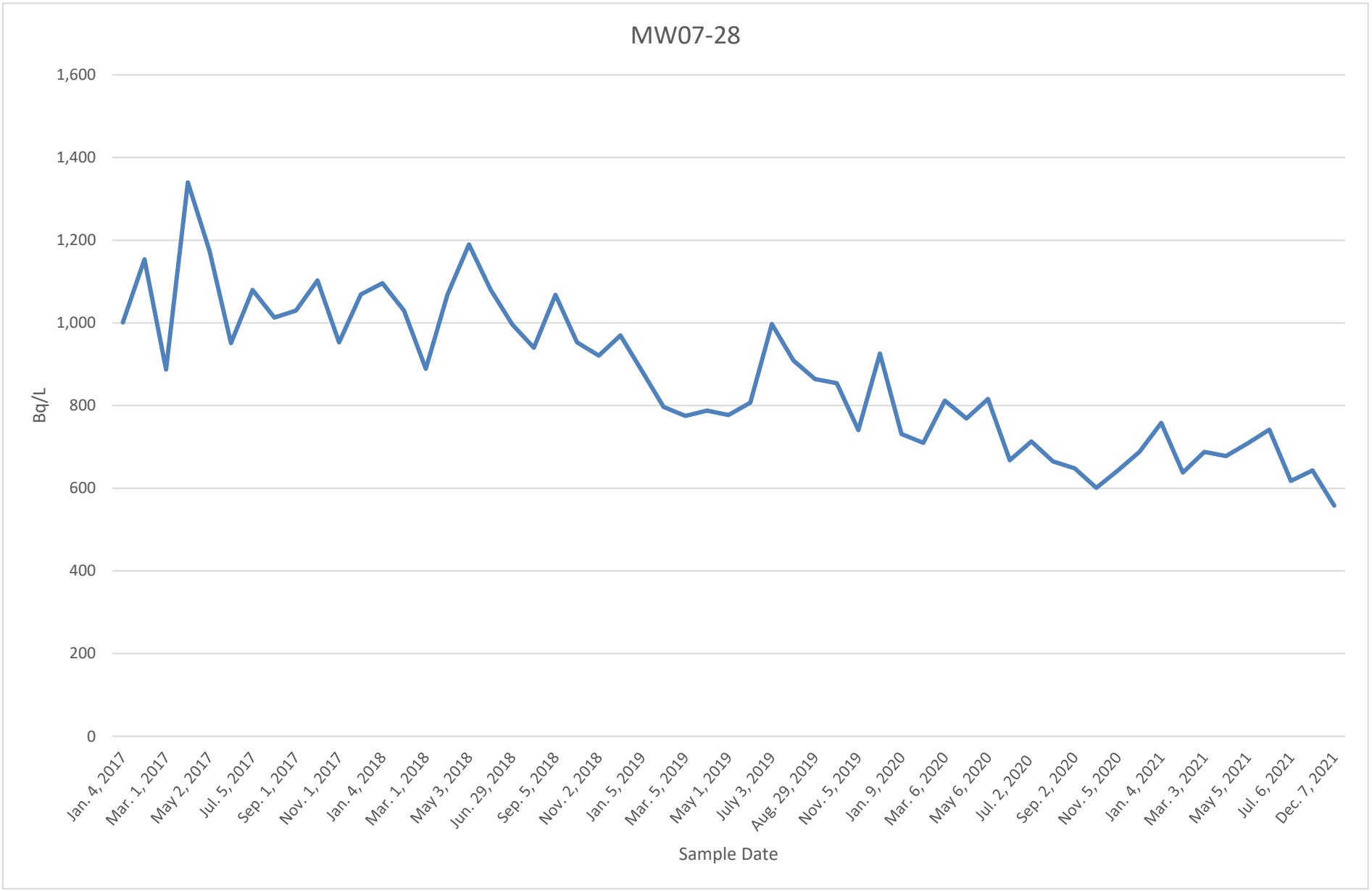


APPENDIX N

Groundwater Monitoring Data



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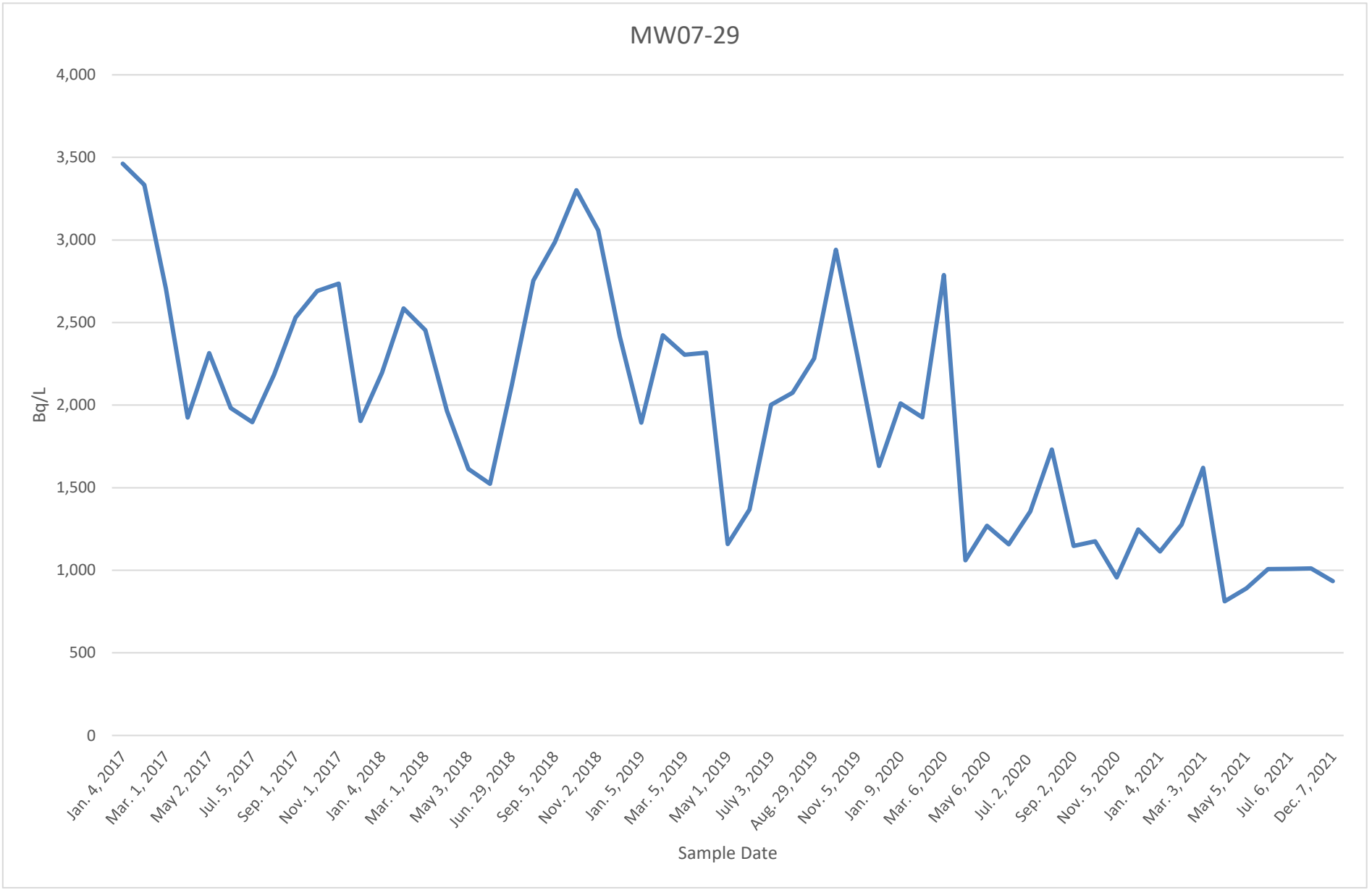
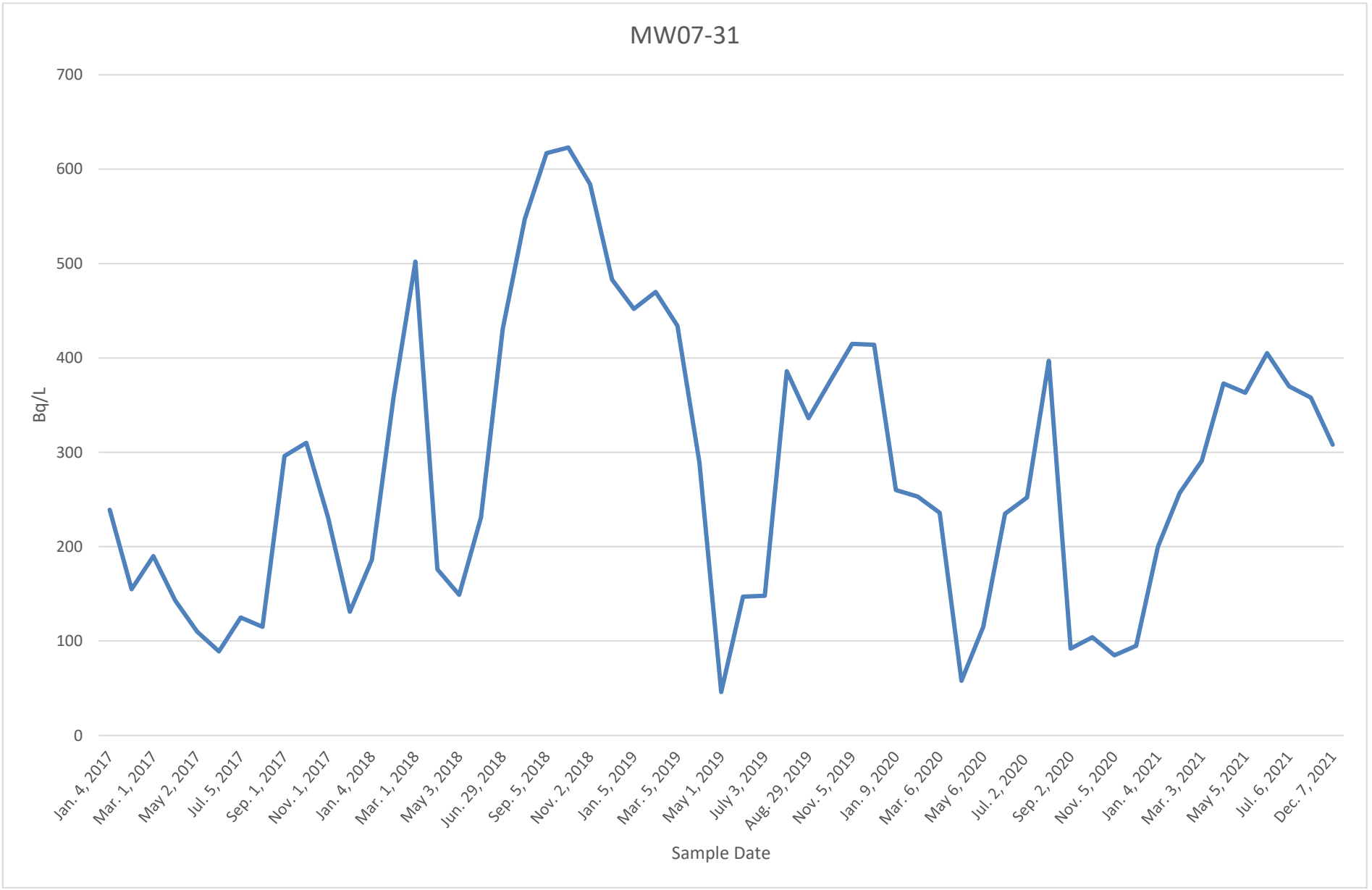


