Evaluation of Corrective Action Alternatives

Energizer, 401 Gage Street, Bennington, Vermont

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Acronyms and Abbreviations

Name	Description
AOC	area of concern
AS/SVE	air sparge/soil vapor extraction
CAP	Corrective Action Plan
COC	constituents of concern
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DNAPL	dense non-aqueous phase liquid
ECAA	Evaluation of Corrective Action Alternatives
Energizer	Energizer Holdings, Inc.
ERM	ERM Consulting and Engineering, Inc.
GWQES	Vermont Primary Groundwater Quality Enforcement Standards
IRule	Investigation and Remediation of Contaminated Properties Rule
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluoroocanotic acid
Site	Energizer Holdings Facility, 401 Gage Street, Bennington, VT, Parcel IDs: 50536100, 51530400, 50536000, and 51534200; School Property Account Numbers (SPANs): 051-015-67173, 051-015-6778, 051-015-67172, and 051-015-67815
SPANs	School Property Account Numbers
TCE	trichloroethylene
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
VTDEC	Vermont Department of Environmental Conservation

EXECUTIVE SUMMARY

ERM Consulting and Engineering, Inc. (ERM), on behalf of Energizer Holdings, Inc. (Energizer), completed an evaluation of corrective action alternatives (ECAA) for the former Energizer facility located at 401 Gage Street in Bennington, Vermont (Site). The Vermont Department of Environmental Conservation (VTDEC) Site Number is 2006-3509. This report was completed in accordance with the VTDEC Environmental Protections Rules Chapter 35 Section 604 (§ 35-604), Investigation and Remediation of Contaminated Properties Rule (IRule) dated 6 July, 2019.

The general location of the Site Property and the surrounding area are depicted on Figure 1. The Site Property comprises five land parcels (four tax ID parcels), which total approximately 9.29 acres, developed with six buildings which include Plant 1, Plant 2, a Boiler House, Tank Farm Enclosure, an unnamed storage building, and a wooden storage shed. The Site has been used for the manufacturing of batteries since the 1940's.

Environmental investigations conducted at the site have identified the following receptors as potential completed exposure pathways for either current and/or future Site use:

- Current and future on-Site workers in Plant 1 as a result of the potential for soil gas, exhibiting perchloroethylene (PCE) and trichloroethylene (TCE) concentrations exceeding nonresidential screening values, to potentially migrate into indoor air via vapor intrusion;
- Potential future residents in Plant 1 and Plant 2 as a result the potential for PCE and TCE in soil gas in exceedance of the residential screening values to migrate into indoor air via vapor intrusion. Future residents may be receptors as the future building use has not been determined.

There are no complete exposure pathways for receptors to groundwater that are identified as related to the Energizer Site; however, Energizer evaluated corrective action alternatives for groundwater at the Site to evaluate the potential to limit exposure to PCE and/or per- and polyfluoroalkyl substances (PFAS) (ERM 2021).

The objective of corrective actions is to mitigate the potential impact of PCE, TCE, and PFAS to sensitive receptors, consistent with IRule § 35-603. The objective of the ECAA is to identify potential corrective actions, evaluate corrective actions against the prescribed criteria in IRule § 35-604, and to select a remedy based on that evaluation. For the purposes of this ECAA, two separate evaluations were performed: one to address potential exposure to impacted groundwater and one to address the potential for soil gas to impact indoor air.

Three separate alternatives were considered to address impacts to groundwater at the Site: restarting a formerly operating air sparge/soil vapor extraction (AS/SVE) system (Alternative A), long term monitoring (Alternative B), and a no action alternative (Alternative C). Based on an evaluation of the criteria referenced above (Table A), Alternative B is recommended.

Five separate alternatives were considered to address the potential for indoor air to be impacted by soil gas (i.e., vapor intrusion) at the Site: active vapor mitigation with institutional controls (Alternative A), passive vapor mitigation with institutional controls (Alternative B), institutional controls alone (Alternative C), excavation for source removal (Alternative D), and a no action alternative (Alternative E). Based on an evaluation of the criteria referenced above (Table B), Alternatives A is recommended.

1. INTRODUCTION

This Evaluation of Corrective Action Alternatives (ECAA) was prepared on behalf of Energizer Holdings, Inc. (Energizer) for its former facility located at 401 Gage Street in Bennington, Vermont (Site). Previous investigation and remediation activities have been completed at the Site and associated reports provided to the Vermont Department of Environmental Conservation (VTDEC) under Site Number 2006-3509. This document describes an evaluation of corrective action alternatives to prepare the former facility for closure per the VTDEC Environmental Protections Rules Chapter 35 Section 304, Investigation and Remediation of Contaminated Properties Rule (IRule). Energizer submitted a Final Supplemental Site Investigation Report on 17 June 2021 (ERM 2021), concluding that site investigation is complete. The Supplemental Site Investigation Report (ERM 2021) provides a summary of historical property use, known spills and releases of hazardous substances, a summary of prior investigations and reports, and the results of investigations completed between 2019 and 2021. A

1.1 Site Description

The Site is located on the south side of Gage Street, northeast of downtown Bennington in Bennington County, Vermont. The Walloomsac River is located to the south. The general location of the Site Property and the surrounding area are depicted on Figure 1. The geographical coordinates of the Site are 73°11’26.99” West, 42°52’50.06” North.

The Site consists of approximately 9.29 acres, developed with six buildings which include Plant 1, Plant 2, a Boiler House, Tank Farm Enclosure, an unnamed storage building, and a wooden storage shed. The two main facility buildings are Plant 1 and Plant 2. Plant 1 is located immediately south of Gage Street and was vacated in 2021. Plant 2 is located further south on Scott Street and was vacated in 2016. Additional Site information on historical Site building use, surrounding properties, potential receptors, and previous investigations can be found in the Supplemental Site Investigation Report (ERM 2021).

1.1.1 Site Geology and Hydrology

The Site geology consists of a high permeability aquifer, comprised of sand, gravel, cobbles, and boulders, overlying an aquitard, comprised of a silt layer overlying a lodgement till. Groundwater flows to the west-northwest at an estimated velocity ranging from 7 to 70 feet per day (Figure 2). A downward vertical component of groundwater flow has been measured at the Site, but is less significant than the horizontal flow component, due to the relatively low permeability of the underlying silt aquitard.

The Site is located immediately north of the Walloomsac River. The reach of the Walloomsac adjacent to the Site appears to be recharging groundwater (i.e., a losing stream); based on the measurement of groundwater flow gradients away from the river (Figure 2). The Walloomsac River flows to the west and then to the north, converging with the Roaring Branch of the Walloomsac about one mile northwest of the Site. Morgan Brook is located on the northern Site boundary along the northern edge of the alley way that runs perpendicular to Division Street and is recharged by groundwater from Morgan Spring (1,900 feet east of the Site), which is sourced by a regional karstic bedrock aquifer. On Site, Morgan Brook flows aboveground along the length of the alley, then flows in an underground conduit from the west end of the alley to its discharge point in the Walloomsac River downstream of the Site. In the alley, Morgan Brook appears to be a perched, but “leaky” stream that does not appear to significantly affect groundwater flow directions, but does appear to partially impede soil gas migration.

1.2 Conceptual Site Model

The conceptual site model (CSM) for the Site was first documented in the 2007 Site Investigation Report (ERM, 2007) following the high resolution site characterization investigations completed at the Site in 2006 and 2007 and then updated as part of the 2020 Site Investigation Work Plan (ERM 2020) and the 2021 Supplemental Site Investigation Report (ERM 2021).

The initial CSM identified six areas of concern (AOCs) under and around Plant 1 documenting impacts of primarily PCE and TCE in soil, groundwater and soil gas. The six AOCs included:

- AOC-1: Former active degreaser area;
- AOC-2: Former machine shop;
- AOC-3: Production area;
- AOC-4: Former loading dock area;
- AOC-5: Former drain line; and
- AOC-6: Former process area sump.

As documented in the 2007 Site Investigation Report, dissolved-phase plumes from the six AOCs coalesced, resulting in a single groundwater plume migrating off-site to the west-northwest along the direction of groundwater flow. Groundwater elevation measurements and interpolated contours and flow directions have consistently showed flow to the northwest throughout numerous rounds of sampling. The dissolved phase plume migrated within the shallow sand and gravel aquifer as the underlying silt layer acts as an aquitard to contaminant migration. Although there is a downward vertical gradient to groundwater flow, it is significantly less than the horizontal migration of groundwater and is impeded by the silt aquitard.

Minimal transverse dispersivity occurs downgradient of the Site, based on observations of a consistent off-Site plume width when the plume was originally delineated in 2006. Evidence of longitudinal dispersivity was observed, based on significant decreases in constituents of concern (COC) concentrations with increased distance downgradient of the AOCs. In addition, groundwater recharge is occurring along the length of the off-Site plume, resulting in dilution of COC concentrations. Remediation activities between 2008 and 2012 targeted off-site migration of this dissolved-phase groundwater plume via operation of an air sparge/soil vapor extraction (AS/SVE) system along the Site boundary. Following remediation, TCE concentrations were reduced to below the Vermont Primary Groundwater Quality Enforcement Standards (GWQES) and are currently below laboratory reporting limits in wells being monitored at the Site. PCE concentrations in the dissolved phase plume have decreased by up to 98% since monitoring began in 2006.

In 2006, evidence suggestive of the presence of dense non-aqueous phase liquid (DNAPL; i.e., detection of PCE in a groundwater sample collected from ERM-1 at a concentration approaching its aqueous solubility) was observed in AOC 1 within the upper portion of the silt aquitard. Total petroleum hydrocarbons (TPH) were detected within the vadose zone and shallow sand and gravel aquifer within AOCs 1 and 3. This TPH was thought to be associated with historical degreasing activities that may have contained PCE and TCE. Source area remediation was completed via thermally enhanced AS/SVE between 2008 and 2009 within the largest AOC, AOC-1. PCE concentrations in groundwater near the former source area have been reduced by over 99.9% and TCE is not currently detected above reporting limits. The current dissolved-phase plume is being monitored on an annual basis and Interim Remedial Measure/CAP Operation, Maintenance, and Monitoring Reports are submitted biennially to VTDEC.

COCs present and migrating within the vadose zone were investigated and discussed in the 2007 SIR CSM as well as in the 2008 Vapor Intrusion Investigation Report (ERM, 2008), the 2011 and 2012 residential property investigations (ERM 2011, 2012a, 2012b) and the November 2019 soil gas survey. Primary risk drivers present in soil gas include PCE and TCE. PCE and TCE continue to be present in soil vapor under Plant 1, however it does not appear that soil gas concentrations migrate significantly from the Site. The 2011 and 2012 investigations on the residential properties (including two passive soil gas surveys, a Waterloo APS™ investigation, and depth-discrete soil sampling) indicate that Morgan Brook impedes soil gas migration. These investigations also demonstrated that soil gas impacts on the residential properties are likely due to the presence of a separate and distinct off-site source of PCE in soil that did not migrate from the Energizer property. In an email dated 17 August 2012, VTDEC concurred with the conclusion that there was “a separate and distinct off-site source area on the residential properties.”