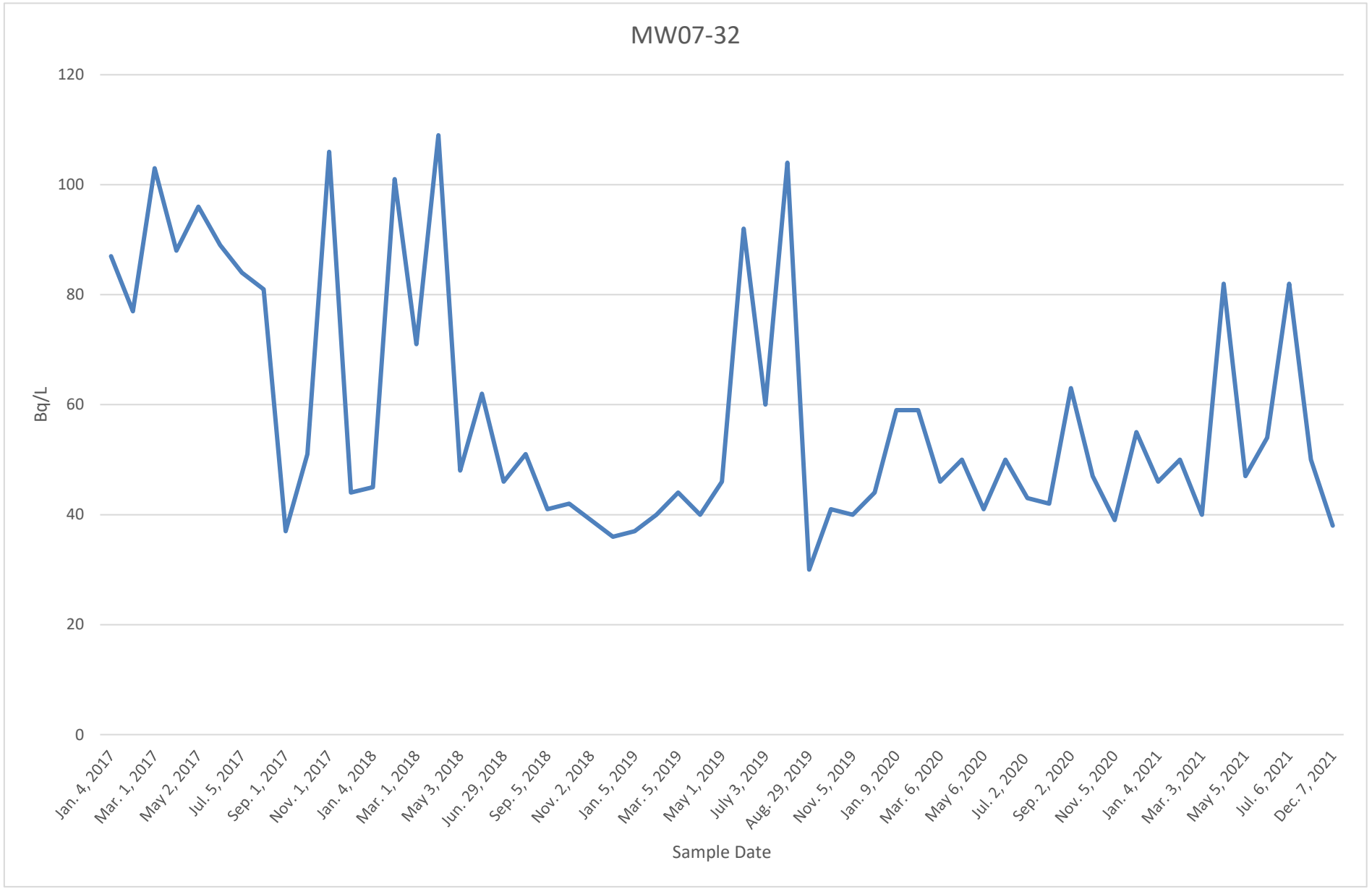
APPENDIX N

Groundwater Monitoring Data



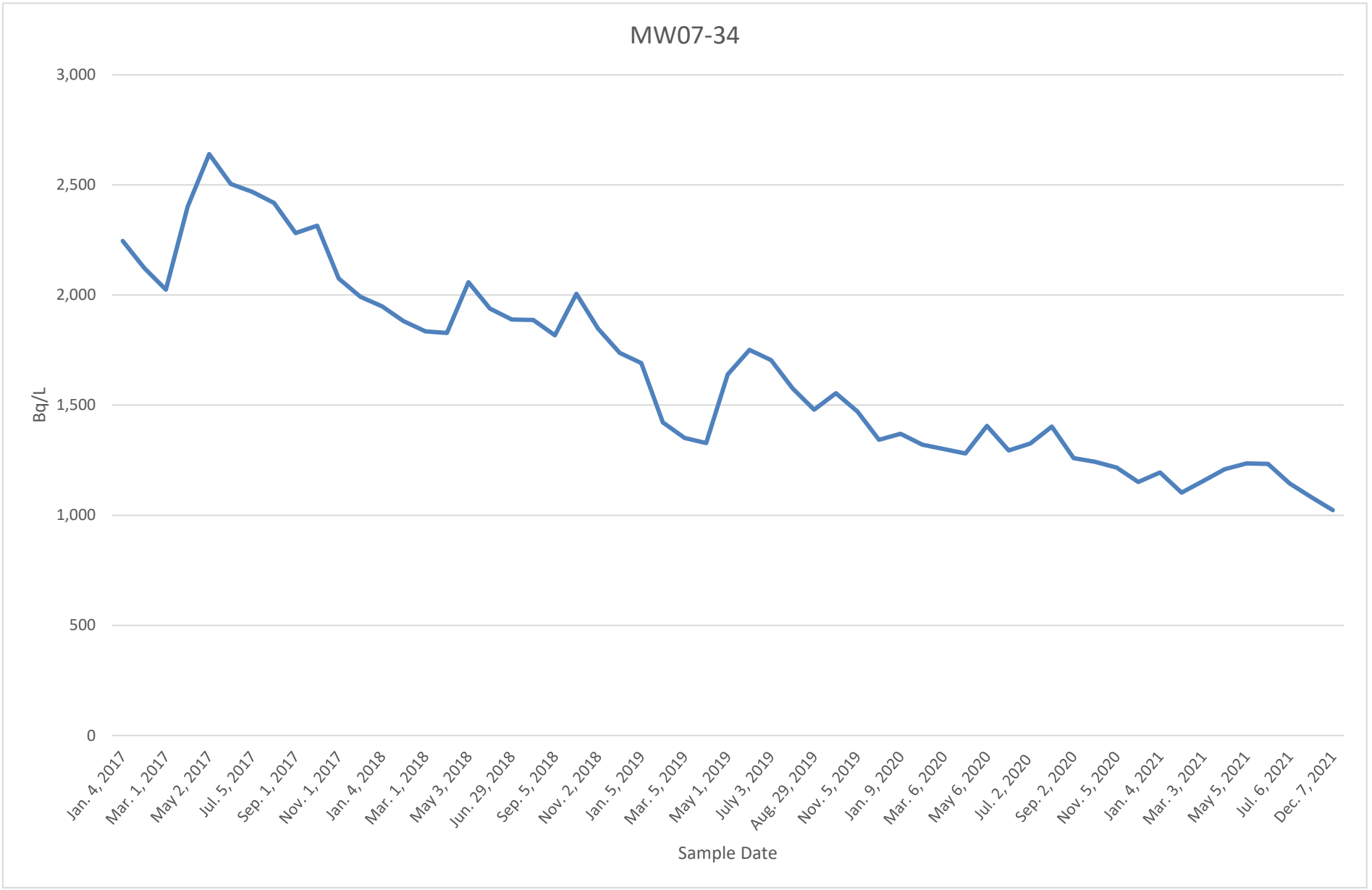
APPENDIX N

Groundwater Monitoring Data



APPENDIX N

Groundwater Monitoring Data



APPENDIX N

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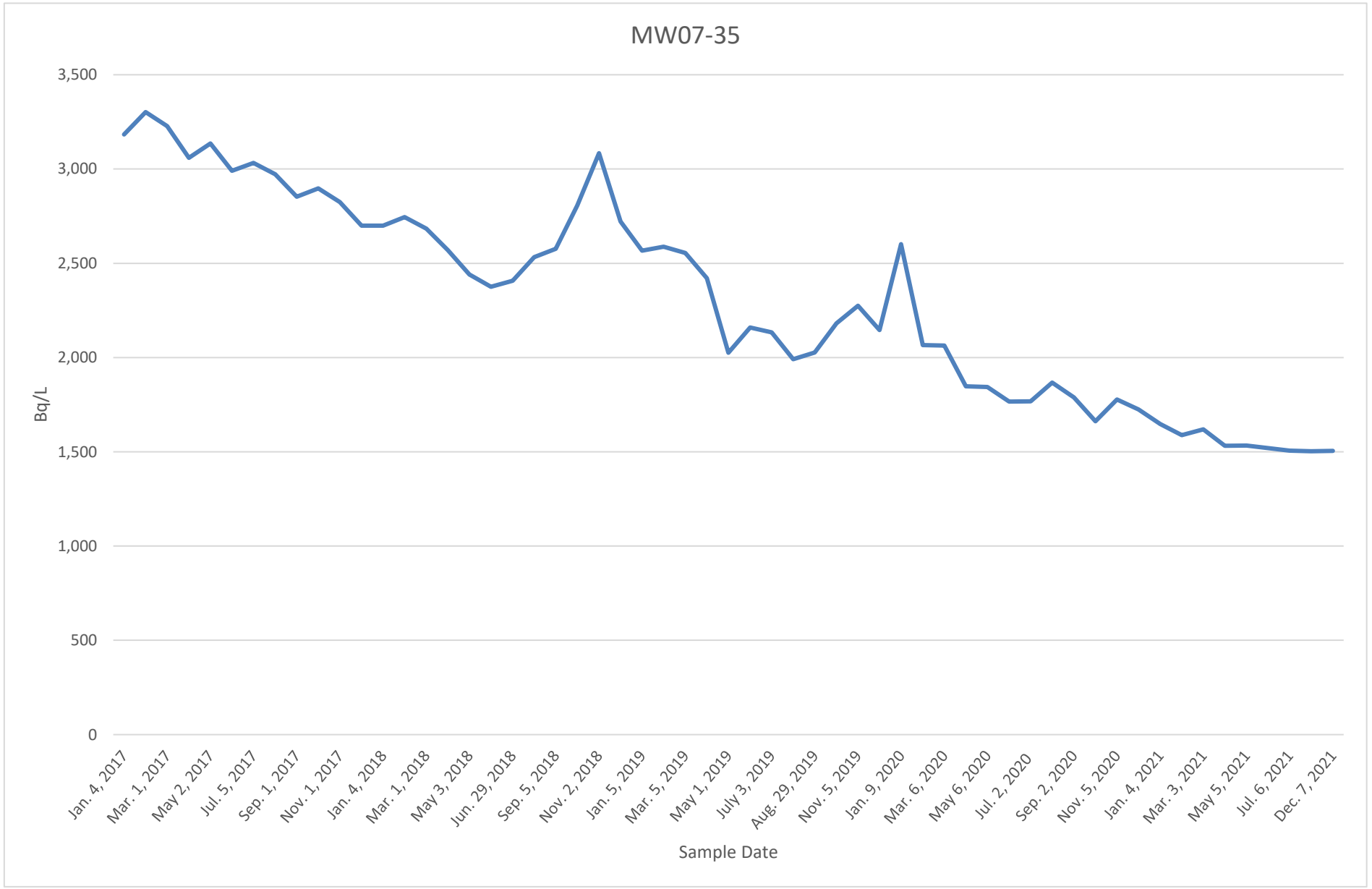
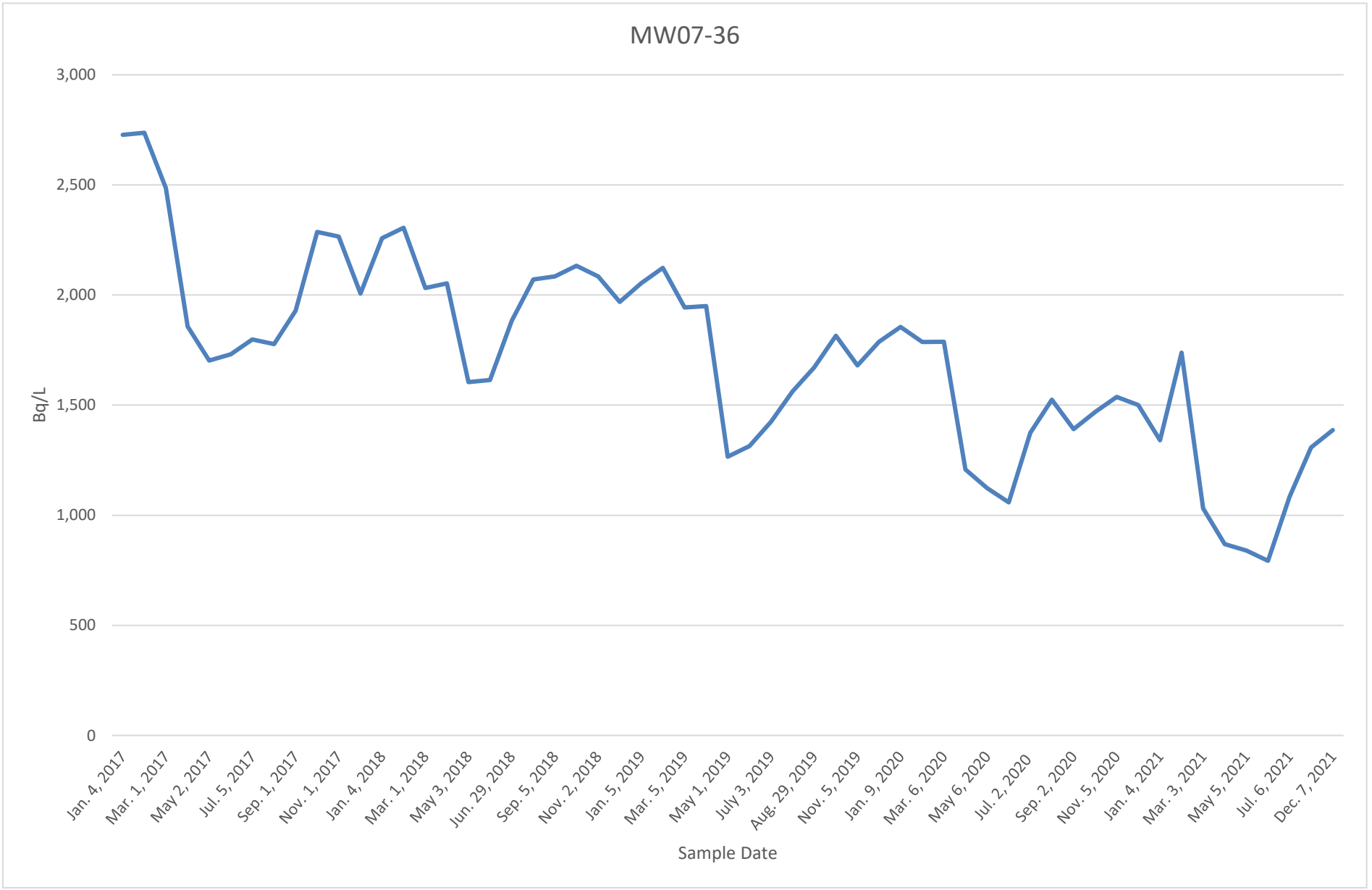


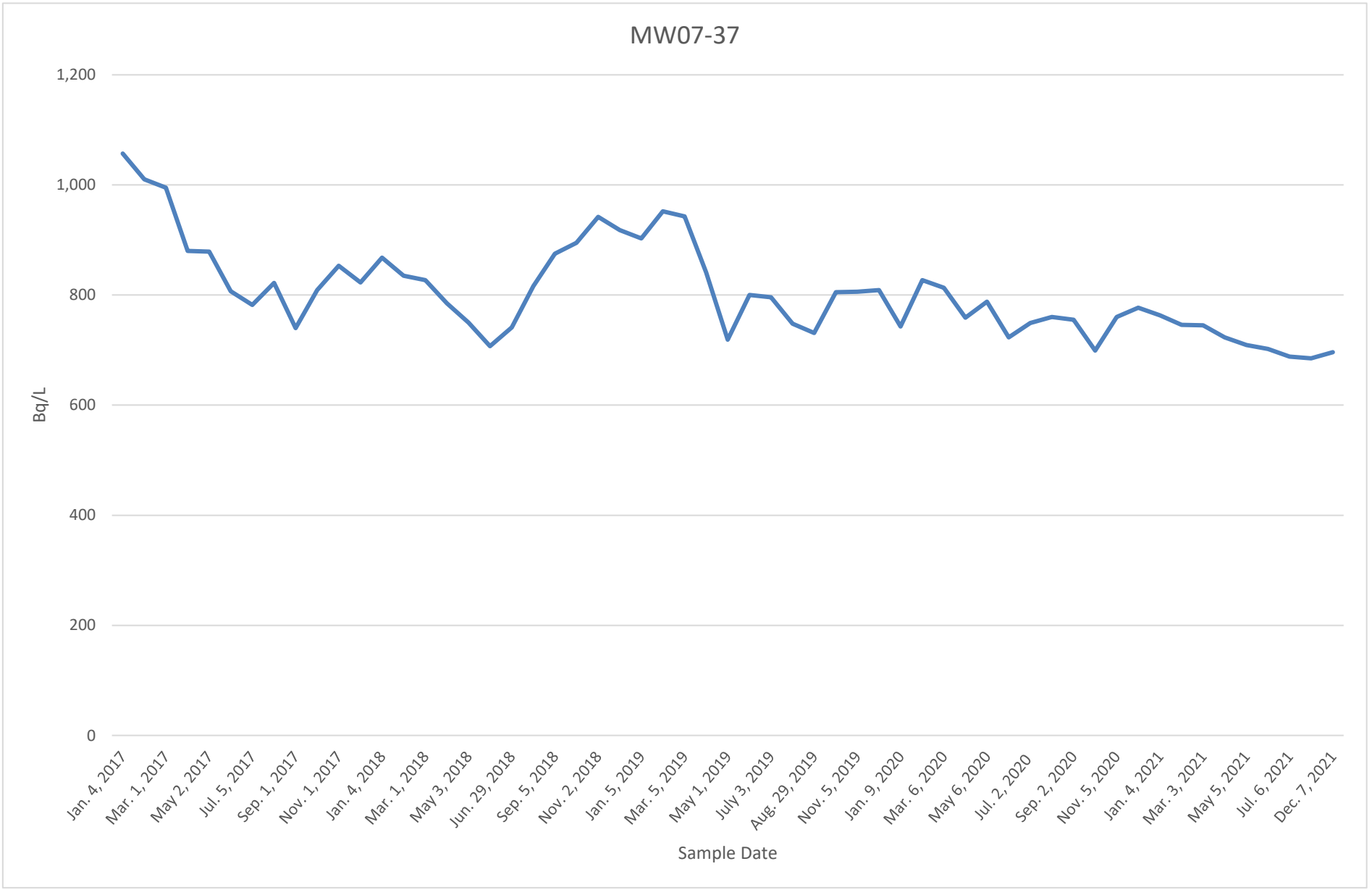
APPENDIX N

Groundwater Monitoring Data



APPENDIX N

Groundwater Monitoring Data



APPENDIX N

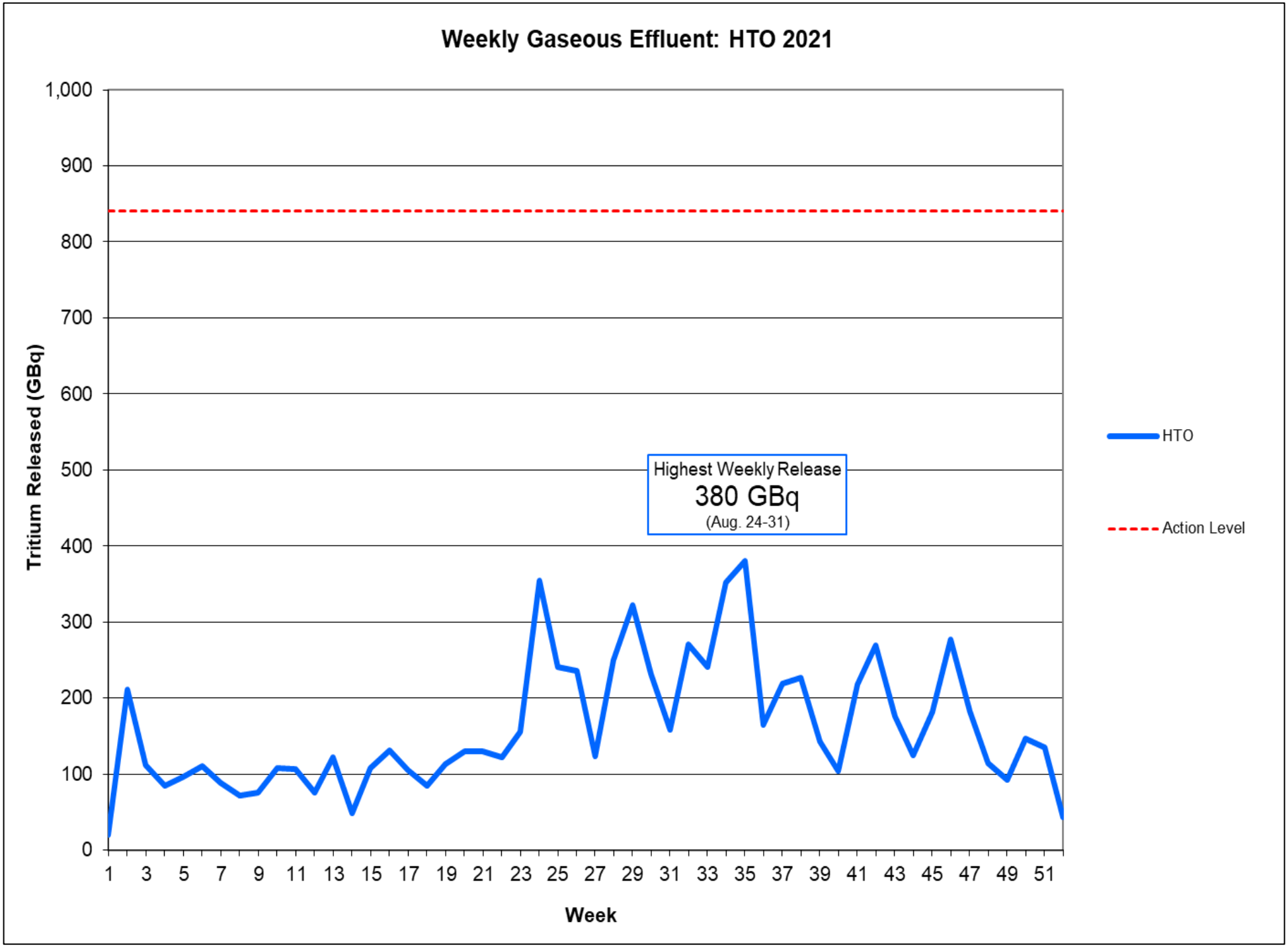
APPENDIX O

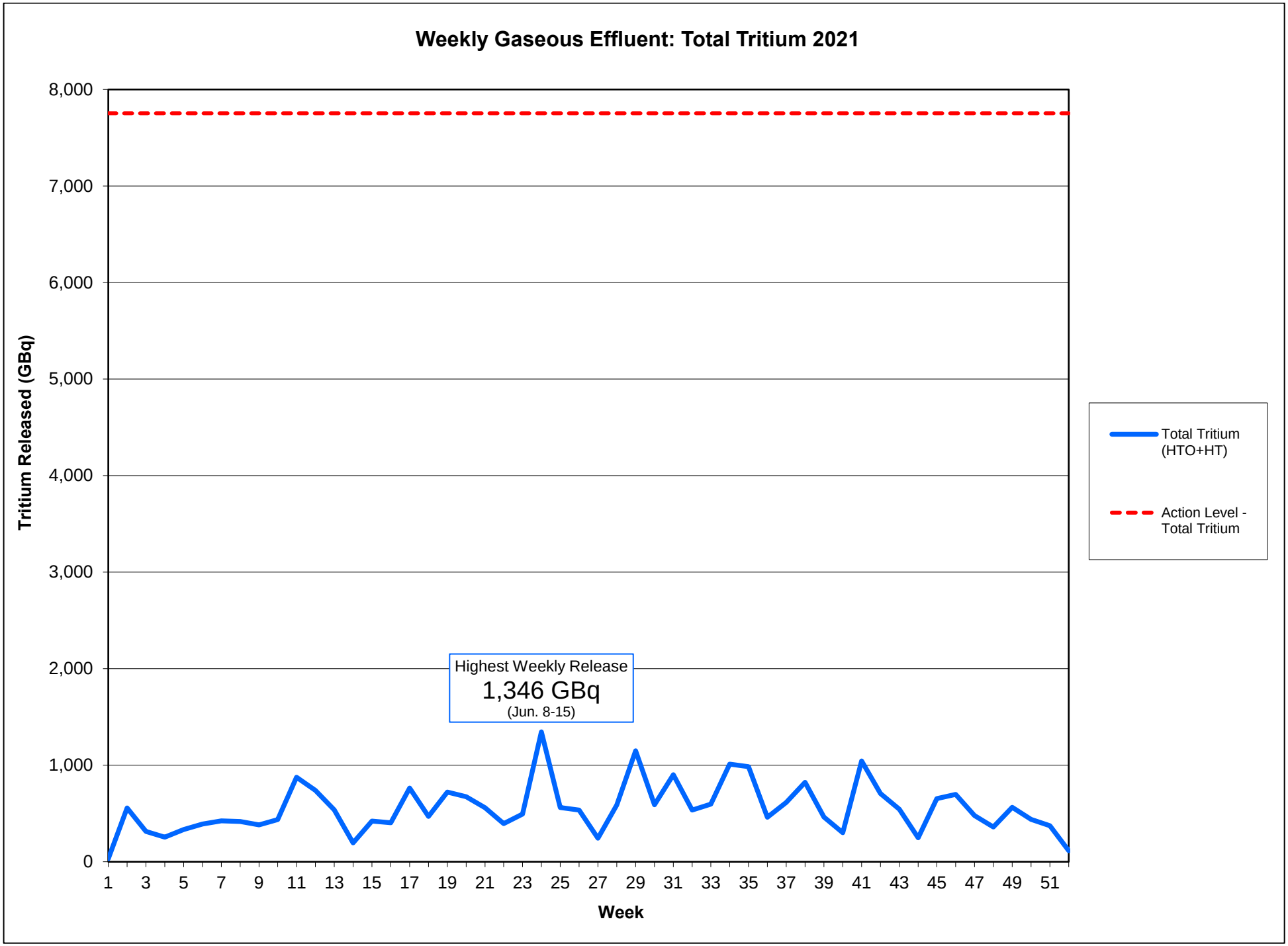
Gaseous Effluent Data

Gaseous Effluent Data

2021 Gaseous Effluent Data

Week	Date		H-3 in Air (GBq)			(GBq)		% 2021 SRBT DRL (12 hr. TJF Data)				Weekly Action Levels	
	Initial	Final	HTO	HT	Total	∑(HTO)	∑(HTO + HT)	1 year old	10 year old	Adult Resident	Adult Worker	HTO (840 GBq)	HTO+HT (7,753 GBq)
1	2020-12-29	2021-01-05	19.53	11.71	31.24	19.53	31.24	0.01	0.01	0.01	0.02	2%	0%
2	2021-01-05	2021-01-12	211.68	345.68	557.36	231.21	588.60	0.08	0.09	0.08	0.21	25%	7%
3	2021-01-12	2021-01-19	111.53	203.18	314.71	342.74	903.31	0.04	0.05	0.04	0.11	13%	4%
4	2021-01-19	2021-01-26	84.91	170.78	255.69	427.65	1159.00	0.03	0.04	0.03	0.08	10%	3%
5	2021-01-26	2021-02-02	95.99	237.99	333.98	523.64	1492.98	0.04	0.04	0.04	0.10	11%	4%
6	2021-02-02	2021-02-09	110.24	281.34	391.58	633.88	1884.56	0.04	0.05	0.04	0.11	13%	5%
7	2021-02-09	2021-02-16	88.47	335.23	423.70	722.35	2308.26	0.04	0.04	0.04	0.09	11%	5%
8	2021-02-16	2021-02-23	72.17	343.96	416.13	794.52	2724.39	0.03	0.03	0.03	0.08	9%	5%
9	2021-02-23	2021-03-02	75.72	307.25	382.97	870.24	3107.36	0.03	0.04	0.03	0.08	9%	5%
10	2021-03-02	2021-03-09	107.91	328.89	436.80	978.15	3544.16	0.04	0.05	0.04	0.11	13%	6%
11	2021-03-09	2021-03-16	107.03	768.70	875.73	1085.18	4419.89	0.05	0.05	0.05	0.12	13%	11%
12	2021-03-16	2021-03-23	74.98	664.03	739.01	1160.16	5158.90	0.04	0.04	0.04	0.09	9%	10%
13	2021-03-23	2021-03-30	122.15	414.69	536.84	1282.31	5695.74	0.05	0.06	0.05	0.12	15%	7%
14	2021-03-30	2021-04-06	49.05	146.31	195.36	1331.36	5891.10	0.02	0.02	0.02	0.05	6%	3%
15	2021-04-06	2021-04-13	108.48	313.02	421.50	1439.84	6312.60	0.04	0.05	0.04	0.11	13%	5%
16	2021-04-13	2021-04-20	131.71	272.42	404.13	1571.55	6716.73	0.05	0.06	0.05	0.13	16%	5%
17	2021-04-20	2021-04-27	104.90	659.12	764.02	1676.45	7480.75	0.05	0.05	0.05	0.12	12%	10%
18	2021-04-27	2021-05-04	84.75	384.08	468.83	1761.20	7949.58	0.03	0.04	0.04	0.09	10%	6%
19	2021-05-04	2021-05-11	112.69	609.51	722.20	1873.89	8671.78	0.05	0.05	0.05	0.12	13%	9%
20	2021-05-11	2021-05-18	129.72	543.15	672.87	2003.61	9344.65	0.05	0.06	0.06	0.14	15%	9%
21	2021-05-18	2021-05-25	129.36	430.56	559.92	2132.97	9904.57	0.05	0.06	0.05	0.13	15%	7%
22	2021-05-25	2021-06-01	122.35	272.46	394.81	2255.32	10299.38	0.05	0.05	0.05	0.12	15%	5%
23	2021-06-01	2021-06-08	155.59	338.93	494.52	2410.91	10793.90	0.06	0.07	0.06	0.15	19%	6%
24	2021-06-08	2021-06-15	354.05	991.63	1345.68	2764.96	12139.58	0.14	0.16	0.15	0.36	42%	17%
25	2021-06-15	2021-06-22	240.57	320.84	561.41	3005.53	12700.99	0.09	0.10	0.09	0.23	29%	7%
26	2021-06-22	2021-06-29	235.15	300.05	535.20	3240.68	13236.19	0.09	0.10	0.09	0.23	28%	7%
27	2021-06-29	2021-07-06	123.33	121.12	244.45	3364.01	13480.64	0.04	0.05	0.05	0.12	15%	3%
28	2021-07-06	2021-07-13	249.50	337.46	586.96	3613.51	14067.60	0.09	0.11	0.10	0.24	30%	8%
29	2021-07-13	2021-07-20	322.84	826.11	1148.95	3936.35	15216.55	0.12	0.14	0.13	0.32	38%	15%
30	2021-07-20	2021-07-27	231.71	359.21	590.92	4168.06	15807.47	0.08	0.10	0.09	0.22	28%	8%
31	2021-07-27	2021-08-03	158.21	743.47	901.68	4326.27	16709.15	0.06	0.08	0.07	0.17	19%	12%
32	2021-08-03	2021-08-10	269.97	264.86	534.83	4596.24	17243.98	0.10	0.11	0.10	0.26	32%	7%
33	2021-08-10	2021-08-17	241.47	356.05	597.52	4837.71	17841.50	0.09	0.10	0.09	0.23	29%	8%
34	2021-08-17	2021-08-24	351.35	659.04	1010.39	5189.06	18851.89	0.13	0.15	0.14	0.34	42%	13%
35	2021-08-24	2021-08-31	380.06	605.79	985.85	5569.12	19837.74	0.14	0.16	0.15	0.37	45%	13%
36	2021-08-31	2021-09-07	164.63	296.46	461.09	5733.75	20298.83	0.06	0.07	0.07	0.16	20%	6%