Consistent with the preliminary CSM, groundwater data collected since the 2007 SIR demonstrate that TCE concentrations have been reduced to below GWQES by active remediation previously completed at the Site. No additional sources of TCE or detections of TCE were identified in the vicinity of Plant 2. PCE continues to be detected in groundwater, with the highest concentrations near the northwest property boundary of the Site and a low concentration plume extending in the direction of groundwater flow, to the northwest. Based on groundwater PCE concentrations measured since 2009, concentrations have not increased, and are expected to decline over time through natural attenuation.

Based on the 2019 sub-slab soil gas survey, PCE and TCE are present in sub-slab soil gas below Plant 1 but indoor air has not been sampled due to ongoing manufacturing and facility closure cleaning activities. PCE and TCE concentrations under Plant 2 and the boiler house are present at lower concentrations than under Plant 1. PCE and TCE are not present under the tank farm enclosure. As PCE and TCE concentrations in groundwater near the Site buildings are generally low or below laboratory reporting limits, the concentrations measured in soil gas are indicative of low concentrations of these compounds adsorbed to organic matter in soils likely near or under Site buildings. As these compounds volatize into soil gas, the concentrations will decrease over time through natural attenuation. Appropriate mitigation measures to address the remaining impacts to groundwater and soil gas under Plants 1 and 2 are discussed in this ECAA.

Per- and polyfluorinated alkyl substances (PFAS) have also been detected in groundwater at the Site. Of the PFAS detected, only perfluoroocanoic acid (PFOA) was detected in all locations sampled. Variability in PFAS concentrations within and immediately downgradient of the site are consistent with the variability noted in groundwater samples collected by others in the Bennington area over the past several years. Based on concentrations detected in groundwater, there is no evidence of a PFAS groundwater source area at the Site. Based on Site records, products potentially containing PFAS were used at the Site (in particular in Plant 2), but they were used as finished products and were unlikely to have released PFOA to Site soils and/or groundwater. The major source of PFOA in the Bennington area is the former ChemFab facility that used PTFE dispersions containing PFOA. Emissions of PFOA from the ChemFab facility to the air are known to have deposited on soils and impacted groundwater in substantial portions of Bennington, although the precise extent of these impacts is currently under investigation. To the extent that there are PFAS impacts in Site groundwater, the distribution of concentrations indicate background concentrations from anthropogenic sources with storm water and subsurface infrastructure as the likely predominant distribution pathway. The isolated and low concentrations of other PFAS are consistent with anthropogenic background and there is no source area to include in the CSM. Appropriate mitigation measures for groundwater impacted by PFAS are addressed in this ECAA. PFAS are not sufficiently volatile to impact indoor air through vapor intrusion and were not considered as part of the evaluation of corrective action alternative for indoor air.

2. RECEPTOR IDENTIFICATION AND ASSESSMENT

An exposure assessment was completed to evaluate the potential pathways and receptors that could be exposed to COCs in Site groundwater or soil gas under current or reasonably foreseeable conditions. A qualitative risk characterization was completed as part of the 2007 SIR which included an exposure assessment. The assessment was updated as documented in the 2021 Supplemental Site Investigation Report (ERM 2021). An evaluation of Site soil is included in the 2007 SIR but was not updated in 2021 as soil was not investigated during this subsequent investigation.

The potential exposure routes evaluated for site COCs include:

- Potential direct contact with groundwater (dermal, ingestion, and inhalation) for PCE and PFAS; and
- Potential inhalation of soil gas vapors containing volatile COCs (PCE and TCE) via vapor intrusion.

Based on groundwater flow directions, it is unlikely that impacted groundwater is discharging to surface water or wetlands; therefore, surface water is not considered as an exposure route. Receptors for groundwater and soil gas are discussed independently below.

2.1 Potential Groundwater Receptors

The following receptors were considered for potential direct contact with groundwater (dermal, ingestion, and inhalation) for PCE and PFAS:

- On-Site Workers – Due to the depth to groundwater, direct inhalation of vapors from exposed groundwater by onsite workers (both for current and future use) is not considered a complete pathway. Site groundwater is not used for drinking, irrigation, or other purpose, so there is no complete pathway for PFAS to impact on-site workers.
- On-Site Construction and Utility Workers – Construction/utility workers could be exposed to groundwater via contact, ingestion, or inhalation of vapors from exposed groundwater during normal construction activities. Depending on the type of work, direct contact, ingestion, or inhalation of groundwater containing PCE, TCE, or PFAS is a potentially complete pathway.
- On-Site Residents – The Site is currently unoccupied so no current site residential receptors exist. Future site use (including water use at the Site) is unknown at this time so potential future exposure of future residents remains a potentially complete future pathway for groundwater via direct contact and/or ingestion. Due to the depth to groundwater, direct inhalation of vapors from exposed groundwater by potential future residents is not considered a complete pathway.
- Downgradient/Off-Site Construction and Utility Workers – Downgradient/off-Site construction/utility workers could be exposed to groundwater via contact, ingestion, or inhalation of vapors from exposed groundwater during normal construction activities. Depending on the type of work, direct contact, ingestion, or inhalation of groundwater containing PCE, TCE, or PFAS is a potentially complete pathway. As noted in the Supplemental Site Investigation Report (ERM 2021), remaining impacts to groundwater are likely contributed to by the off-site source area and this source did not migrate from the Energizer property. The potentially completed pathways to this receptor, however, will still be taken into consideration when evaluating and implementing remedial actions.
- Downgradient/Off-Site Residents – The nearest identified private well is located 0.17 miles downgradient of the Site (Figure 1), beyond the delineated extent of groundwater impacts. Groundwater immediately downgradient of the Site is not currently used for drinking, irrigation, or other purpose. Future use of groundwater is unknown, however, so there is a potentially complete pathway for PCE, TCE, and PFAS to impact downgradient future residents through direct contact or ingestion of groundwater. Due to the depth to groundwater, direct inhalation of vapors from exposed

groundwater by downgradient residents is not considered a complete pathway. As noted in the Supplemental Site Investigation Report (ERM 2021), remaining VOC impacts to groundwater are likely contributed to by the off-site source and this source did not migrate from the Energizer property. The potentially completed pathways to this receptor, however, will still be taken into consideration when evaluating and implementing remedial actions.

- Ecological receptors – There are no Threatened or Endangered Species within 5,000 feet of the Site. Therefore, exposure of ecological receptors was not evaluated as a complete pathway.

2.2 Potential Soil Gas Receptors

The following receptors were considered for potential inhalation of soil gas vapors containing volatile COCs (PCE and TCE) via vapor intrusion on-site:

- On-Site Workers – On-site workers (both for current and future use) may be exposed to soil gas via vapor intrusion into Site buildings. This exposure is considered a potentially complete pathway for VOCs (PCE and TCE).
- On-Site Construction and Utility Workers – Construction/utility workers could be exposed to impacted soil gas via vapor intrusion into Site buildings and during subsurface work. Depending on the location and type of work, exposure to vapors from groundwater and vapor intrusion is a potentially complete pathway for PCE and TCE.
- On-Site Residents – The Site is currently unoccupied so no current site residential receptors exist. Future site use (including water use at the Site) is unknown at this time so potential future exposure of future residents remains a potentially complete future pathway for soil gas via vapor intrusion.
- Downgradient/Off-Site Construction and Utility Workers – As described in the CSM, soil gas concentrations are not expected to migrate significantly from the Site so exposure of downgradient/off-site construction and utility workers to soil gas was not evaluated as a complete pathway.
- Downgradient/Off-Site Residents – As described in the CSM, soil gas concentrations are not expected to migrate significantly from the Site so exposure of downgradient/off-site residents to soil gas was not evaluated as a complete pathway.

3. INDENTIFICATION OF CORRECTIVE ACTION ALTERNATIVES

Per IRule § 35-604(c), for each evaluation, a minimum of two alternatives must be considered:

- An alternative that reduces the toxicity, mobility, or volume of the hazardous materials released to the extent feasible. This alternative shall minimize the need for long term management at the site; and
- An alternative that involves little or no treatment, but controls impacts to sensitive receptors through engineered controls, containment, long term monitoring, and institutional controls.

Two sets of corrective actions were evaluated: corrective actions for groundwater (Section 3.1) and separate corrective actions for soil gas to indoor air (vapor intrusion) (Section 3.2). Both Sections 3.1 and 3.2 provide a detailed evaluation of each corrective action alternative against the following criteria established by IRule § 35-604(d):

1. Overall protection of human health and the environment;
2. Compliance with legal requirements;
3. Long-term effectiveness and permanence;
4. Land use restrictions;
5. Reducing toxicity, mobility, or volume through treatment;
6. Short-term effectiveness;
7. Implementability;
8. Cost;
9. Environmental impact and sustainability; and
10. Community acceptance.

Tables 1 and 2 present the scoring of each corrective action alternative against the criteria listed above. Detailed budgetary cost estimates are included as Appendix A.

3.2 Groundwater Corrective Action Alternatives

The following alternatives have been considered to control exposure of receptors to COC-impacted groundwater:

- Alternative A: Restart the existing AS/SVE system;
- Alternative B: Long-term monitoring of groundwater concentrations; and
- Alternative C: No Action.

3.2.1 Alternative A – Restart Air Sparge/ Soil Vapor Extraction System

Alternative A, restarting the existing AS/SVE system, is an alternative that has the potential to “reduce the toxicity, mobility, or volume of the hazardous materials released to the extent feasible” (IRule 2019). If effective, this alternative may minimize the need for long term management at the Site. The existing AS/SVE system was installed in September 2007 and operated until May 2010. From 2007 through 2009, steam injection was used in combination with portions of the AS/SVE system to enhance mobilization of CVOCs from soils and groundwater into the vapor phase (in the former degreaser source area only). Alternative A includes restarting the AS/SVE system and utilizing a subset of recovery and injection points to try to volatilize PCE from groundwater. This alternative does not include restarting the steam injection system.

The AS/SVE system consists of 32 SVE wells and 75 AS wells. The SVE system includes 2 rotary lobe blowers capable of extracting 1600 standard cubic feet per minute 6 inches of mercury, 1 air-water heat exchanger, 2 moisture separators, 3 granular activated carbon vessels for off gas treatment, and associated pumps and instruments. The AS system includes 2 rotary lobe blowers capable of injecting 12 pounds per square inch (gauge) of compressed air, 1 air-water heat exchanger, and associated pumps and instruments. Extracted water and SVE system condensate were processed through bag filters, an air stripper, and granular activated carbon vessels. This alternative considered connecting 11 existing SVE points and 30 existing AS points along the downgradient portion of the Site as shown on Figure 4. These locations are along the northern Site property boundary and are the closest existing points to the remaining impacted groundwater observed off-Site.

3.2.2 Alternative B – Long Term Monitoring

Alternative B, long term monitoring, is an alternative that involves little or no treatment, but, as per IRule § 35-604(c) “controls impacts to sensitive receptors through engineered controls, containment, long term monitoring, and institutional controls”. Long term monitoring consists of collecting samples from on- and off-site monitoring wells to monitor CVOC and PFAS concentrations. Although this does not reduce contaminant mass and concentrations, routine monitoring will allow routine assessment of COC concentrations to determine if they are increasing, if there are potential exposures that have not been controlled, and will monitor natural attenuation over time. There are currently 17 monitoring wells on-Site and 6 monitoring wells downgraient/off-Site. Wells are screened at the target depth which is the shallow aquifer above the silt aquitard. Consistent with the CSM, this aquitard prevents vertical migration of COCs. Alternative B includes annual monitoring of up to 8 monitoring wells in the shallow aquifer, as shown on Figure 5.