37	2021-09-07	2021-09-14	218.76	395.30	614.06	5952.51	20912.89	0.08	0.10	0.09	0.21	26%	8%
38	2021-09-14	2021-09-21	226.19	596.89	823.08	6178.70	21735.97	0.09	0.10	0.09	0.23	27%	11%
39	2021-09-21	2021-09-28	143.02	320.83	463.85	6321.72	22199.82	0.05	0.06	0.06	0.14	17%	6%
40	2021-09-28	2021-10-05	104.38	197.07	301.45	6426.10	22501.27	0.04	0.05	0.04	0.10	12%	4%
41	2021-10-05	2021-10-12	217.17	827.90	1045.07	6643.27	23546.34	0.09	0.10	0.09	0.22	26%	13%
42	2021-10-12	2021-10-19	269.28	438.23	707.51	6912.55	24253.85	0.10	0.12	0.11	0.26	32%	9%
43	2021-10-19	2021-10-26	176.59	368.63	545.22	7089.14	24799.07	0.07	0.08	0.07	0.17	21%	7%
44	2021-10-26	2021-11-02	124.78	124.44	249.22	7213.92	25048.29	0.04	0.05	0.05	0.12	15%	3%
45	2021-11-02	2021-11-09	180.85	472.59	653.44	7394.77	25701.73	0.07	0.08	0.07	0.18	22%	8%
46	2021-11-09	2021-11-16	277.25	421.42	698.67	7672.02	26400.40	0.10	0.12	0.11	0.27	33%	9%
47	2021-11-16	2021-11-23	182.71	296.11	478.82	7854.73	26879.22	0.07	0.08	0.07	0.18	22%	6%
48	2021-11-23	2021-11-30	113.86	246.45	360.31	7968.59	27239.53	0.04	0.05	0.05	0.11	14%	5%
49	2021-11-30	2021-12-07	92.77	470.49	563.26	8061.36	27802.79	0.04	0.04	0.04	0.10	11%	7%
50	2021-12-07	2021-12-14	146.93	291.60	438.53	8208.29	28241.32	0.05	0.06	0.06	0.14	17%	6%
51	2021-12-14	2021-12-21	135.55	237.60	373.15	8343.84	28614.47	0.05	0.06	0.05	0.13	16%	5%
52	2021-12-21	2021-12-28	43.60	70.93	114.53	8387.44	28729.00	0.02	0.02	0.02	0.04	5%	1%
	Annual Total		8387.44	20341.56	28729.00					Average % DRL			
	Weekly Average		161.30	391.18	552.48			0.06	0.07	0.07	0.16		
				Limit (Bq/a)	% Limit (2021)					Projected Dose (uSv/a)			
% Annual Release Limit:		HTO		6.72E+13	12.48			0.61	0.72	0.65	1.60		
		HTO + HT		4.48E+14	6.41			1 year old	10 year old	Adult Resident	Adult Worker		
Derived Weekly HTO Release/Emission Limit (GBq/week)								2.90E+05	2.45E+05	2.71E+05	1.08E+05		
Derived Weekly HT Release/ Emission Limit (GBq/week)								7.24E+06	6.83E+06	6.90E+06	3.63E+06		


Weekly Gaseous Effluent: HTO 2021
Tritium Released (GBq)
1,000
900
800
700
600
500
400
300
200
100
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51
Week
Highest Weekly Release
380 GBq
(Aug. 24-31)
HTO
Action Level


Weekly Gaseous Effluent: Total Tritium 2021
Tritium Released (GBq)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51
Week
Highest Weekly Release
1,346 GBq
(Jun. 8-15)
Total Tritium (HTO+HT)
Action Level - Total Tritium

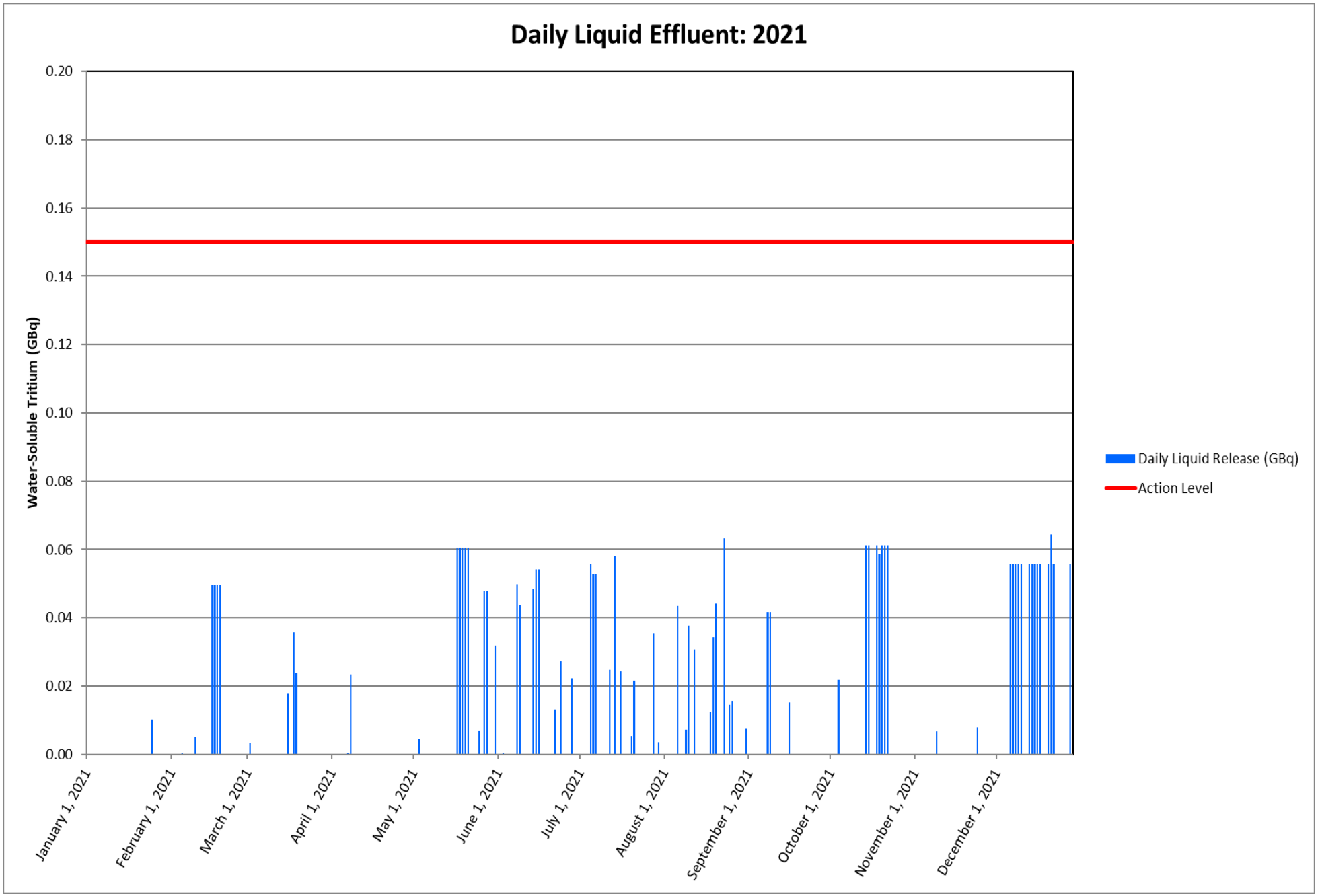
APPENDIX P

Liquid Effluent Data

Liquid Effluent Data

ANNUAL LIQUID EFFLUENT TRACKING TABLE		
Year = 2021		
WEEK ENDING	**WEEKLY RELEASE (Bq)**	**WEEK**
10-Jan-21	206,080	1
17-Jan-21	0	2
24-Jan-21	0	3
31-Jan-21	10,098,333	4
7-Feb-21	330,933	5
14-Feb-21	5,205,417	6
21-Feb-21	198,824,112	7
28-Feb-21	0	8
7-Mar-21	3,530,093	9
14-Mar-21	0	10
21-Mar-21	77,420,867	11
28-Mar-21	0	12
4-Apr-21	0	13
11-Apr-21	23,639,507	14
18-Apr-21	0	15
25-Apr-21	0	16
2-May-21	0	17
9-May-21	4,639,783	18
16-May-21	0	19
23-May-21	302,550,300	20
30-May-21	102,531,800	21
6-Jun-21	32,167,087	22
13-Jun-21	93,356,120	23
20-Jun-21	156,927,511	24
27-Jun-21	40,452,580	25
4-Jul-21	22,277,640	26
11-Jul-21	161,186,847	27
18-Jul-21	107,344,267	28
25-Jul-21	26,930,207	29
1-Aug-21	39,038,160	30
8-Aug-21	43,531,400	31
15-Aug-21	75,652,867	32
22-Aug-21	90,995,660	33
29-Aug-21	93,531,240	34
5-Sep-21	7,654,813	35
12-Sep-21	83,287,348	36
19-Sep-21	15,181,807	37
26-Sep-21	0	38
3-Oct-21	0	39
10-Oct-21	21,743,787	40
17-Oct-21	122,245,620	41
24-Oct-21	303,259,633	42
31-Oct-21	0	43
7-Nov-21	0	44
14-Nov-21	6,825,690	45
21-Nov-21	0	46
28-Nov-21	7,986,207	47
5-Dec-21	0	48
12-Dec-21	278,638,515	49
19-Dec-21	278,638,515	50
26-Dec-21	175,919,689	51
2-Jan-22	55,727,703	52
		53
Annual Total (Bq)	3,069,478,138	
Annual Total (GBq)	3.07	
Limit (GBq)	200	
% of limit	**1.53**	

Liquid Effluent Data



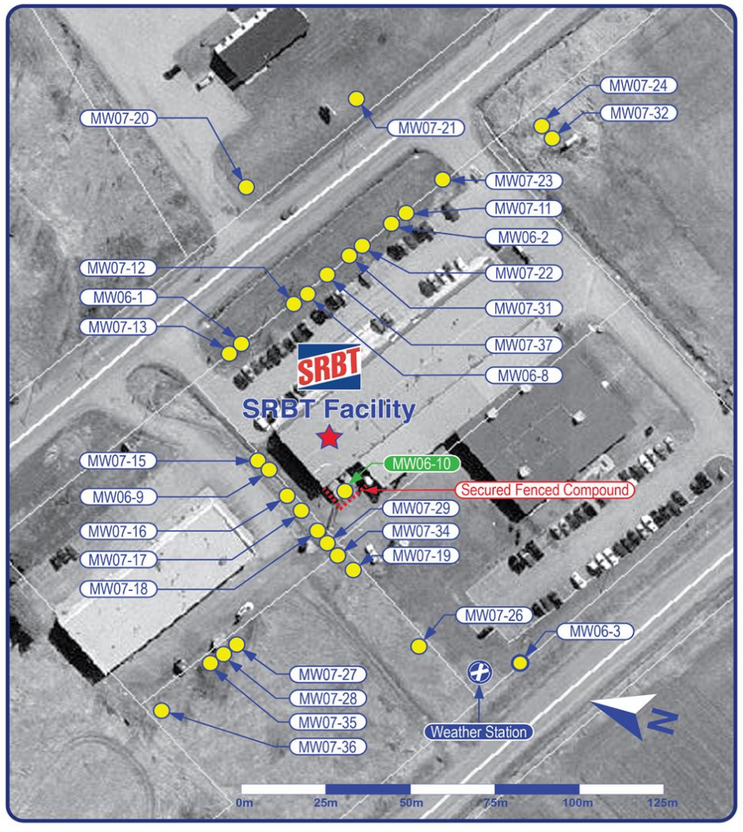
APPENDIX P

APPENDIX Q

Groundwater Monitoring Well Level Data

Groundwater Monitoring Well Level Data

	MW06-1	MW06-2	MW06-3	MW06-8	MW06-9	MW06-10	MW07-11	MW07-12	MW07-13	MW07-15	MW07-16	MW07-17	MW07-18	MW07-19	MW07-20	MW07-21	MW07-22	MW07-23	MW07-24	MW07-26	MW07-27	MW07-28	MW07-29	MW07-31	MW07-32	MW07-34	MW07-35	MW07-36	MW07-37
Easting	335449	335478	335363	335464	335401	335408	335478	335465	335448	335403	335393	335392	335387	335378	335296	335522	335472	335492	335519	335357	335354	335352	335384	335471	335517	335393	335354	335338	335468
Northing	5074615	5074578	5074535	5074590	5074605	5074506	5074576	5074588	5074616	5074605	5074599	5074599	5074595	5074587	5074616	5074584	5074584	5074560	5074530	5074567	5074611	5074612	5074592	5074583	5074530	5074591	5074613	5074629	5074589
TOP Elevation (m)	130.99	130.03	133.09	130.30	131.15	131.32	130.06	130.41	130.92	130.84	130.98	131.08	131.23	131.61	130.70	129.51	130.25	130.04	129.03	132.42	132.89	132.71	131.09	130.16	128.86	131.12	132.89	133.10	130.06
GS Elevation (m)	130.17	129.24	132.32	129.58	129.86	130.24	129.15	129.58	130.03	129.93	130.16	130.16	130.37	130.79	129.85	128.78	129.05	129.29	128.22	131.85	132.02	132.04	130.57	129.38	128.23	130.71	132.16	132.31	129.47
Well Diameter (m)	0.051	0.051	0.051	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.051	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
Well Depth (m)	5.165	5.330	6.130	6.700	5.930	7.770	7.215	7.450	6.615	7.230	7.050	14.610	7.250	7.400	7.820	7.580	7.465	5.905	6.525	7.310	8.330	14.400	13.000	13.240	13.090	9.110	9.390	9.330	8.590
Stick-up (m)	0.820	0.788	0.767	0.720	1.290	1.077	0.905	0.835	0.893	0.910	0.822	0.915	0.868	0.815	0.850	0.730	1.200	0.750	0.810	0.570	0.870	0.670	0.520	0.780	0.630	0.410	0.730	0.790	0.590
dd/mm/yy	All levels expressed in metres above sea level (masl)																												
05-Jan-21	128.44	127.93	128.24	127.20	128.55	127.72	127.06	127.13	127.09	128.11	128.00	123.48	128.00	128.19	126.65	126.11	127.04	127.45	126.73	128.12	127.72	123.51	123.53	122.26	122.29	127.12	127.34	126.29	127.26
02-Feb-21	127.11	126.99	127.05	126.06	127.05	126.53	126.14	126.03	125.71	126.49	126.40	122.13	126.53	126.55	125.13	124.57	125.95	126.72	126.00	126.32	125.71	122.22	122.20	121.06	121.04	125.52	125.49	124.80	126.18
04-Mar-21	126.89	126.53	127.03	125.60	126.15	126.57	125.76	125.65	125.57	126.64	126.52	121.39	126.47	126.56	124.18	124.06	125.56	126.28	125.76	126.07	126.18	121.51	121.69	120.32	120.26	125.48	125.97	125.25	125.80
07-Apr-21	129.09	128.15	128.08	127.99	129.68	129.39	127.96	128.00	128.09	129.45	129.47	124.33	129.59	129.69	127.42	126.95	127.88	128.13	127.28	129.96	129.52	124.36	124.34	123.04	123.07	128.56	129.16	128.23	128.11
04-May-21	129.09	127.97	129.17	127.93	129.52	129.17	127.93	127.92	127.92	129.23	129.19	123.78	129.28	129.36	127.20	126.41	127.81	128.13	127.20	129.33	129.78	123.96	123.90	121.96	121.98	128.23	128.71	127.63	128.06
01-Jun-21	128.70	127.55	128.07	127.27	129.06	128.52	127.28	127.26	127.28	128.60	128.53	123.13	128.57	128.62	126.25	125.21	127.16	127.51	126.52	128.44	128.38	123.31	123.31	121.40	121.39	127.56	128.00	126.95	127.40
05-Jul-21	128.79	127.60	129.06	127.36	129.02	128.42	127.37	127.34	127.27	128.51	128.42	123.08	128.38	128.55	126.56	126.07	127.23	127.70	126.78	128.50	127.92	123.06	123.07	122.36	122.33	127.23	127.52	126.31	127.46
08-Sep-21	127.70	127.19	127.02	126.18	127.46	126.84	126.25	126.13	125.86	126.86	126.77	121.83	126.70	126.84	124.76	123.97	126.04	126.71	125.85	126.35	125.90	121.94	121.94	120.62	120.58	125.58	125.68	124.87	126.29
06-Dec-21	128.09	127.65	127.56	126.68	127.81	127.25	126.72	126.61	126.32	126.17	126.15	122.24	127.23	127.24	125.48	125.28	126.51	127.34	126.69	126.91	126.29	122.45	122.45	121.20	120.98	126.00	126.05	125.24	126.84

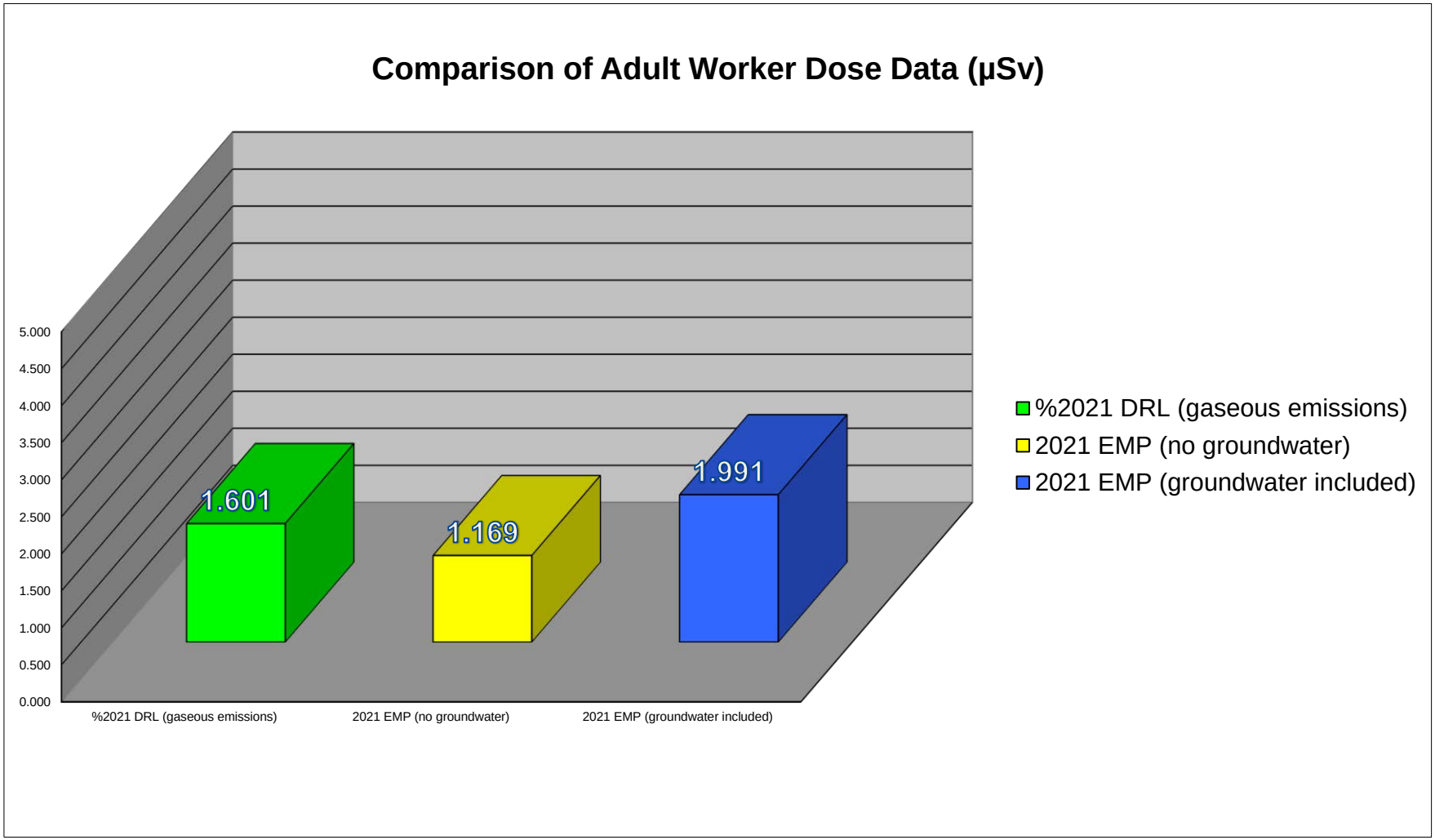


APPENDIX R

Public Dose Data

Public Dose Data
ADULT WORKER

Dose Calculation	2021 µSv
%2021 DRL (gaseous emissions)	1.601
2021 EMP (no groundwater)	1.169
2021 EMP (groundwater included)	1.991



Public Dose Data
ADULT WORKER

Stack Emissions

	2021 Emissions as %2021 SRBT DRL	
	ADULT WORKER	
Sample End	% weekly DRL	(uSv)
2021-01-05	0.02	0.0035
2021-01-12	0.21	0.0395
2021-01-19	0.11	0.0209
2021-01-26	0.08	0.0160
2021-02-02	0.10	0.0184
2021-02-09	0.11	0.0211
2021-02-16	0.09	0.0175
2021-02-23	0.08	0.0147
2021-03-02	0.08	0.0151
2021-03-09	0.11	0.0210
2021-03-16	0.12	0.0231
2021-03-23	0.09	0.0169
2021-03-30	0.12	0.0239
2021-04-06	0.05	0.0095
2021-04-13	0.11	0.0210
2021-04-20	0.13	0.0249
2021-04-27	0.12	0.0222
2021-05-04	0.09	0.0171
2021-05-11	0.12	0.0233
2021-05-18	0.14	0.0260
2021-05-25	0.13	0.0253
2021-06-01	0.12	0.0232
2021-06-08	0.15	0.0295
2021-06-15	0.36	0.0683
2021-06-22	0.23	0.0445
2021-06-29	0.23	0.0435
2021-07-06	0.12	0.0226
2021-07-13	0.24	0.0462
2021-07-20	0.32	0.0619
2021-07-27	0.22	0.0432
2021-08-03	0.17	0.0321
2021-08-10	0.26	0.0495
2021-08-17	0.23	0.0449
2021-08-24	0.34	0.0661
2021-08-31	0.37	0.0709
2021-09-07	0.16	0.0309
2021-09-14	0.21	0.0410
2021-09-21	0.23	0.0434
2021-09-28	0.14	0.0272
2021-10-05	0.10	0.0196
2021-10-12	0.22	0.0431
2021-10-19	0.26	0.0503
2021-10-26	0.17	0.0334
2021-11-02	0.12	0.0229
2021-11-09	0.18	0.0347
2021-11-16	0.27	0.0516
2021-11-23	0.18	0.0341
2021-11-30	0.11	0.0216
2021-12-07	0.10	0.0190
2021-12-14	0.14	0.0277
2021-12-21	0.13	0.0254
2021-12-28	0.04	0.0081
Sum (uSv)		**1.601**
Ave. (%DRL)	**0.16**	
Annual Dose Est.	**1.601 uSv/a**	

Public Dose Data
ADULT WORKER
EMP Factors for Dose

Pathways Analysis of Dose to the Public			
		per annum	
Atmospheric HTO inhalation, immersion	P(i)19, P(e)19	0.784	
Surface HTO ingestion	P(i)29	0.822	
Surface HTO immersion	P(e)29	0.000	
External soil exposure	P39	0.000	
Forage & crop ingestion	P49	0.370	
Animal produce ingestion	P59	0.015	
Aquatic animal ingestion	P69	0.000	
Aquatic plant ingestion	P79	0.000	
External sediment exposure	P89	0.000	
Total (uSv)		**1.991**	**uSv/a**
Total without P_{29} (uSv)		**1.169**	**uSv/a**

Public Dose Data
ADULT WORKER
EMP Factors for Dose P19

P19 is the transfer pathway of exposure to HTO from compartment 1 (Atmosphere) to 9 (dose)
P(i)19 is the pathway of exposure due to inhalation of HTO, and also implicitly captures skin absorption dose P(e)19 as per CSA N288.1-14 Table C.1.

Formula:
P(i)19 (uSv) = [HTO]air (Bq/m3) x Inhalation (m3) x DCF (uSv/Bq)

Calculation:

PAS # (#)	P(i)19 (uSv)	[HTO]air (Bq/m^3)	Volume (m^3)	(uSv/Bq)	(uSv/a)	(uSv/a)	(uSv/a)	Maximum (uSv/a)
1	0.348	5.820	1994.496	3.000E-05	0.348			
2	0.216	3.610	1994.496	3.000E-05		0.216		
3	0.000			3.000E-05				
4	0.436	2.270	6405.504	3.000E-05	0.436	0.436	0.436	
5	0.000			3.000E-05				
6	0.000			3.000E-05				
7	0.000			3.000E-05				
8	0.000			3.000E-05				
9	0.000			3.000E-05				
10	0.000			3.000E-05				
11	0.000			3.000E-05				
12	0.000			3.000E-05				
13	0.199	3.320	1994.496	3.000E-05			0.199	
			P(i)19	**Sum**	**0.784**	**0.652**	**0.635**	**0.784** **uSv/a**

Public Dose Data
ADULT WORKER
EMP Factors for Dose P29

P29 is the transfer pathway of exposure to HTO from compartment 2 (Surface Water) to 9 (Dose)
P(i)29 is the pathway of exposure due to ingestion of HTO
P(e)29 is the pathway of exposure due to immersion in HTO

Formula:
P(i)29 = [HTO] (Bq/L) x Ingestion (L) x DCF (uSv/Bq)

Well	P(i)29 (uSv/a)	[HTO]well (Bq/L)	Ingestion (L/a)	DCF (uSv/Bq)
2	0.778	36	1081.1	2.00E-05
3	0.822	38	1081.1	2.00E-05
5	0.123	6	1081.1	2.00E-05
6	0.094	4	1081.1	2.00E-05
7	0.097	5	1081.1	2.00E-05
Avg P(i)29	**0.383**	**uSv/annum**		

Date	Well 2 (Bq/L)	Well 3 (Bq/L)	Well 5 (Bq/L)	Well 6 (Bq/L)	Well 7 (Bq/L)
March 3, 2021	41	28	7	4	No sample
July 6, 2021	32	44	5	4	4
September 3, 2021	35	42	5	5	5
Average	**36**	**38**	**6**	**4**	**5**

Well 2	185 Mud Lake Road
Well 3	183 Mud Lake Road
Well 5	171 Sawmill Road
Well 6	40987 Highway 41
Well 7	40925 Highway 41

Well 3	**P(i)29**	**0.822**	**uSv/a**
	P(e)29	**0.000**	**uSv/a**
	P29	**0.822**	**uSv/a**

P(e)29 is the pathway of exposure to HTO due to immersion in surface water, and is negligible.