3.2.3 Alternative C – No Action

Alternative C, no action, does not control impacts. It has been included for comparison purposes but does not include additional action or sample collection.

3.2.4 Evaluation of Groundwater Corrective Action Alternatives

IRule § 35-604(d) specifies that each corrective action alternative shall be evaluated against ten specific criteria. The results of ERM’s evaluation are provided as Table 1 and summarized below.

3.2.4.1 Alternative A – Restart Air Sparge/Soil Vapor Extraction System

Alternative A was determined to be most protective of human health and the environment as it has the potential to remove COC mass and reduce groundwater concentrations. This alternative complies with legal requirements but will likely require emission controls (as previously operated) and/or a permit to discharge extracted vapors to the atmosphere. The long-term effectiveness and permanence of this remedy is unknown. Although the technology has been used to reduce contaminant mass in the past, there are no defined source areas or defined migrating dissolved phase plumes to treat and the rate of mass removal from dilute, dissolved phase concentrations, like those present near the current location of the AS/SVE system, is likely to be very low. The existing system was shut down due to decreasing mass removal relative to cost and it is unlikely that restarting the system will reduce contaminant mass in the short term. The operational duration of the system to reduce COC concentrations below the GWQES is undefined but is expected to exceed 30 years. Additionally, the AS/SVE system will not remove an appreciable mass of PFAS as AS/SVE is not a technology proven to be effective in PFAS remediation.

Due to the long timeframe required to reduce COC concentrations and the ineffectiveness of this remedy for PFAS, land-use restrictions, including groundwater reclassification may be necessary, in the short- to mid-term to address the exposure pathways identified in Section 2.1.

Alternative A presents the following when compared to the criteria established by IRule § 35-604(d):

- Has the potential to reduce COC toxicity, mobility, or volume through treatment but will only be effective for volatile COCs and not PFAS;
- May have limited effectiveness because the efficiency AS/SVE declines with decreasing concentrations and, based on VOC concentrations currently observed at the Site, it is unlikely that large reductions will be achieved using this technology;
- May be effective in the short-term and poses little risk to sensitive receptors, workers, and the environment during implementation;
- Could be implemented but there are technical and administrative limitations, including declining recovery rates and the unknown future use of the building;
- Would require coordination with future owners and/or occupants of the building which may limit future operations (future building use is unknown);
- Has all materials and services required for implementation available as the system has operated previously;
- Has the highest cost of the groundwater corrective action alternatives considered with an estimated net-present value (NPV) of $1,268,000 over a 30 year period (Appendix A);.
- Has the highest environmental impact due to the energy needed to operate the system; the environmental impacts of electricity use and materials are expected to exceed the environmental benefits of reducing the low concentrations of COCs remaining at the Site; and
- Is assumed to be likely acceptable to the community as it is an active remedy with the potential to reduce contaminant concentrations.

For each of the receptors identified in Section 2.1, Alternative A will mitigate risk by:

- On-Site Workers – using land-use restrictions (groundwater reclassification and/or deed restrictions) to prevent the use of groundwater for drinking, irrigation, or other purpose will prevent a complete risk pathway in the short term. If successful in the long term, restrictions may be removed if concentrations are sufficiently reduced.
- On-Site Construction and Utility Workers – using land-use restrictions (groundwater reclassification and/or deed restrictions and a soil/groundwater management plan) to mandate proper monitoring and personal protective equipment will mitigate risk to on-site construction and utility workers in the short term. If successful in the long term, restrictions may be removed if concentrations are sufficiently reduced.
- On-Site Residents – using land-use restrictions (groundwater reclassification and/or deed restrictions) to prevent the use of groundwater for drinking, irrigation, or other purpose will prevent a complete risk pathway in the short term. If successful in the long term, restrictions may be removed if concentrations are sufficiently reduced.
- Downgradient/Off-Site Construction and Utility Workers – using land-use restrictions (groundwater reclassification and a soil/groundwater management plan) to mandate proper monitoring and personal protective equipment will mitigate risk to off-site construction and utility workers in the short

term. If successful in the long term, restrictions may be removed if concentrations are sufficiently reduced.

- Downgradient/Off-Site Residents – using land-use restrictions (groundwater reclassification) to prevent the use of groundwater for drinking, irrigation, or other purpose will prevent a complete risk pathway in the short term. If successful in the long term, restrictions may be removed if concentrations are sufficiently reduced.

3.2.4.2 Alternative B – Long Term Monitoring

Alternative B was determined to be protective of human health and the environment by identifying potential exposure conditions and allowing for implementation of additional corrective actions if needed in the future. The only legal requirements for implementing Alternative B are a VTDEC-approved work plan; no additional permits are needed. Long term monitoring is an effective and permanent remedy as long as it continues to be conducted. Because there is no active COC mass removal, long term monitoring is assumed to continue indefinitely. Land-use restrictions, including groundwater reclassification, would be a part of the long term monitoring remedy to eliminate the potential exposure pathways identified in Section 2.1.

Alternative B presents the following when compared to the criteria established by IRule § 35-604(d):

- Will not reduce COC toxicity, mobility, or volume through treatment although some reductions in concentrations are expected over time due to natural degradation and retardation processes;
- Will utilize existing infrastructure (i.e., existing monitoring wells) so, in the short-term, there are no risks to sensitive receptors, workers, or the environment during implementation;
- Has no technical or administrative barriers to implementation as all wells are already installed, are outdoors, and are readily accessible;
- Does not require service or materials as the wells have been sampled in the past 12 to 18 months and are in working condition;
- Has an estimated NPV of $366,000 over a 30 year period (Appendix A) which is substantially lower than that of Alternative A;
- Has a low environmental impact which is limited to travel to and from the Site and disposal of small volumes of wastewater during sample collection; and
- Is assumed to be likely acceptable to the community due to the low environmental impact and ongoing monitoring and evaluation of Site conditions and potential risks, Alternative B.

For each of the receptors identified in Section 2.1, Alternative B will mitigate risk by:

- On-Site Workers – using land-use restrictions (groundwater reclassification and/or deed restrictions) to prevent the use of groundwater for drinking, irrigation, or other purpose will prevent a complete risk pathway in the short term. Ongoing monitoring will allow additional action to be taken if concentrations increase and the removal of restrictions if concentrations naturally attenuate to sufficiently low concentrations.
- On-Site Construction and Utility Workers – using land-use restrictions (groundwater reclassification and/or deed restrictions and a soil/groundwater management plan) and mandating proper monitoring and personal protective equipment will mitigate risk to on-site construction and utility workers in the short term. Ongoing monitoring will allow additional action to be taken if concentrations increase and the removal of restrictions if concentrations naturally attenuate to sufficiently low concentrations.

- On-Site Residents – using land-use restrictions (groundwater reclassification and/or deed restrictions) to prevent the use of groundwater for drinking, irrigation, or other purpose will prevent a complete risk pathway in the short term. Ongoing monitoring will allow additional action to be taken if concentrations increase and the removal of restrictions if concentrations naturally attenuate to sufficiently low concentrations.
- Downgradient/Off-Site Construction and Utility Workers – using land-use restrictions (groundwater reclassification and a soil/groundwater management plan) and mandating proper monitoring and personal protective equipment will mitigate risk to off-site construction and utility workers in the short term. Ongoing monitoring will allow additional action to be taken if concentrations increase and the removal of restrictions if concentrations naturally attenuate to sufficiently low concentrations.
- Downgradient/Off-Site Residents – using land-use restrictions (groundwater reclassification) to prevent the use of groundwater for drinking, irrigation, or other purpose will prevent a complete risk pathway in the short term. Ongoing monitoring will allow additional action to be taken if concentrations increase and the removal of restrictions if concentrations naturally attenuate to sufficiently low concentrations.

3.2.4.3 Alternative C – No Action

Alternative C would not be protective of human health and the environment as COCs would be left in place with no monitoring or containment. This alternative would not meet legal requirements or be accepted by VTDEC. 'No action' is not an effective or permanent remedy as COCs are left in place and potential future risks would not be managed. Although land-use restrictions, including groundwater reclassification would be necessary to eliminate the potential exposure pathways identified in Section 2.1, Alternative C does not provide for implementing these restrictions.

Alternative C presents the following when compared to the criteria established by IRule § 35-604(d):

- Will not reduce COC toxicity, mobility, or volume through treatment although some reductions in concentrations are expected over time due to natural degradation and retardation processes but these would not be detected in the absence of future monitoring;
- Poses no risks to sensitive receptors or workers during implementation as there are no activities, but leaving the COCs unmonitored has potential future environmental impacts;
- Has no technical barriers to implementation;
- Is not effective and will likely not be accepted administratively;
- Does not require service or materials for implementation;
- Has an estimated NPV of $0 over a 30 year period (Appendix A), making it the least expensive alternative for groundwater;
- Has a low environmental impact as no activities will be conducted; and
- Is likely unacceptable to the community due to the lack of active monitoring and evaluation of potential future risks.

Alternative C will not mitigate risk to receptors identified in Section 2.1.

3.2.5 Recommended Groundwater Corrective Action Alternative

Based on the scoring of alternatives presented in Table 1, Alternative B, long term monitoring, is the recommended corrective action alternative. As described above, this remedy will protect human health and the environment through land-use restrictions and by monitoring contaminant concentrations and allowing identification of future risks, unlike Alternative C (no action). In addition, both the financial and environmental costs of Alternative B are substantially lower than those of Alternative A (restarting the AS/SVE system). The potential benefits of Alternative A are uncertain and would require similar land-use restrictions in the short term. Figure 5 shows the proposed monitoring well network for long term monitoring.

3.3 Soil Gas to Indoor Air (Vapor Intrusion) Evaluation

The following alternatives have been considered to control exposure of receptors to the migration of COCs in soil gas into indoor air:

- Alternative A: Active vapor mitigation;
- Alternative B: Passive vapor mitigation;
- Alternative C: Institutional controls;
- Alternative D: Excavation; and
- Alternative E: No Action.

3.3.1 Alternative A – Active Vapor Mitigation with Institutional Controls

Alternative A, active vapor mitigation, is an alternative that involves little or no soil gas treatment but, as per IRule § 35-604(c), “controls impacts to sensitive receptors through engineered controls, containment, long term monitoring, and institutional controls”. The active vapor mitigation technology considered would be one or more sub-slab depressurization systems which consist of installing a series of sub-slab suction points through all or a portion of the buildings’ foundations and connecting those points to one or more electrically powered fans. The system(s) will draw air from the subsurface through vent stacks to the outside atmosphere and will create a negative pressure (vacuum) under the slab relative to the indoor air space. By maintaining a negative pressure below the buildings’ foundations, migration of soil vapors into indoor air (vapor intrusion) can be mitigated. Institutional controls consist of deed restrictions to limit the use of some or all of the buildings to certain uses (e.g., limit to non-residential use only) and may be needed depending on the future configuration of the buildings.