Public Dose Data
ADULT WORKER
EMP Factors for Dose P49

P49 is the pathway for exposure to HTO due to ingestion of forage and crops.

Produce Sample Results (Bq free water tritium / kg fresh weight)											
Source	**Farm Gate Market 11133 Round Lake Road**					**Residences**					
Type	**Tomato**	**Pumpkin**	**Carrot**		**Average**	**LOCATION**	**Tomato**	**Apple**	**Pepper**	**Herbs**	**Average**
	4	4	3		**3.7**	413 SWEEZEY COURT	67	52	55	18	48.0
						406 BOUNDARY ROAD		63			63.0
						408 BOUNDARY ROAD	117				**117.0**
						611 MOSS DRIVE	53				53.0
Average					3.7		79.0	57.5	55.0	18.0	60.7
Produce Sample Results (Bq organically bound tritium / kg fresh weight)											
Comm.	4				**4.0**	408 BOUNDARY ROAD	1.0				**1.0**

Produce Consumption						
100%=	**413.300**	**kg/a**	**[HTO] (Bq/kg)**	**(Bq/a)**	**[OBT] (Bq/kg)**	**(Bq/a)**
70%	289.310	**kg/a**	3.7	1060.80	4.0	1157.24
30%	123.990	**kg/a**	117.0	14506.83	1.0	123.99

P49 = [HTO or OBT]produce (Bq/kg) x Produce Ingested (kg/mo) x DCF (uSv/Bq)

P49 (uSv/a)	[HTO] pro (Bq/a)	DCF (uSv/Bq)	[OBT] pro (Bq/a)	DCF (uSv/Bq)
0.370	**15567.63**	2.00E-05	**1281.23**	4.60E-05

P49	**0.370**	**uSv/a**

Public Dose Data
ADULT WORKER
EMP Factors for Dose P59

P59 is the exposure to HTO due to ingestion of animal produce.

2021 Sample Results

Local Producer	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

Local Distributor	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

TOTAL AVERAGE	**4.00**	Bq/L

Milk Density Adjustment		
Milk Average (Bq/L) x Milk density (L/kg)		
Bq/L	**L/kg**	**Bq/kg**
4.00	0.97	**3.880**

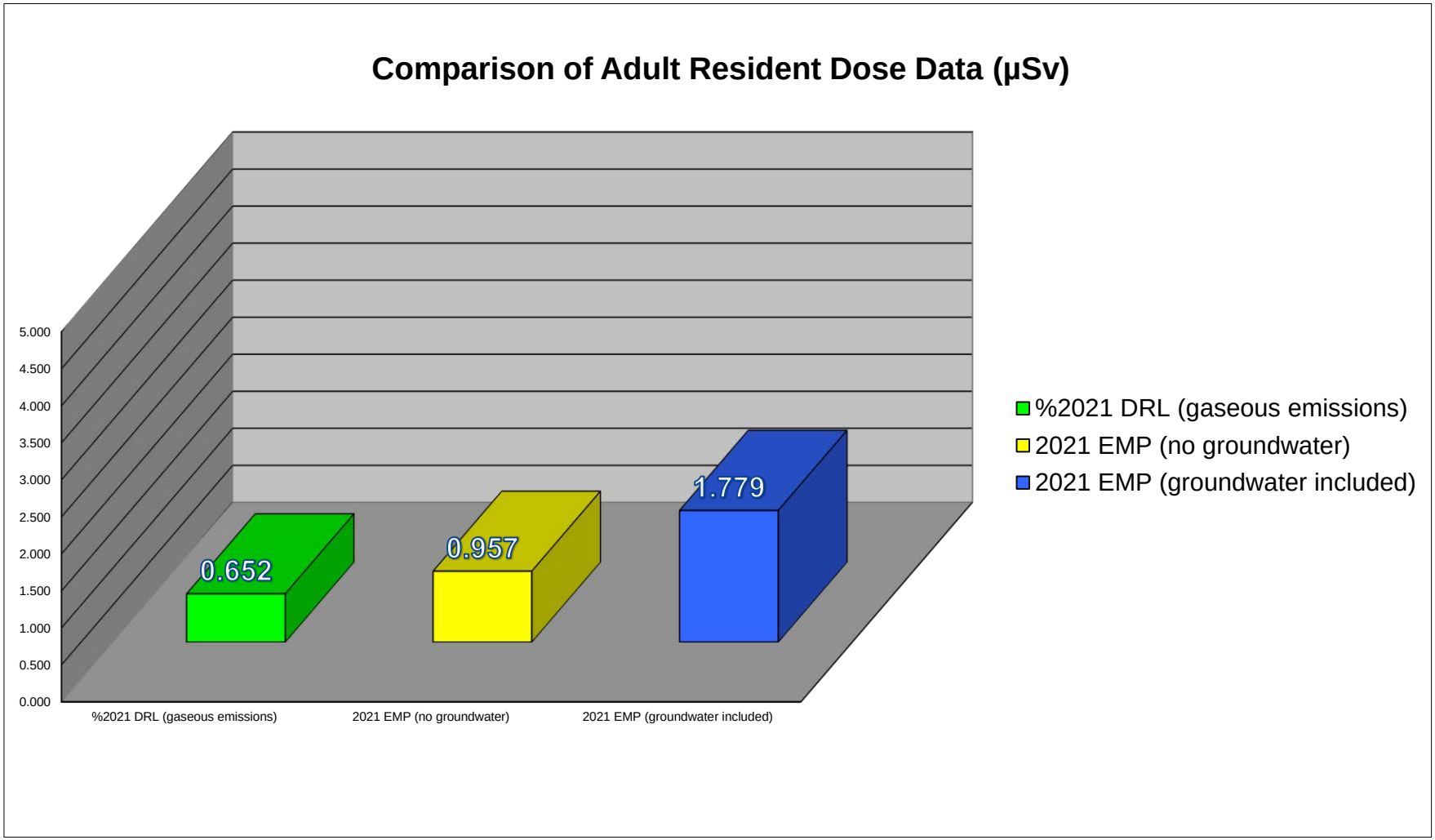
Consumption		
kg/da x da/a = kg/a		
(kg/da)	**(da/a)**	**(kg/a)**
0.516	365.25	**188.5**

P59 = [HTO]animal produce (Bq/kg) x Ingestion (kg) x DCF				
P59	**[HTO]**	**Ingested**	**DCF**	
(uSv/a)	**(Bq/kg)**	**(kg/a)**	**(uSv/Bq)**	
0.015	**3.88**	**188.5**	2.00E-05	

P59	**0.015**	**uSv/a**

Public Dose Data
ADULT RESIDENT

Dose Calculation	2021 µSv
%2021 DRL (gaseous emissions)	0.652
2021 EMP (no groundwater)	0.957
2021 EMP (groundwater included)	1.779



Public Dose Data
ADULT RESIDENT

Stack Emissions

	2021 Emissions as %2021 SRBT DRL	
	ADULT RESIDENT	
Sample End	% weekly DRL	(uSv)
2021-01-05	0.01	0.0014
2021-01-12	0.08	0.0160
2021-01-19	0.04	0.0085
2021-01-26	0.03	0.0065
2021-02-02	0.04	0.0075
2021-02-09	0.04	0.0086
2021-02-16	0.04	0.0072
2021-02-23	0.03	0.0061
2021-03-02	0.03	0.0062
2021-03-09	0.04	0.0086
2021-03-16	0.05	0.0097
2021-03-23	0.04	0.0072
2021-03-30	0.05	0.0098
2021-04-06	0.02	0.0039
2021-04-13	0.04	0.0086
2021-04-20	0.05	0.0101
2021-04-27	0.05	0.0093
2021-05-04	0.04	0.0071
2021-05-11	0.05	0.0097
2021-05-18	0.06	0.0107
2021-05-25	0.05	0.0104
2021-06-01	0.05	0.0094
2021-06-08	0.06	0.0120
2021-06-15	0.15	0.0279
2021-06-22	0.09	0.0180
2021-06-29	0.09	0.0175
2021-07-06	0.05	0.0091
2021-07-13	0.10	0.0186
2021-07-20	0.13	0.0252
2021-07-27	0.09	0.0174
2021-08-03	0.07	0.0133
2021-08-10	0.10	0.0199
2021-08-17	0.09	0.0181
2021-08-24	0.14	0.0268
2021-08-31	0.15	0.0287
2021-09-07	0.07	0.0125
2021-09-14	0.09	0.0166
2021-09-21	0.09	0.0177
2021-09-28	0.06	0.0110
2021-10-05	0.04	0.0080
2021-10-12	0.09	0.0177
2021-10-19	0.11	0.0203
2021-10-26	0.07	0.0136
2021-11-02	0.05	0.0092
2021-11-09	0.07	0.0142
2021-11-16	0.11	0.0208
2021-11-23	0.07	0.0138
2021-11-30	0.05	0.0088
2021-12-07	0.04	0.0079
2021-12-14	0.06	0.0112
2021-12-21	0.05	0.0103
2021-12-28	0.02	0.0033
Sum (uSv)		**0.652**
Ave. (%DRL)	**0.07**	
Annual Dose Est.	**0.652 uSv/a**	

Public Dose Data
ADULT RESIDENT
EMP Factors for Dose

Pathways Analysis of Dose to the Public			
		per annum	
Atmospheric HTO inhalation, immersion	P(i)19, P(e)19	0.572	
Surface HTO ingestion	P(i)29	0.822	
Surface HTO immersion	P(e)29	0.000	
External soil exposure	P39	0.000	
Forage & crop ingestion	P49	0.370	
Animal produce ingestion	P59	0.015	
Aquatic animal ingestion	P69	0.000	
Aquatic plant ingestion	P79	0.000	
External sediment exposure	P89	0.000	
Total (uSv)		**1.779**	**uSv/a**
Total without P_{29} (uSv)		**0.957**	**uSv/a**

Public Dose Data
ADULT RESIDENT
EMP Factors for Dose P19

P19 is the transfer pathway of exposure to HTO from compartment 1 (Atmosphere) to 9 (dose)
P(i)19 is the pathway of exposure due to inhalation of HTO, and also implicitly captures skin absorption dose P(e)19 as per CSA N288.1-14 Table C.1.

Formula:
P(i)19 (uSv) = [HTO]air (Bq/m3) x Inhalation (m3) x DCF (uSv/Bq)

Calculation:

PAS # (#)	P(i)19 (uSv)	[HTO]air (Bq/m^3)	Volume (m^3)	(uSv/Bq)	(uSv/a)	(uSv/a)	(uSv/a)	Maximum (uSv/a)	
1	0.000			3.000E-05					
2	0.000			3.000E-05					
3	0.000			3.000E-05					
4	0.572	2.270	8400.000	3.000E-05	0.572	0.572	0.572		
5	0.000			3.000E-05					
6	0.000			3.000E-05					
7	0.000			3.000E-05					
8	0.000			3.000E-05					
9	0.000			3.000E-05					
10	0.000			3.000E-05					
11	0.000			3.000E-05					
12	0.000			3.000E-05					
13	0.000			3.000E-05					
			P(i)19	**Sum**	**0.572**	**0.572**	**0.572**	**0.572**	**uSv/a**

Public Dose Data
ADULT RESIDENT
EMP Factors for Dose P29

P29 is the transfer pathway of exposure to HTO from compartment 2 (Surface Water) to 9 (Dose)
P(i)29 is the pathway of exposure due to ingestion of HTO
P(e)29 is the pathway of exposure due to immersion in HTO

Formula:
P(i)29 = [HTO] (Bq/L) x Ingestion (L) x DCF (uSv/Bq)

Well	P(i)29 (uSv/a)	[HTO]well (Bq/L)	Ingestion (L/a)	DCF (uSv/Bq)
2	0.778	36	1081.1	2.00E-05
3	0.822	38	1081.1	2.00E-05
5	0.123	6	1081.1	2.00E-05
6	0.094	4	1081.1	2.00E-05
7	0.097	5	1081.1	2.00E-05
Avg P(i)29	**0.383**	**uSv/annum**		

Date	Well 2 (Bq/L)	Well 3 (Bq/L)	Well 5 (Bq/L)	Well 6 (Bq/L)	Well 7 (Bq/L)
March 3, 2021	41	28	7	4	No sample
July 6, 2021	32	44	5	4	4
September 3, 2021	35	42	5	5	5
Average	**36**	**38**	**6**	**4**	**5**

Well 2	185 Mud Lake Road
Well 3	183 Mud Lake Road
Well 5	171 Sawmill Road
Well 6	40987 Highway 41
Well 7	40925 Highway 41

Well 3	**P(i)29**	**0.822**	**uSv/a**
	P(e)29	**0.000**	**uSv/a**
	P29	**0.822**	**uSv/a**

P(e)29 is the pathway of exposure to HTO due to immersion in surface water, and is negligible.

Public Dose Data
ADULT RESIDENT
EMP Factors for Dose P49

P49 is the pathway for exposure to HTO due to ingestion of forage and crops.

Produce Sample Results (Bq free water tritium / kg fresh weight)											
Source	**Farm Gate Market 11133 Round Lake Road**					**Residences**					
Type	**Tomato**	**Pumpkin**	**Carrot**		**Average**	**LOCATION**	**Tomato**	**Apple**	**Pepper**	**Herbs**	**Average**
	4	4	3		**3.7**	413 SWEEZEY COURT	67	52	55	18	48.0
						406 BOUNDARY ROAD		63			63.0
						408 BOUNDARY ROAD	117				**117.0**
						611 MOSS DRIVE	53				53.0
Average					3.7		79.0	57.5	55.0	18.0	60.7
Produce Sample Results (Bq organically bound tritium / kg fresh weight)											
Comm.	4				**4.0**	408 BOUNDARY ROAD	1.0				**1.0**

Produce Consumption						
100%=	**413.300**	**kg/a**	**[HTO] (Bq/kg)**	**(Bq/a)**	**[OBT] (Bq/kg)**	**(Bq/a)**
70%	289.310	**kg/a**	3.7	1060.80	4.0	1157.24
30%	123.990	**kg/a**	117.0	14506.83	1.0	123.99

P49 = [HTO or OBT]produce (Bq/kg) x Produce Ingested (kg/mo) x DCF (uSv/Bq)

P49 (uSv/a)	[HTO] pro (Bq/a)	DCF (uSv/Bq)	[OBT] pro (Bq/a)	DCF (uSv/Bq)
0.370	**15567.63**	2.00E-05	**1281.23**	4.60E-05

P49	**0.370**	**uSv/a**

Public Dose Data
ADULT RESIDENT
EMP Factors for Dose P59

P59 is the exposure to HTO due to ingestion of animal produce.

2021 Sample Results

Local Producer	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

Local Distributor	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

TOTAL AVERAGE	**4.00**	Bq/L

Milk Density Adjustment		
Milk Average (Bq/L) x Milk density (L/kg)		
Bq/L	**L/kg**	**Bq/kg**
4.00	0.97	**3.880**

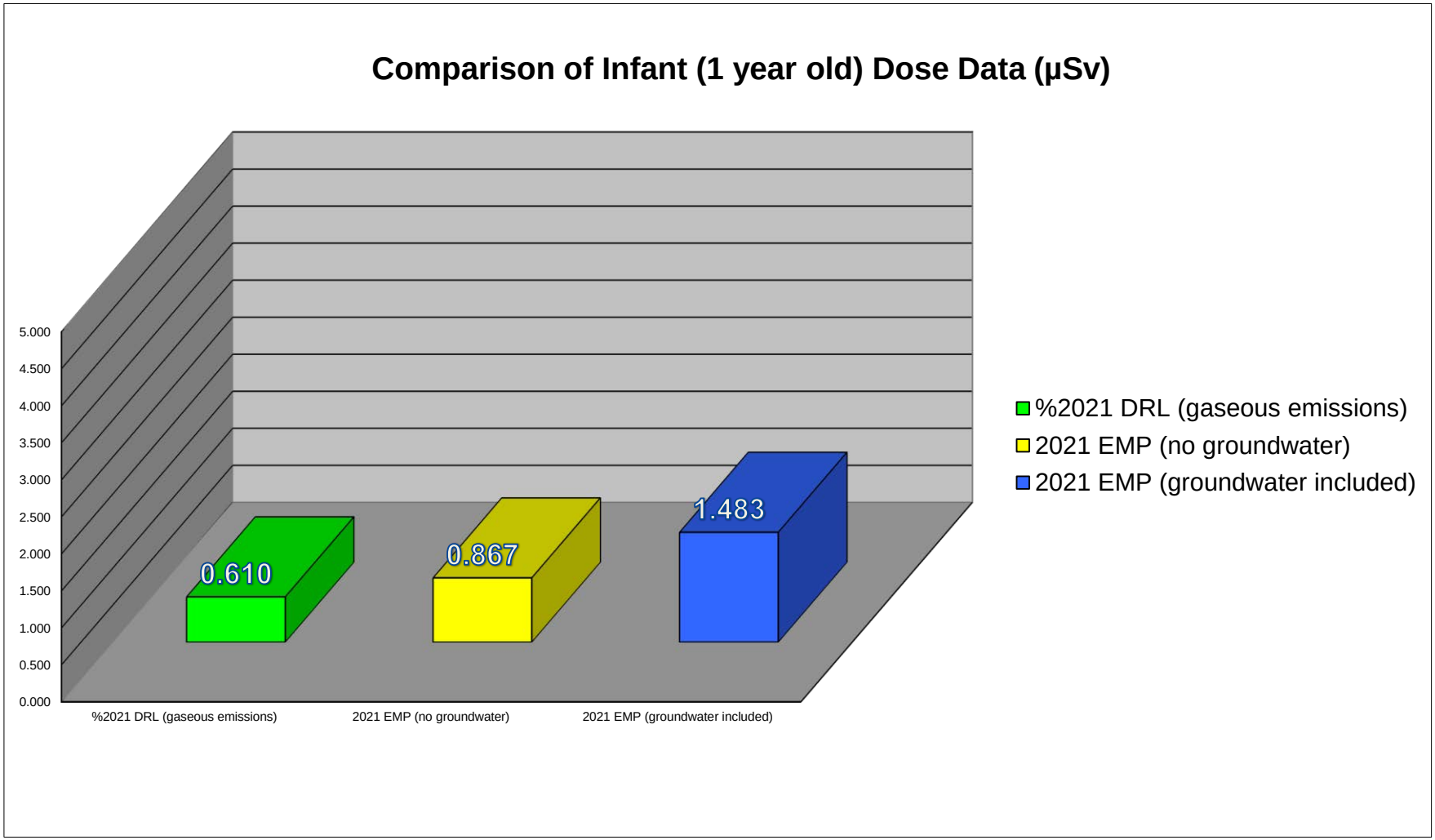
Consumption		
kg/da x da/a = kg/a		
(kg/da)	**(da/a)**	**(kg/a)**
0.516	365.25	**188.5**

P59 = [HTO]animal produce (Bq/kg) x Ingestion (kg) x DCF				
P59	**[HTO]**	**Ingested**	**DCF**	
(uSv/a)	**(Bq/kg)**	**(kg/a)**	**(uSv/Bq)**	
0.015	**3.88**	**188.5**	2.00E-05	

P59	**0.015**	**uSv/a**

Public Dose Data
INFANT (1 YEAR OLD)

Dose Calculation	2021 µSv
%2021 DRL (gaseous emissions)	0.610
2021 EMP (no groundwater)	0.867
2021 EMP (groundwater included)	1.483



Public Dose Data
INFANT (1 YEAR OLD)

Stack Emissions

	2021 Emissions as %2021 SRBT DRL	
	INFANT (1 YEAR OLD)	
Sample End	% weekly DRL	(uSv)
2021-01-05	0.01	0.0013
2021-01-12	0.08	0.0150
2021-01-19	0.04	0.0079
2021-01-26	0.03	0.0061
2021-02-02	0.04	0.0070
2021-02-09	0.04	0.0081
2021-02-16	0.04	0.0068
2021-02-23	0.03	0.0057
2021-03-02	0.03	0.0058
2021-03-09	0.04	0.0080
2021-03-16	0.05	0.0091
2021-03-23	0.04	0.0067
2021-03-30	0.05	0.0092
2021-04-06	0.02	0.0036
2021-04-13	0.04	0.0080
2021-04-20	0.05	0.0095
2021-04-27	0.05	0.0087
2021-05-04	0.03	0.0066
2021-05-11	0.05	0.0091
2021-05-18	0.05	0.0100
2021-05-25	0.05	0.0097
2021-06-01	0.05	0.0088
2021-06-08	0.06	0.0112
2021-06-15	0.14	0.0261
2021-06-22	0.09	0.0168
2021-06-29	0.09	0.0164
2021-07-06	0.04	0.0085
2021-07-13	0.09	0.0174
2021-07-20	0.12	0.0236
2021-07-27	0.08	0.0163
2021-08-03	0.06	0.0125
2021-08-10	0.10	0.0186
2021-08-17	0.09	0.0170
2021-08-24	0.13	0.0250
2021-08-31	0.14	0.0268
2021-09-07	0.06	0.0117
2021-09-14	0.08	0.0156
2021-09-21	0.09	0.0166
2021-09-28	0.05	0.0103
2021-10-05	0.04	0.0074
2021-10-12	0.09	0.0166
2021-10-19	0.10	0.0190
2021-10-26	0.07	0.0127
2021-11-02	0.04	0.0086
2021-11-09	0.07	0.0132
2021-11-16	0.10	0.0195
2021-11-23	0.07	0.0129
2021-11-30	0.04	0.0082
2021-12-07	0.04	0.0074
2021-12-14	0.05	0.0105
2021-12-21	0.05	0.0096
2021-12-28	0.02	0.0031
Sum (uSv)		**0.610**
Ave. (%DRL)	**0.06**	
Annual Dose Est.	**0.610 uSv/a**	

Public Dose Data
INFANT (1 YEAR OLD)
EMP Factors for Dose

Pathways Analysis of Dose to the Public			
		per annum	
Atmospheric HTO inhalation, immersion	P(i)19, P(e)19	0.498	
Surface HTO ingestion	P(i)29	0.616	
Surface HTO immersion	P(e)29	0.000	
External soil exposure	P39	0.000	
Forage & crop ingestion	P49	0.299	
Animal produce ingestion	P59	0.070	
Aquatic animal ingestion	P69	0.000	
Aquatic plant ingestion	P79	0.000	
External sediment exposure	P89	0.000	
Total (uSv)		**1.483**	**uSv/a**
Total without P_{29} (uSv)		**0.867**	**uSv/a**

Public Dose Data
INFANT (1 YEAR OLD)
EMP Factors for Dose P19

P19 is the transfer pathway of exposure to HTO from compartment 1 (Atmosphere) to 9 (dose)
P(i)19 is the pathway of exposure due to inhalation of HTO, and also implicitly captures skin absorption dose P(e)19 as per CSA N288.1-14 Table C.1.

Formula:
P(i)19 (uSv) = [HTO]air (Bq/m3) x Inhalation (m3) x DCF (uSv/Bq)

Calculation:

PAS # (#)	P(i)19 (uSv)	[HTO]air (Bq/m^3)	Volume (m^3)	(uSv/Bq)	(uSv/a)	(uSv/a)	(uSv/a)	Maximum (uSv/a)	
1	0.000			8.000E-05					
2	0.000			8.000E-05					
3	0.000			8.000E-05					
4	0.498	2.270	2740.000	8.000E-05	0.498	0.498	0.498		
5	0.000			8.000E-05					
6	0.000			8.000E-05					
7	0.000			8.000E-05					
8	0.000			8.000E-05					
9	0.000			8.000E-05					
10	0.000			8.000E-05					
11	0.000			8.000E-05					
12	0.000			8.000E-05					
13	0.000			8.000E-05					
			P(i)19	**Sum**	**0.498**	**0.498**	**0.498**	**0.498**	**uSv/a**

Public Dose Data
INFANT (1 YEAR OLD)
EMP Factors for Dose P29

P29 is the transfer pathway of exposure to HTO from compartment 2 (Surface Water) to 9 (Dose)
P(i)29 is the pathway of exposure due to ingestion of HTO
P(e)29 is the pathway of exposure due to immersion in HTO

Formula:
P(i)29 = [HTO] (Bq/L) x Ingestion (L) x DCF (uSv/Bq)

Well	P(i)29 (uSv/a)	[HTO]well (Bq/L)	Ingestion (L/a)	DCF (uSv/Bq)
2	0.583	36	305.7	5.30E-05
3	0.616	38	305.7	5.30E-05
5	0.092	6	305.7	5.30E-05
6	0.070	4	305.7	5.30E-05
7	0.073	5	305.7	5.30E-05
Avg P(i)29	**0.287**	**uSv/annum**		

Date	Well 2 (Bq/L)	Well 3 (Bq/L)	Well 5 (Bq/L)	Well 6 (Bq/L)	Well 7 (Bq/L)
March 3, 2021	41	28	7	4	No sample
July 6, 2021	32	44	5	4	4
September 3, 2021	35	42	5	5	5
Average	**36**	**38**	**6**	**4**	**5**

Well 2	185 Mud Lake Road
Well 3	183 Mud Lake Road
Well 5	171 Sawmill Road
Well 6	40987 Highway 41
Well 7	40925 Highway 41

Well 3	**P(i)29**	**0.616**	**uSv/a**
	P(e)29	**0.000**	**uSv/a**
	P29	**0.616**	**uSv/a**

P(e)29 is the pathway of exposure to HTO due to immersion in surface water, and is negligible.

Public Dose Data
INFANT (1 YEAR OLD)
EMP Factors for Dose P49

P49 is the pathway for exposure to HTO due to ingestion of forage and crops.

Produce Sample Results (Bq free water tritium / kg fresh weight)											
Source	**Farm Gate Market 11133 Round Lake Road**					**Residences**					
Type	**Tomato**	**Pumpkin**	**Carrot**		**Average**	**LOCATION**	**Tomato**	**Apple**	**Pepper**	**Herbs**	**Average**
	4	4	3		**3.7**	413 SWEEZEY COURT	67	52	55	18	48.0
						406 BOUNDARY ROAD		63			63.0
						408 BOUNDARY ROAD	117				**117.0**
						611 MOSS DRIVE	53				53.0
Average					3.7		79.0	57.5	55.0	18.0	60.7
Produce Sample Results (Bq organically bound tritium / kg fresh weight)											
Comm.	4				**4.0**	408 BOUNDARY ROAD	1.0				**1.0**

Produce Consumption						
100%=	**124.800**	**kg/a**	**[HTO] (Bq/kg)**	**(Bq/a)**	**[OBT] (Bq/kg)**	**(Bq/a)**
70%	87.360	**kg/a**	3.7	320.32	4.0	349.44
30%	37.440	**kg/a**	117.0	4380.48	1.0	37.44

P49 = [HTO or OBT]produce (Bq/kg) x Produce Ingested (kg/mo) x DCF (uSv/Bq)

P49 (uSv/a)	[HTO] pro (Bq/a)	DCF (uSv/Bq)	[OBT] pro (Bq/a)	DCF (uSv/Bq)
0.299	**4700.80**	5.30E-05	**386.88**	1.30E-04

P49	**0.299**	**uSv/a**

Public Dose Data
INFANT (1 YEAR OLD)
EMP Factors for Dose P59

P59 is the exposure to HTO due to ingestion of animal produce.