3.3.2 Alternative B – Passive Vapor Mitigation with Institutional Controls

Alternative B, passive vapor mitigation, is an alternative that involves little or no soil gas treatment, but, as per IRule § 35-604(c), “controls impacts to sensitive receptors through engineered controls, containment, long term monitoring, and institutional controls”. Passive vapor mitigation involves sealing floors and floor penetrations (i.e., cracks, joints, utility penetrations, etc.) to mitigate the migration of soil gas through the buildings foundations and into indoor air. Although it is not possible to fully seal all surfaces, maintaining sufficient passive barriers has the potential to reduce the concentrations of COCs in indoor air sufficiently to reduce the risk to potential receptors. Institutional controls consist of deed restrictions to limit the use of some or all of the building to certain uses (e.g., limit to non-residential use only) and may be needed depending on the effectiveness of the barrier and future configuration of the building.

3.3.3 Alternative C – Institutional Controls Only

Alternative C, institutional controls, is an alternative that involves little or no soil vapor treatment, but, as per IRule § 35-604(c), “controls impacts to sensitive receptors through engineered controls, containment, long term monitoring, and institutional controls”. Institutional controls consist of deed restrictions that would limit the use of some or all of the buildings to certain uses (e.g., limit to non-residential use only) to mitigate potential receptors that may be exposed to COCs in indoor air. This alternative may be effective if COC concentrations in indoor air are below non-residential thresholds.

3.3.4 Alternative D – Excavation

Alternative D, excavation, is an alternative that "reduces the toxicity, mobility, or volume of the hazardous materials released to the extent feasible" (IRule 2019). This alternative may minimize the need for long term management at the Site. It includes removal of floors from portions of the buildings and excavation of soils from those areas. For the cost estimate, the area was selected based on soil gas concentrations and an average depth of 4 feet below grounds surface was assumed (Figure 6). Prior to implementing the remedy, soil sampling would be required to confirm the excavation areas therefore pre-excavation soil sampling costs are included in the design estimate. Excavations would be backfilled with clean fill and new floors would be installed. Excavated soil would be sampled and characterized for off-site disposal at appropriately licensed facilities (for costing purposes this was assumed to be non-hazardous soil). Removing COC-impacted soils would reduce/eliminate the potential source of soil vapors and prevent migration into indoor air.

3.3.5 Alternative E – No Action

Alternative E, no action, does not control impacts. It has been included for comparison purposes but does not include additional action, controls, or sample collection.

3.3.6 Evaluation of Indoor Air Corrective Action Alternatives

IRule § 35-604(d) specifies that each corrective action alternative shall be evaluated against ten specific criteria. The results of ERM's evaluation are provided as Table 2 and summarized below.

3.3.6.1 Alternative A – Active Vapor Mitigation with Institutional Controls

Alternative A was determined to be protective of human health and the environment as it has the potential to mitigate the migration of COCs from soil gas into indoor air. This alternative complies with legal requirements but will require VTDEC approval of a work plan. Active vapor mitigation is an effective remedy as long as the system is maintained and operated. Because the system is not designed specifically for COC mass removal, active vapor mitigation is assumed to continue for a long period of time until soil gas concentrations naturally degrade below risk-based thresholds (likely greater than 30 years). Land-use restrictions will be required to mandate that future Site owners continue to maintain and operate the mitigation system and to eliminate the potential exposure pathways identified in Section 2.2.

Alternative A presents the following when compared to the criteria established by IRule § 35-604(d):

- Reduces COC toxicity by mitigation of an exposure pathway and, although the system would not be designed for COC mass removal, limited removal will occur during the ventilation process;
- Would not impact residents or facility workers during system(s) construction (buildings are currently unoccupied and construction would take place prior to building re-occupancy);
- Would cause minimal exposure to system construction workers during implementation and impacts would be managed by proper health and safety planning;
- Would leave COCs in place and, thus, have limited environmental impact during implementation;
- Has few technical or administrative barriers to implementation; active vapor mitigation is feasible and has been implemented at similar sites (Due to the unique construction, age, and complexity of Plant 1, installation of active vapor mitigation may be difficult in some areas. These areas are limited portions of the building were mitigation will need to be modified either due to the presence of shallow

water, the absence of a slab (i.e, dirt floor crawl space) or the presence of sleeper floors. As the future use of the buildings is unknown, the design of active vapor mitigation must be coordinated and compatible with future building use once it is known.);

- Uses materials and services that are readily available;
- Has an estimated NPV of $2,120,000 over an assumed 30 year period (Appendix A);
- Has a moderate environmental impact due to the energy requirements of operating one or more fans; energy use can be minimized by proper design and fan selection; and
- Is assumed to likely be acceptable to the community due to the potential to mitigate exposure.

For each of the receptors identified in Section 2.2, Alternative A will mitigate risk by:

- On-Site Workers – eliminating an exposure pathway by using pressure differentials to reduce the migration of soil gas into indoor air and reduce indoor air concentrations to below risk-based criteria.
- On-Site Construction and Utility Workers – eliminating an exposure pathway by using pressure differentials to reduce the migration of soil gas into indoor air and reduce indoor air concentrations to below risk-based criteria.
- On-Site Residents – eliminating an exposure pathway by using pressure differentials to reduce the migration of soil gas into indoor air and reduce indoor air concentrations to below risk-based criteria. Depending on the use of the building and the amount of reduction achieved by the mitigation system, institutional controls (e.g. limit portions to non-residential use) will be used to prevent exposure to these receptors.

3.3.6.2 Alternative B – Passive Vapor Mitigation with Institutional Controls

Alternative B was determined to be protective of human health and the environment as it has the potential to mitigate the migration of COCs from soil gas into indoor air. This alternative may not be acceptable to regulators unless continued indoor air monitoring is used to monitor the passive barriers' effectiveness over time. Passive vapor mitigation may be an effective remedy if floor sealants are properly maintained and monitored; routine indoor air monitoring is likely necessary to demonstrate ongoing effectiveness. Passive vapor mitigation will not remove COC mass and is assumed to remain in place indefinitely. Land-use restrictions will be required to mandate that future Site owners continue to maintain and monitor the passive barrier and to eliminate the potential exposure pathways identified in Section 2.2.

Alternative B presents the following when compared to the criteria established by IRule § 35-604(d):

- Reduces COC toxicity by mitigation of an exposure pathway but will not reduce contaminant mass in the environment;
- Would not impact residents or facility workers during passive barrier installation (building is currently unoccupied and installation would take place prior to building re-occupancy);
- Would not expose system construction workers to COCs during implementation as there is no subsurface disturbance;
- Would leave COCs in place and, thus, have limited environmental impact during implementation;
- May be technically difficult to implement as there are numerous potential soil vapor migration pathways and it may not be possible to seal all of them and, as the future use of the buildings is unknown, the design of the passive vapor mitigation system must be coordinated and compatible with potential future use;
- Uses materials and services that are readily available;

- Has an estimated NPV of $2,700,000 over a 30 year period (Appendix A);
- Has a moderate to low environmental impact due to the use of chemical sealants and requirements for routine inspection visits; the environmental impact can be mitigated by consideration and selection of chemical sealants with lower environmental impact; and
- Is assumed to likely be moderately acceptable to the community due to the difficulty of implementing passive vapor mitigation and the difficulty in proving effectiveness.

For each of the receptors identified in Section 2.2, Alternative B will mitigate risk by:

- On-Site Workers – eliminating an exposure pathway by using physical barriers to reduce the migration of soil gas into indoor air and reduce indoor air concentrations to below risk-based criteria. Routine indoor air monitoring will be required to identify potential failure of the barrier. Institutional controls limiting access to portions of the building may be necessary if concentrations cannot be sufficiently reduced by passive mitigation.
- On-Site Construction and Utility Workers – eliminating an exposure pathway by using physical barriers to reduce the migration of soil gas into indoor air and reduce indoor air concentrations to below risk-based criteria. Routine indoor air monitoring will be required to identify potential failure of the barrier. Institutional controls limiting access to portions of the building may be necessary if concentrations cannot be sufficiently reduced by passive mitigation.
- On-Site Residents – eliminating an exposure pathway by using physical barriers to reduce the migration of soil gas into indoor air and reduce indoor air concentrations to below risk-based criteria. Depending on the use of the building and the amount of reduction achieved by the mitigation system, institutional controls (e.g. limit portions to non-residential use) will be used to prevent exposure to these receptors.

3.3.6.3 Alternative C – Institutional Controls Only

Alternative C was determined to be partially protective of human health and the environment as it can limit the exposure of receptors to the potential for vapor intrusion. This alternative utilizes legal controls to limit the receptors that may be exposed to soil gas through vapor intrusion. Depending on the future use and configuration of the buildings, it may not be possible to meet acceptable exposure levels through legal controls alone. Institutional controls may not always be an effective remedy if future occupants or owners fail to adhere to the limitations of the controls. Alternative C will not remove COC mass and the controls are assumed to remain in place indefinitely. The institutional controls will take the form of land-use restrictions such that future Site owners adhere to the restricted Site use to eliminate the potential exposure pathways identified in Section 2.2.

Alternative C presents the following when compared to the criteria established by IRule § 35-604(d):

- Will not reduce COC toxicity, mobility, or volume through treatment;
- Does not include a physical implementation that could pose a risk to workers or the environment; environmental impacts would remain in place as there is no physical mitigation of the subsurface;
- Implementation is complicated by the unknown future use of the facility and institutional controls (i.e., land use restrictions) prevent potential buyers from acquiring the facility in its current state;
- Does not require services or materials for implementation;
- Has an estimated NPV of $10,000 over a 30 year period (Appendix A);
- Has a low environmental impact as there is no active removal of COC mass but it does reduce the potential uses of the Site; and

- Is assumed to likely be moderately acceptable to the community due to the unknown future use of the Site.

For each of the receptors identified in Section 2.2, Alternative C will mitigate risk by:

- On-Site Workers – removing potential receptors by limiting access to portions of the building where indoor air concentrations pose a risk.
- On-Site Construction and Utility Workers – removing potential receptors by limiting access to portions of the building where indoor air concentrations pose a risk and requiring property monitoring and health and personal protective equipment if access is required.
- On-Site Residents – removing potential receptors by limiting the use of portions of the building to non-residential uses.

3.3.6.4 Alternative D – Excavation

Alternative D was determined to be most protective of human health and the environment as it will remove COC mass in the vadose zone under the building. This alternative complies with legal requirements but requires construction permitting, soil management, structural assessments of the building, excavation shoring, and a VTDEC approved work plan. Excavation is likely to be effective but the lack of a defined source area could result in residual impacts that remain after excavation. Alternative D has the potential to eliminate the need for land-use restrictions after soil removal.

Alternative D presents the following when compared to the criteria established by IRule § 35-604(d):

- Will reduce COC volume and mobility by removing soil from the Site;
- Would not impact residents or workers as the building would be closed during implementation;
- Would cause potential exposure to construction workers during implementation but impacts would be managed by proper health and safety planning;
- Would remove COCs from the Site but they would be potentially placed elsewhere (e.g., landfilled) and there is the potential for additional releases of material during excavation, staging, and transportation of excavated materials;
- Is difficult to implement due to the presence of large structures (Plant 1 and Plant 2) on the Site that would require structural support during excavation and need for careful coordination between subcontractors, site owners, and local authorities;
- The necessary services and materials for implementation are expected to be available;
- Has the highest cost of the soil vapor corrective action alternatives considered with an estimated net-present value (NPV) of $4,420,000 (Appendix A);
- Has the highest environmental impact due to the impacts associated with construction activities but, after excavation, there would be no operations and maintenance which would limit the long-term environmental impacts; and
- Is assumed to likely be accepted by the community as it would remove COCs from the Site and short-term impacts and disruptions are limited to the vicinity of the Site.

For each of the receptors identified in Section 2.2, Alternative C will mitigate risk by:

- On-Site Workers – removing COCs from the subsurface to potentially eliminate exposure.
- On-Site Construction and Utility Workers – removing COCs from the subsurface to potentially eliminate exposure.

- On-Site Residents – removing COCs from the subsurface to potentially eliminate exposure.

3.3.6.5 Alternative E – No Action

Alternative E would not be protective of human health and the environment as COCs would be left in place with no monitoring or mitigation. This alternative would not meet legal requirements or likely be accepted by VTDEC. No action is not an effective remedy as COCs are left in place and potential future risks would not be managed. Although land-use restrictions, including limiting the types of site occupants, would be necessary to eliminate the potential exposure pathways identified in Section 2.2, Alternative E does not provide for implementing these restrictions

Alternative E presents the following when compared to the criteria established by IRule § 35-604(d):

- Will not reduce COC toxicity, mobility, or volume through treatment although some reductions in concentrations are expected over time due to natural degradation and retardation processes but these would not be detected in the absence of future monitoring actions;
- Poses no risks to residents or workers during implementation, as there are no activities, but leaving the COCs unmonitored has potential future environmental impacts;
- Has no technical barriers to implementation but it is not effective and will likely not be accepted administratively;
- Does not require services or materials for implementation;
- Has an estimated NPV of $0 over a 30 year period (Appendix A), making it the least expensive alternative for soil gas;
- Has a low environmental impact as no activities will be conducted; and
- Is assumed to likely be unacceptable to the community due to the lack of active monitoring and evaluation of potential future risks.

Alternative E will not mitigate risk to receptors identified in Section 2.2.

3.3.7 Recommended Soil Gas to Indoor Air Corrective Action Alternative

Based on the scoring of alternatives presented in Table 2, Alternative A, active vapor mitigation with institutional controls, is the recommended corrective action alternative for soil gas migration to indoor air. As described above, this remedy will protect human health and the environment by mitigating the potential for soil vapors migration into indoor air (i.e., mitigate the potential for vapor intrusion). It is more likely to mitigate vapor intrusion than Alternative B, passive vapor mitigation, and both alternatives have similar costs. Alternative D, excavation, has substantial financial and environmental costs and would be very difficult to implement due to the presence of existing buildings. Alternative E, no action, will not be protective of human health. The institutional controls considered under Alternative C may be appropriate for portions of the property in conjunction with active vapor mitigation but were determined to be insufficient as a standalone remedy. For cost purposes, Alternative A considered active mitigation over the entirety of Plant 1 and Plant 2. The extent of active mitigation may be limited by additional institutional controls (e.g. limiting portions to non-residential use). The final combination of institutional controls and active vapor mitigation will be determined once future building use and layout is known.

4. CONCLUSIONS AND RECOMMENDATIONS

ERM, on behalf of Energizer has evaluated two sets of corrective action alternatives in accordance with IRule § 35-604, one set for COCs present in groundwater and one set for the migration of COCs into indoor air through vapor intrusion.

Based on the criteria presented in the IRule and the scoring shown in Table 1, long term monitoring is the proposed corrective action for COCs in groundwater. This remedy will also include the land use restrictions necessary to mitigate risk to future potential receptors including groundwater reclassification and site and soil management plans. Upon written approval of this ECAA by VTDEC, Energizer will complete, submit, and implement a corrective action plan (CAP) for long term monitoring of COCs in groundwater.

Based on the criteria presented in the IRule and the scoring shown in Table 2, active vapor mitigation with institutional controls is the proposed corrective action to mitigate the potential for vapor intrusion. Institutional controls will be implemented in conjunction with active vapor mitigation but the exact controls and extent of mitigation systems depends on the future use and configuration of the Site buildings. The facility buildings are still undergoing closure and cleaning and future use of the properties is unknown at this time. Once facility cleaning is complete, indoor air sampling[1] will be used to further define areas where active mitigation may be appropriate. The location and design of active mitigation systems will then be completed once future building use and layouts are determined by a new buyer. Upon approval of this ECAA by VTDEC and identification of a future Site owner or occupant, Energizer will prepare and submit a CAP for active vapor mitigation and institutional controls to mitigate exposure of occupants to COCs through vapor intrusion. The CAP will be prepared and implemented in conjunction with the new owner to protect human health, meets the requirements of the IRule, and be consistent with the proposed new use of the Site.

[1] Due to timing of facility cleaning, indoor air sampling has not yet been completed. A work plan for indoor air sampling will be submitted to VTDEC under separate cover. Indoor air sampling results will either be reported as part of the CAP or will be submitted to VTDEC prior to submittal of the CAP.

5. REFERENCES

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TABLES

Table 1. Groundwater Remedial Alternatives Analysis
Energizer Holdings, Inc., Bennington, VT

		Groundwater					
		Restart Existing Air-Sparge/ SVE System		**Long-Term Monitoring**		**No Action**	
Description		Injection of air into the subsurface to encourage transfer of chlorinated solvents from the aqueous phase to the vapor phase. Conducted in conjunction with soil vapor extraction.		Continued monitoring of target comounds in groundwater over the long term and monitoring of natural subsurface processes		No remedial action completed	
Protection of Human Health and the Environment		Protects human health and the environment by removing impacts to the subsurface	5	Protects human health and the environment by identifying potential exposure condition and allows for implementing corrective actions if needed in the future	4	No actions taken to address potential impacts to human health or the environment	1
Compliance with Legal Requirements		Work plan approvals and discharge permits will need to be obtained but are reasonable to obtain from local and state agencies.	4	An approved long term management work plan will be needed to implement this remedial action but approval is possible from state agency.	5	This alternative will likely not meet legal requirements for the applicable agency.	2
Long Term Effectiveness and Permanence		Potential to remove subsurface impacts; however, no defined significant source areas to treat and unlikely to remove significant additional mass (relative to previous system operation). In addition, current system is built as a border containment system and not located where current mass may be located. Operational duration of the system is not yet defined.	3	Effective as long as monitoring is conducted; monitoring will likely need to be conducted over a long duration.	4	Not effective; subsurface impacts remain unmanaged	1
Land Use Restrictions		Land-use restrictions may be necessary including groundwater reclassification.	3	Land-use restrictions may be necessary including groundwater reclassification.	3	Land-use restrictions may be necessary including groundwater reclassification.	3
Reducing Toxicity, Mobility, or Volume through Treatment		If targeted in areas of specific concern there is a high likely of reducing mobility and volume of mass. Existing system however may not be as effective at mass reduction since it is at the border of the property. May work to reduce impact mobility of mass still on the property.	3	Passive monitoring of changes to subsurface impacts. Impacts likely to naturally reduce over time.	2	Subsurface impacts remain unchanged	1
Short Term Effectiveness (Implementation/Construction Phase)	**Risk to Sensitive Receptors During Implementation**	Currently Site is closed to receptors so no short-term risk to sensitive receptors during implementation. Operation of system likely to continue after Site occupation but not likely to post risk to sensitive receptors - 5	4	Currently Site is closed to receptors so no short-term risk to sensitive receptors during implementation. Operation of system likely to continue after Site occupation but not likely to post risk to sensitive receptors - 5	4	No risk; no implementation of remedy - 5	3
	Impacts to Workers (i.e. construction workers)	Minimal exposure risk to workers during implementation. -4		Ground will not be disturbed so no exposure risk to workers during implementation. 5		No risk; no implementation of remedy - 5	
	Environmental Impact	Operation should reduce impacts to groundwater - 4		Monitoring allows for implementing corrective actions if needed in the future - 3		No implementation of a remedy - 1	
Implementability	**Technical**	Moderately difficult to implement, as demonstrated by declining recovery observed during the system's previous operation at the site - 3	4	Feasible to implement a long-term monitoring program -5	5	Feasible to conduct no action at the site but not likely effective - 2	3
	Administrative	Coordination with future use of building will be needed to provide for long term system O&M - 4		All wells are outdoors and readily accessible - 5		Agency coordination will be needed to obtain approval for no action. Will be dependent on future site use - 4	
	Availability of Services and Materials	Air-Sparge/ SVE System is already in place (operational condition unknown). Readily available resources if additional system components needed - 5		Groundwater monitoring wells required for monitoring are already installed on-site and are in working condition - 5		No services or materials needed -5	

Table 1. Groundwater Remedial Alternatives Analysis
Energizer Holdings, Inc., Bennington, VT

		Groundwater					
		Restart Existing Air-Sparge/ SVE System		**Long-Term Monitoring**		**No Action**	
Approximate Cost	Capital	$95,000	1	$0.00	4	$0.00	5
	Annual O&M	$51,000		$15,000		$0.00	
	Land Use Restrictions	$30,000		$30,000		$0.00	
	Net Present Value	**$1,268,000**		**$366,000**		**$0.00**	
Environmental Impacts and Sustainability		High environmental impact; system is very energy intensive but has potential to reduce contamination	2	Low environmental impact; purge water waste can be minimized.	4	No action; therefore, low environmental impacts from remedy.	4
Community Acceptance		Likely to be accepted because it minimizes potential exposure conditions and mitigates risk to future building occupants	5	Likely to be accepted as groundwater conditions will continue to be monitored	5	Unlikely to be accepted; leaves impacts unmanaged.	1
Recommendation and Total Score			**34**		**40**		**24**

Notes:

1	= Unfavorable
2	= Mostly Unfavorable
3	= Some Limitations
4	= Somewhat Favorable
5	= Favorable

Table 2. Indoor Air Remedial Alternatives Analysis
Energizer Holdings, Inc.; Bennington, VT