2021 Sample Results

Local Producer	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

Local Distributor	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

TOTAL AVERAGE	**4.00**	Bq/L

Milk Density Adjustment		
Milk Average (Bq/L) x Milk density (L/kg)		
Bq/L	**L/kg**	**Bq/kg**
4.00	0.97	**3.880**

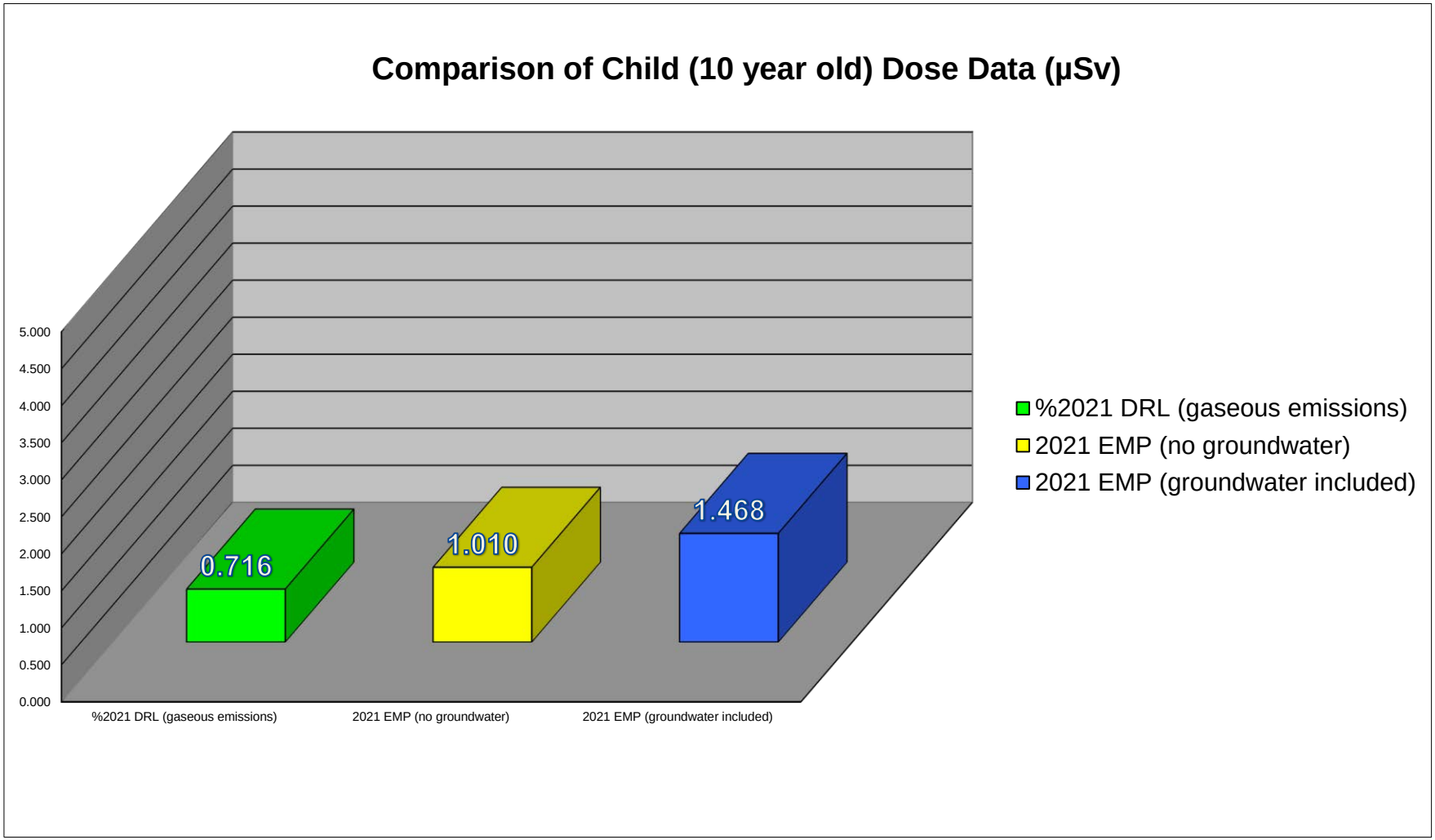
Consumption		
kg/da x da/a = kg/a		
(kg/da)	**(da/a)**	**(kg/a)**
0.931	365.25	**340.0**

P59 = [HTO]animal produce (Bq/kg) x Ingestion (kg) x DCF				
P59	**[HTO]**	**Ingested**	**DCF**	
(uSv/a)	**(Bq/kg)**	**(kg/a)**	**(uSv/Bq)**	
0.070	**3.88**	**340.0**	5.30E-05	

P59	**0.070**	**uSv/a**

Public Dose Data
CHILD (10 YEAR OLD)

Dose Calculation	2021 µSv
%2021 DRL (gaseous emissions)	0.716
2021 EMP (no groundwater)	1.010
2021 EMP (groundwater included)	1.468



Public Dose Data
CHILD (10 YEAR OLD)

Stack Emissions

	2021 Emissions as %2021 SRBT DRL	
	CHILD (10 YEAR OLD)	
Sample End	**% weekly DRL**	**(uSv)**
2021-01-05	0.01	0.0016
2021-01-12	0.09	0.0176
2021-01-19	0.05	0.0093
2021-01-26	0.04	0.0071
2021-02-02	0.04	0.0082
2021-02-09	0.05	0.0094
2021-02-16	0.04	0.0079
2021-02-23	0.03	0.0066
2021-03-02	0.04	0.0068
2021-03-09	0.05	0.0094
2021-03-16	0.05	0.0106
2021-03-23	0.04	0.0078
2021-03-30	0.06	0.0108
2021-04-06	0.02	0.0043
2021-04-13	0.05	0.0094
2021-04-20	0.06	0.0111
2021-04-27	0.05	0.0101
2021-05-04	0.04	0.0077
2021-05-11	0.05	0.0106
2021-05-18	0.06	0.0117
2021-05-25	0.06	0.0114
2021-06-01	0.05	0.0104
2021-06-08	0.07	0.0132
2021-06-15	0.16	0.0306
2021-06-22	0.10	0.0198
2021-06-29	0.10	0.0193
2021-07-06	0.05	0.0100
2021-07-13	0.11	0.0205
2021-07-20	0.14	0.0277
2021-07-27	0.10	0.0192
2021-08-03	0.08	0.0145
2021-08-10	0.11	0.0219
2021-08-17	0.10	0.0200
2021-08-24	0.15	0.0294
2021-08-31	0.16	0.0315
2021-09-07	0.07	0.0138
2021-09-14	0.10	0.0183
2021-09-21	0.10	0.0194
2021-09-28	0.06	0.0121
2021-10-05	0.05	0.0087
2021-10-12	0.10	0.0194
2021-10-19	0.12	0.0224
2021-10-26	0.08	0.0149
2021-11-02	0.05	0.0101
2021-11-09	0.08	0.0155
2021-11-16	0.12	0.0229
2021-11-23	0.08	0.0152
2021-11-30	0.05	0.0096
2021-12-07	0.04	0.0086
2021-12-14	0.06	0.0124
2021-12-21	0.06	0.0113
2021-12-28	0.02	0.0036
Sum (uSv)		**0.716**
Ave. (%DRL)	**0.07**	
Annual Dose Est.	**0.716 uSv/a**	

Public Dose Data
CHILD (10 YEAR OLD)
EMP Factors for Dose

Pathways Analysis of Dose to the Public			
		per annum	
Atmospheric HTO inhalation, immersion	P(i)19, P(e)19	0.677	
Surface HTO ingestion	P(i)29	0.458	
Surface HTO immersion	P(e)29	0.000	
External soil exposure	P39	0.000	
Forage & crop ingestion	P49	0.302	
Animal produce ingestion	P59	0.031	
Aquatic animal ingestion	P69	0.000	
Aquatic plant ingestion	P79	0.000	
External sediment exposure	P89	0.000	
Total (uSv)		**1.468**	**uSv/a**
Total without P_{29} (uSv)		**1.010**	**uSv/a**

Public Dose Data
CHILD (10 YEAR OLD)
EMP Factors for Dose P19

P19 is the transfer pathway of exposure to HTO from compartment 1 (Atmosphere) to 9 (dose)
P(i)19 is the pathway of exposure due to inhalation of HTO, and also implicitly captures skin absorption dose P(e)19 as per CSA N288.1-14 Table C.1.

Formula:
P(i)19 (uSv) = [HTO]air (Bq/m3) x Inhalation (m3) x DCF (uSv/Bq)

Calculation:

PAS # (#)	P(i)19 (uSv)	[HTO]air (Bq/m^3)	Volume (m^3)	(uSv/Bq)	(uSv/a)	(uSv/a)	(uSv/a)	Maximum (uSv/a)	
1	0.000			3.800E-05					
2	0.000			3.800E-05					
3	0.000			3.800E-05					
4	0.677	2.270	7850.000	3.800E-05	0.677	0.677	0.677		
5	0.000			3.800E-05					
6	0.000			3.800E-05					
7	0.000			3.800E-05					
8	0.000			3.800E-05					
9	0.000			3.800E-05					
10	0.000			3.800E-05					
11	0.000			3.800E-05					
12	0.000			3.800E-05					
13	0.000			3.800E-05					
			P(i)19	**Sum**	**0.677**	**0.677**	**0.677**	**0.677**	**uSv/a**

Public Dose Data
CHILD (10 YEAR OLD)
EMP Factors for Dose P29

P29 is the transfer pathway of exposure to HTO from compartment 2 (Surface Water) to 9 (Dose)
P(i)29 is the pathway of exposure due to ingestion of HTO
P(e)29 is the pathway of exposure due to immersion in HTO

Formula:
P(i)29 = [HTO] (Bq/L) x Ingestion (L) x DCF (uSv/Bq)

Well	P(i)29 (uSv/a)	[HTO]well (Bq/L)	Ingestion (L/a)	DCF (uSv/Bq)
2	0.434	36	482.1	2.50E-05
3	0.458	38	482.1	2.50E-05
5	0.068	6	482.1	2.50E-05
6	0.052	4	482.1	2.50E-05
7	0.054	5	482.1	2.50E-05
Avg P(i)29	**0.213**	**uSv/annum**		

Date	Well 2 (Bq/L)	Well 3 (Bq/L)	Well 5 (Bq/L)	Well 6 (Bq/L)	Well 7 (Bq/L)
March 3, 2021	41	28	7	4	No sample
July 6, 2021	32	44	5	4	4
September 3, 2021	35	42	5	5	5
Average	**36**	**38**	**6**	**4**	**5**

Well 2	185 Mud Lake Road
Well 3	183 Mud Lake Road
Well 5	171 Sawmill Road
Well 6	40987 Highway 41
Well 7	40925 Highway 41

Well 3	**P(i)29**	**0.458**	**uSv/a**
	P(e)29	**0.000**	**uSv/a**
	P29	**0.458**	**uSv/a**

P(e)29 is the pathway of exposure to HTO due to immersion in surface water, and is negligible.

Public Dose Data
CHILD (10 YEAR OLD)
EMP Factors for Dose P49

P49 is the pathway for exposure to HTO due to ingestion of forage and crops.

Produce Sample Results (Bq free water tritium / kg fresh weight)											
Source	**Farm Gate Market 11133 Round Lake Road**					**Residences**					
Type	**Tomato**	**Pumpkin**	**Carrot**		**Average**	**LOCATION**	**Tomato**	**Apple**	**Pepper**	**Herbs**	**Average**
	4	4	3		**3.7**	413 SWEEZEY COURT	67	52	55	18	48.0
						406 BOUNDARY ROAD		63			63.0
						408 BOUNDARY ROAD	117				**117.0**
						611 MOSS DRIVE	53				53.0
Average					3.7		79.0	57.5	55.0	18.0	60.7
Produce Sample Results (Bq organically bound tritium / kg fresh weight)											
Comm.	4				**4.0**	408 BOUNDARY ROAD	1.0				**1.0**

Produce Consumption						
100%=	**265.200**	**kg/a**	**[HTO] (Bq/kg)**	**(Bq/a)**	**[OBT] (Bq/kg)**	**(Bq/a)**
70%	185.640	**kg/a**	3.7	680.68	4.0	742.56
30%	79.560	**kg/a**	117.0	9308.52	1.0	79.56

P49 = [HTO or OBT]produce (Bq/kg) x Produce Ingested (kg/mo) x DCF (uSv/Bq)

P49 (uSv/a)	[HTO] pro (Bq/a)	DCF (uSv/Bq)	[OBT] pro (Bq/a)	DCF (uSv/Bq)
0.302	**9989.20**	2.50E-05	**822.12**	6.30E-05

P49	**0.302**	**uSv/a**

Public Dose Data
CHILD (10 YEAR OLD)
EMP Factors for Dose P59

P59 is the exposure to HTO due to ingestion of animal produce.

2021 Sample Results

Local Producer	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

Local Distributor	
	(Bq/L)
1	4.00
2	4.00
3	4.00
Average	**4.00**

TOTAL AVERAGE	**4.00**	Bq/L

Milk Density Adjustment		
Milk Average (Bq/L) x Milk density (L/kg)		
Bq/L	**L/kg**	**Bq/kg**
4.00	0.97	**3.880**

Consumption		
kg/da x da/a = kg/a		
(kg/da)	**(da/a)**	**(kg/a)**
0.875	365.25	**319.6**

P59 = [HTO]animal produce (Bq/kg) x Ingestion (kg) x DCF				
P59	**[HTO]**	**Ingested**	**DCF**	
(uSv/a)	**(Bq/kg)**	**(kg/a)**	**(uSv/Bq)**	
0.031	**3.88**	**319.6**	2.50E-05	

P59	**0.031**	**uSv/a**

APPENDIX S

Summary of Outgoing Shipments Containing Radioactive Material

Summary of Outgoing Shipments Containing Radioactive Material

Month	Number of Shipments
January	64
February	77
March	70
April	80
May	69
June	81
July	50
August	65
September	55
October	66
November	78
December	56
TOTAL	**811**
Average per month	*68*

Distribution of Outgoing Shipments

Country	Number of Shipments
United States	461
Canada	253
United Kingdom	28
Mexico	16
South Korea	6
Germany	6
The Netherlands	5
Switzerland	4
Singapore	4
Australia	4
Israel	3
China	2
New Zealand	2
Lithuania	2
Denmark	2
France	1
Bulgaria	1
Norway	1
Spain	1
Turkey	1
Latvia	1
India	1
United Arab Emirates	1
Nepal	1
Mauritius	1
Austria	1
Brazil	1
Oman	1

APPENDIX T

Summary of Incoming Shipments Containing Radioactive Material

Summary of Incoming Shipments Containing Radioactive Material

Month	Number of Shipments
January	20
February	12
March	27
April	18
May	14
June	12
July	10
August	11
September	14
October	11
November	6
December	10
TOTAL	**165**
Average per month	*14*

Distribution of Incoming Shipments

Country	Number of Shipments
United States	141
Canada	12
Singapore	3
United Kingdom	3
France	1
The Netherlands	1
Japan	1
South Korea	1
Switzerland	1
Malaysia	1