		Indoor Air									
		Active Vapor Mitigation		**Passive Vapor Mitigation**		**Institutional Controls**		**Excavation**		**No Action**	
Description		Installing an electrically powered, mechanical system to mitigate the potential for soil gas migration into selected portions of Plant 1 and Plant 2.		Sealing floors in Plant 1 and Plant 2 to minimize the potential for soil gas to migrate into indoor air.		Non-engineering controls such as property use limitations (legal or administrative) that minimize the potential for human exposure to contamination by limiting building use.		Physical removal of portions of the floors in Plant 1 and 2. Excavate soil down to a specified depth below the slab, with disposal/treatment at an off-site waste facility. Reconstruction of floors.		No remedial action completed.	
Protection of Human Health and the Environment		Protects human health by mitigating potential soil vapors from migrating into indoor air	5	Protects human health by inhibiting potential soil vapors from migrating into indoor air	4	Protects human health by limiting exposure to the contaminated environment	3	Protects human health and the environment by removing impacted soil permanently	5	Not protective of human health or the environment	1
Compliance with Legal Requirements		Active systems may still not be acceptable indoor air risk-based thresholds. Potential need for vapor treatment and air discharge permit.	4	Passive mitigation methods alone may not be acceptable to state regulators when human health risk is above acceptable limits	1	Legal controls required. May not be possible to meet acceptable exposure by just limiting access.	3	Requires construction permitting, soil management, and assessment of structural integrity of the building.	4	Not likely to be acceptable to state regulators when human health risk is above acceptable limits	1
Long Term Effectiveness and Permanence		Effective as long as active vapor mitigation system is maintained; system may need to be operated indefinitely	4	Potentially effective as long as floor sealant is maintained; sealant may need to be monitored and maintained indefinitely and indoor air monitoring may be needed to prove effectiveness.	2	May be difficult for occupants to adhere to limitations of institutional control	3	Potential to remove contamination permanently; however, contamination source area is not clearly defined and residual impacts could remain	4	Not effective; contaminant remains unmanaged	1
Land Use Restrictions		Requires subsequent operators to maintain system	4	Requires subsequent operators to maintain sealants	4	Restricted use of on-site buildings	3	Potential for no restrictions after excavation	5	Restricted use of portions of the site	2
Reducing Toxicity, Mobility, or Volume through Treatment		Reduces toxicity by mitigating exposure pathway and some mass removal will happen during the ventilation process. Some mass still remains in subsurface.	4	Reduces toxicity by inhibiting exposure pathway but impacts still remain in subsurface.	3	No reduction of contaminant	1	Reduces volume by permanently removing contamination from below the building slab	5	No reduction of contaminant	1
Short Term Effectiveness (Implementation/Construction Phase)	**Risk to Sensitive Receptors During Implementation**	Site will be closed to receptors so no short-term risk to sensitive receptors during implementation - 5	4	Site will be closed to receptors so no short-term risk to sensitive receptors during implementation - 5	4	Implementation is administrative; no physical risk to sensitive receptors - 5	4	Site will be closed to receptors so no short-term risk to sensitive receptors during implementation - 5	3	No risk; no implementation of remedy - 5	4
	Impacts to Workers (i.e. construction workers)	Minimal exposure risk to workers during implementation. -4		Ground will not be disturbed so no exposure risk to workers during implementation. 5		Implementation is administrative; no physical risk to sensitive receptors - 5		Workers will be directly exposed to contaminated soil during excavation activities; increased air quality risk while managing soil; workers also exposed to other hazards associated with construction activities - 2		No risk; no implementation of remedy - 5	
	Environmental Impact	Impacts remains in the subsurface but potential indoor exposure is reliably mitigated - 4		Impacts remains in the subsurface but potential indoor exposure is inhibited - 3		Contaminant remains in the environment - 2		Moves contaminated soil to another location with the potential to spread impacts over a larger area - 3		Contaminant remains in the environment - 2	
Implementability	**Technical**	Feasible and typical method of mitigation at similar sites - 4	4	May be difficult to fully seal all potential pathways - 3	4	Limiting future site use may go against re-use objectives of a future buyer - 3	3	Significant building and structural issues will need to be taken into account as well as additional soil/soil vapor data to define excavation areas - 3	3	No technical implementation component - 5	5
	Administrative	Coordination with future use of building will be needed ahead of installation but possible for system to be built around future site use activities - 4		Coordination with future use of building will be needed ahead of installation but possible for system to be built around future site use activities - 3		New site owners and unknown future use; difficult to coordinate; institutional controls will limit future use - 2		Excavation activities will require coordination with various subcontractors and, if after property sale, then also new site owners. Possibly also coordination with local building department - 2		Agency coordination will be needed to obtain approval for no action. Will be dependent on future site use - 4	
	Availability of Services and Materials	System installation requires typical off the shelf building materials and resources - 5		Application requires typical off the shelf building materials and resources - 5		No services or materials required - 5		Multiple subcontractors and resources required to complete work but work is possible within reasonably available construction resources - 5		No services or materials required - 5	

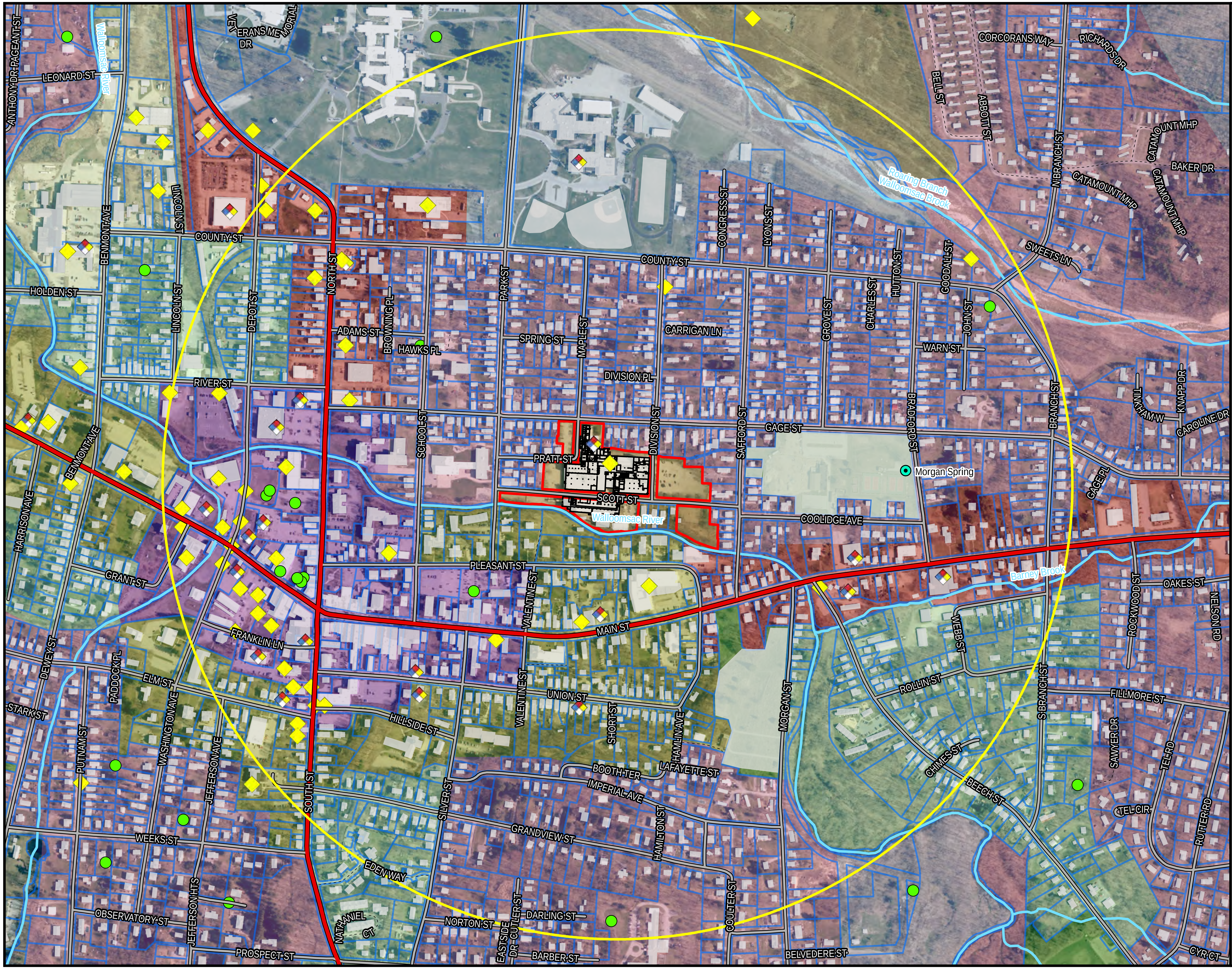
Table 2. Indoor Air Remedial Alternatives Analysis
Energizer Holdings, Inc.; Bennington, VT

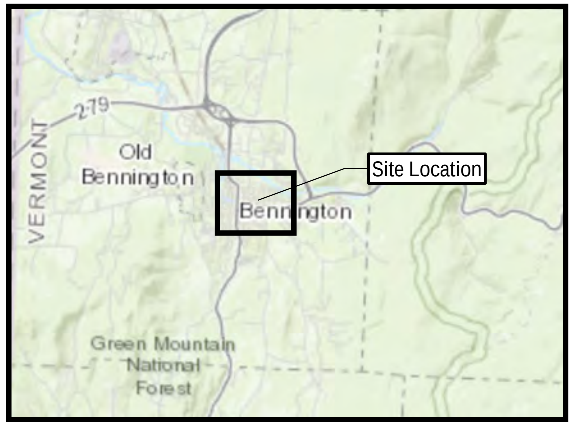
		Indoor Air									
		Active Vapor Mitigation		**Passive Vapor Mitigation**		**Institutional Controls**		**Excavation**		**No Action**	
Approximate Cost	Capital	$1,840,000	3	$1,270,000	3	$0.00	4	$4,420,000	1	$0.00	5
	Annual O&M	$12,000		$63,000		$0.00		$0.00		$0.00	
	Land Use Restrictions	$10,000		$10,000		$10,000		$0.00		$0.00	
	Net Present Value	**$2,120,000**		**$2,700,000**		**$10,000**		**$4,420,000**		**$0.00**	
Environmental Impacts and Sustainability		Moderate environmental impact; system requires operation of electric, low energy blowers, telemetry could be used to reduce field visits to site for O&M.	4	Moderate to low environmental impact due to no active mitigation system operation; use of chemical sealants during implementation. Likely will require energy usage for routine O&M visits.	4	No environmental impacts but reduces the potential use of property	4	High environmental impact associated with construction activity but likely no ongoing O&M	2	No action; therefore, no environmental impacts	5
Community Acceptance		Likely to be accepted; preferable because it minimizes potential exposure conditions and mitigates risk to occupants	5	Community acceptance is moderate as ongoing protectiveness is difficult to prove.	3	Likely to be accepted because it minimizes potential exposure conditions; however, also restricts possible uses for facility	3	Likely to be accepted; Eliminates contamination in subsurface; however, creates major disruption and has high economic and environmental costs	4	Unlikely to be accepted; leaves impacts to building unmanaged.	1
Recommendation and Total Score			**41**		**32**		**31**		**36**		**26**

Notes:

1	= Unfavorable
2	= Mostly Unfavorable
3	= Some Limitations
4	= Somewhat Favorable
5	= Favorable

FIGURES





Legend

- Site Building Outline
- Site Property Boundaries
- Property Boundary Lines
- 2,000 Foot Buffer
- Surface Water - Rivers/ Streams

Public Water Sources

- Active
- Proposed
- Inactive
- Private Wells
- VT E911 Building Footprints

Zoning

- Central Business
- Office and Apartment
- Public Open Space
- Village Commercial
- Village Industrial
- Village Residential
- Industrial and Profession
- Mixed Residential
- Rural Residential
- Urban Mixed Use
- Industrial
- Hazardous Waste Site
- Hazardous Waste Generators

NOTES:

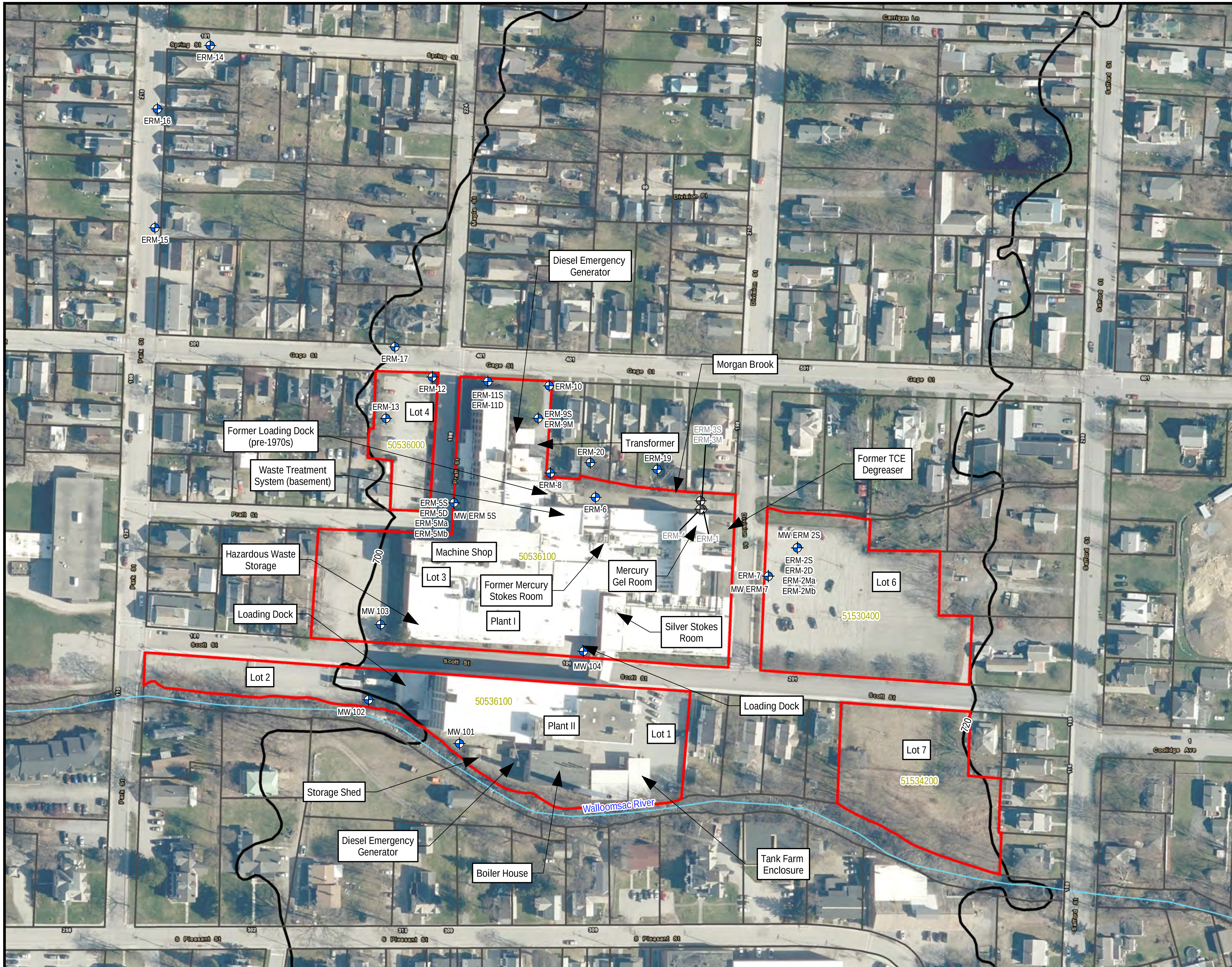
1. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.7
2. Data collected from Vermont Agency of Natural Resources in 2021

N

0 250 500 1,000
Feet

Figure 1: Site Location Map
Energizer Holdings, Inc.
Bennington, Vermont

ERM



Legend

- Monitoring Well
- Decomissioned Monitoring Well
- Elevation Contours (ft)
- Site Property Boundaries
- Tax Parcels
- 50536100 Tax Parcel ID

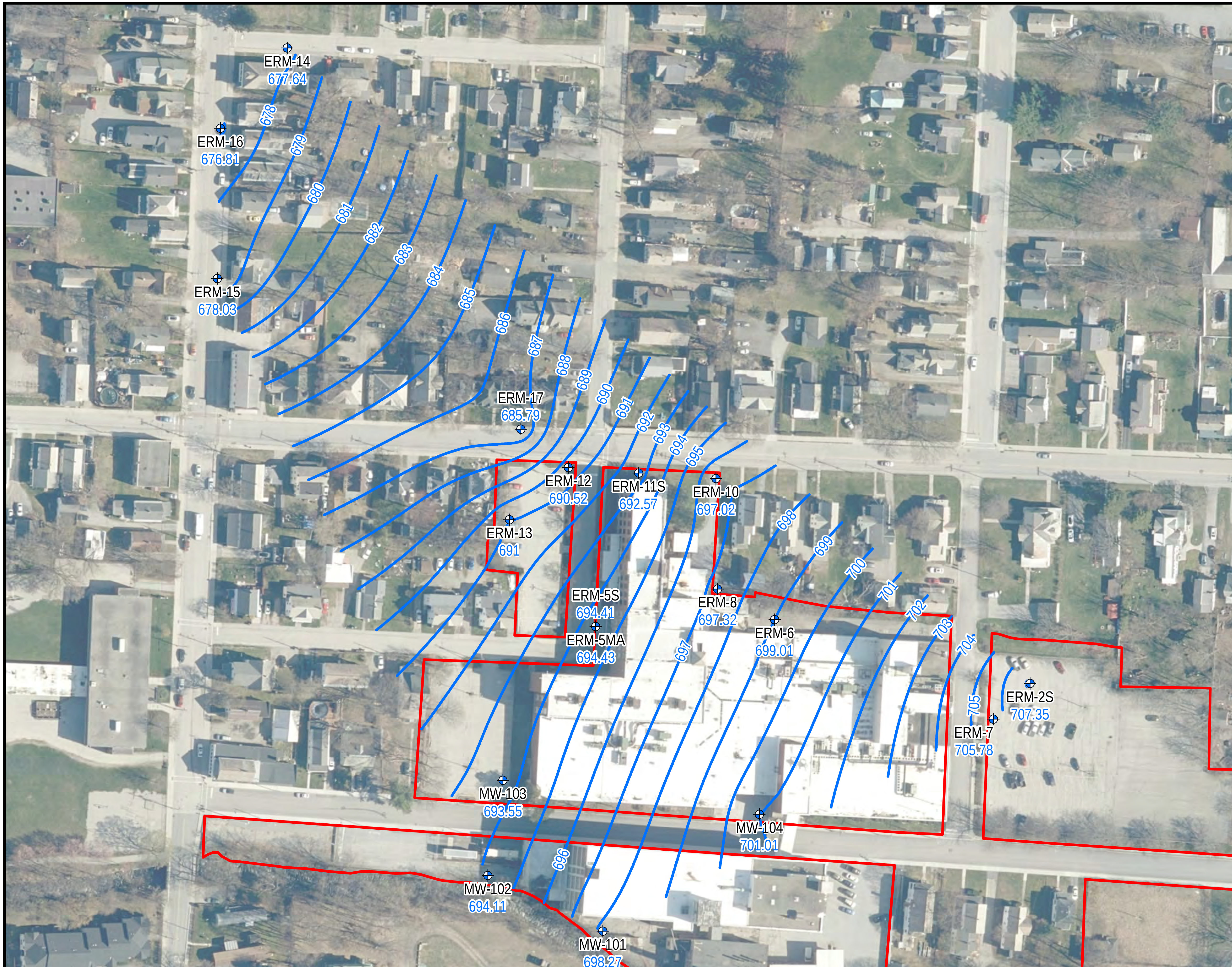
NOTES:
1. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.7
2. Data collected from Vermont Agency of Natural Resources and USGS

N

0 25 50 100 150 200
Feet

Figure 2: Site Layout Map
Energizer Holding, Inc.
Bennington, Vermont

ERM



Legend

- Monitoring Well
- Groundwater Elevation Contour (ft)
- Site Property Boundaries

NOTES:
1. Aerial Imagery: ESRI World Imagery
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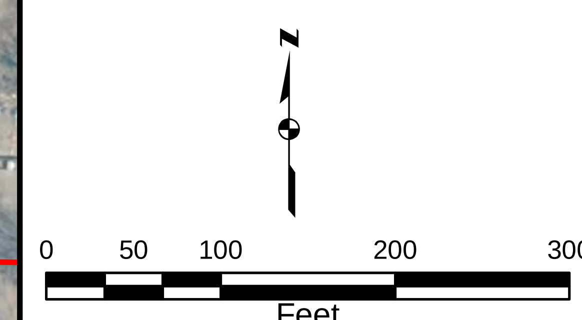
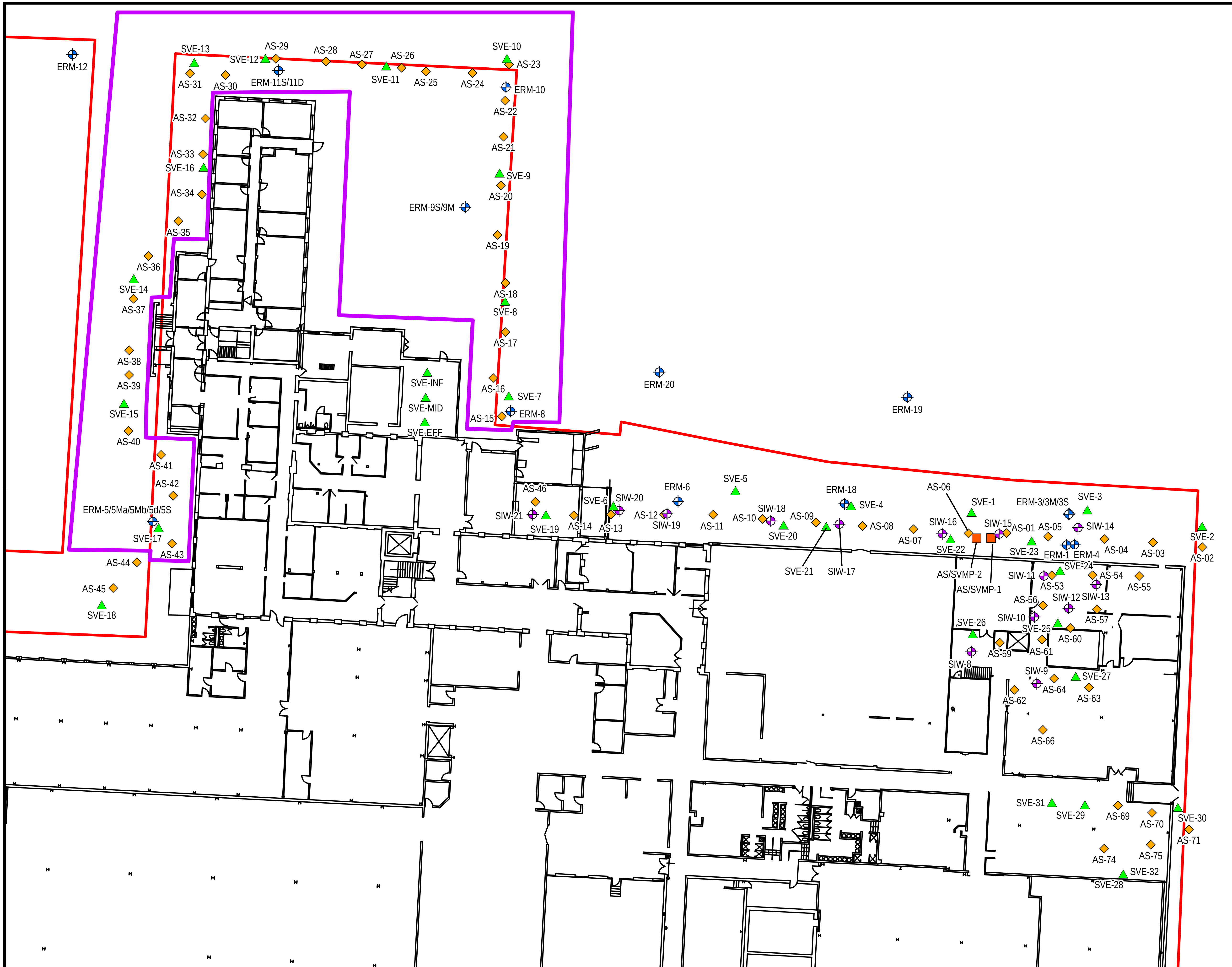


Figure 3: Groundwater Elevation
Contours October 2020
Energizer Holding, Inc.
Bennington, Vermont

ERM



Legend

- Air Sparge Point
- Air Sparge/Soil Vapor Point
- Monitoring Well
- Steam Extraction Well
- Soil Vapor Extraction Point
- Portion of SVE/AS System to Restart
- Site Property Boundaries

NOTES:

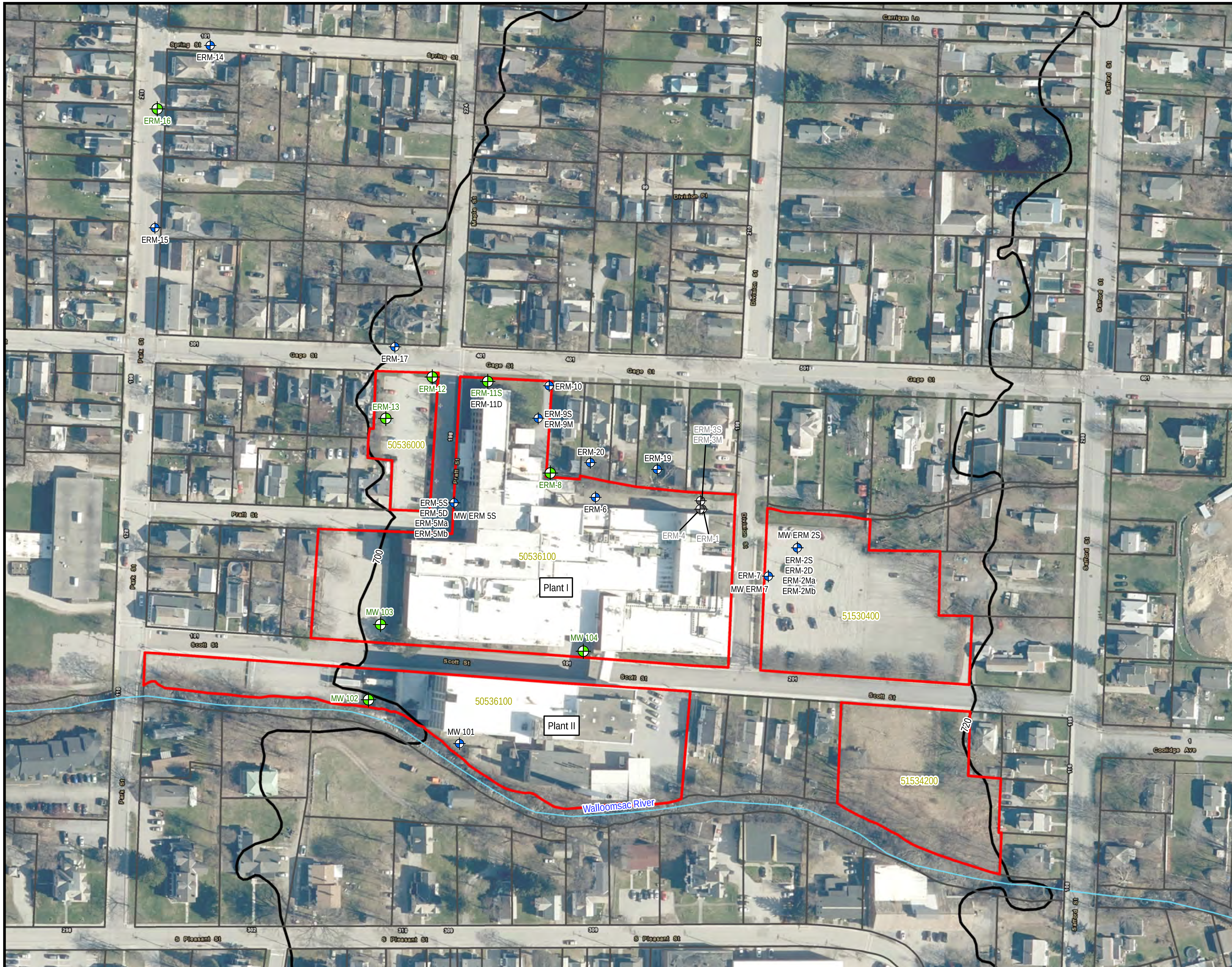
1. Basemap: Air Sparge/Soil Vapor Extraction System As Built Drawing. ERM. 2008

Figure 4: Air Sparge/Soil Vapor Extraction System

Energizer Holding, Inc.

Bennington, Vermont

ERM



Legend

- Existing Well Proposed for Long-Term Monitoring
- Monitoring Well
- Decomissioned Monitoring Well
- Elevation
- Site Property
- Tax Parcels
- 50536100 Tax Parcel ID

NOTES:

1. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.7
2. Data collected from Vermont Agency of Natural Resources and USGS

N

0 25 50 100 150 200
Feet

Figure 5: Long-Term Monitoring Well Locations
Energizer Holding, Inc.
Bennington, Vermont

ERM

Legend

Sub-Slab Soil Gas PCE Concentration (µg/m3)

- <1
- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- 10,000-100,000
- >100,000
- Non-Detect
- Not Sampled
- Potential Excavation Areas

NOTES:
1. Sub-slab soil gas PCE concentrations measured in 2019 (ERM. 2021. Supplemental Site Investigation Report Appendix A)
2. Basemap: Air Sparge/Soil Vapor Extraction System As Built Drawing. ERM. 2008

N

0 10 20 40 60 80 100
Feet

Figure 6: Excavation Areas
Energizer Holding, Inc.
Bennington, Vermont

ERM

APPENDIX A COST ESTIMATES FOR ALTERNATIVES

Groundwater Alternative A - Restart AS/SVE System

CAPITAL COSTS				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Refurbish Equipment	1	LS	$ 35,000	$ 35,000
Repair Connections	1	LS	$ 7,500	$ 7,500
Startup	7	days	$ 3,200	$ 22,400
Initial Sampling	1	LS	$ 2,300	$ 2,300
Permitting	1	LS	$ 10,000	$ 10,000
Project/Consturction Management			12%	$ 9,264
Contingency			10%	$ 8,646
TOTAL				**$ 95,120**

Land Use Restrictions				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Groundwater Reclassification	1	LS	$ 30,000	$ 30,000
TOTAL				**$ 30,000**

O&M Costs				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Labor	1	LS	$ 10,000	$ 10,000
Sampling	4	events	$ 1,800	$ 7,200
Reporting	1	LS	$ 6,000	$ 6,000
Carbon, Utilities, & Maintenance	1	LS	$ 21,000	$ 21,000
Project Management			5%	$ 2,210
Contingency			10%	$ 4,641
Annual Total				**$ 51,060**

30-year Costs (NPV)	
Discount Rate	5%
Inflation Rate	3%
Year 0 Costs	$ 125,120
Year 1 - 30 Costs	$ 51,060
Net Present Value (NPV)	**$ 1,268,683**

Groundwater Alternative B - Long Term Monitoring

CAPITAL COSTS				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
None	1	LS	$ -	$ -
Project Management			12%	$ -
Contingency			10%	$ -
TOTAL				**$ -**

Land Use Restrictions				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Groundwater Reclassification	1	LS	$ 30,000	$ 30,000
TOTAL				**$ 30,000**

O&M Costs				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Sampling	1	events	$ 8,000	$ 8,000
Reporting	1	LS	$ 5,000	$ 5,000
Project Management			5%	$ 650
Contingency			10%	$ 1,365
Annual Total				**$ 15,020**

30-year Costs (NPV)	
Discount Rate	5%
Inflation Rate	3%
Year 0 Costs	$ 30,000
Year 1 - 30 Costs	$ 15,020
Net Present Value (NPV)	**$ 366,395**

Vapor Intrusion Alternative A - Active Vapor Mitigation

CAPITAL COSTS				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Diagnostics and Design	1	LS	$ 50,000	$ 50,000
System Installation and Reporting (Plant 1 and 2)	1	LS	$ 1,430,000	$ 1,430,000
Post System Installation Verification Samplig	1	LS	$ 12,000	$ 12,000
Project/Construction Management			12%	$ 179,040
Contingency			10%	$ 167,104
TOTAL				**$ 1,838,150**

Land Use Restrictions				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Deed Restriction	1	LS	$ 10,000	$ 10,000
TOTAL				**$ 10,000**

O&M Costs				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Annual Inspection	1	events	$ 1,000	$ 1,000
Reporting	1	LS	$ 5,000	$ 5,000
Utilities & Maintenance	1	LS	$ 3,900	$ 3,900
Project Management			10%	$ 1,000
Contingency			10%	$ 1,100
Annual Total				**$ 12,000**

30-year Costs (NPV)	
Discount Rate	5%
Inflation Rate	3%
Year 0 Costs	$ 1,848,150
Year 1 - 30 Costs ($/yr)	$ 12,000
Net Present Value (NPV)	**$ 2,116,907**

Vapor Intrusion Alternative B - Passive Vapor Mitigation

CAPITAL COSTS				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Design	1	LS	$ 10,000	$ 10,000
Floor Sealing and Reporting	1	LS	$ 1,013,000	$ 1,013,000
Post Installation Verification Samplig	1	LS	$ 10,000	$ 10,000
Project/Construction Management			12%	$ 123,960
Contingency			10%	$ 115,696
TOTAL				**$ 1,272,660**

Land Use Restrictions				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Deed Restriction	1	LS	$ 10,000	$ 10,000
TOTAL				**$ 10,000**

O&M Costs				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Inspection/Sampling	1	events	$ 4,800	$ 4,800
Reporting	1	LS	$ 5,000	$ 5,000
Maintain Floor Sealants	1	LS	$ 45,000	$ 45,000
Project Management			5%	$ 2,740
Contingency			10%	$ 5,754
Annual Total				**$ 63,300**

30-year Costs (NPV)	
Discount Rate	5%
Inflation Rate	3%
Year 0 Costs	$ 1,282,660
Year 1 - 30 Costs ($/yr)	$ 63,300
Net Present Value (NPV)	**$ 2,700,356**

Vapor Intrusion Alternative C - Administrative Controls

CAPITAL COSTS				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
None	1	LS	$ -	$ -
Project Management			12%	$ -
Contingency			10%	$ -
TOTAL				**$ -**

Land Use Restrictions				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Deed Restriction	1	LS	$ 10,000	$ 10,000
TOTAL				**$ 10,000**

O&M Costs				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
None	0	LS	$ -	$ -
Project Management			5%	$ -
Contingency			10%	$ -
Annual Total				**$ -**

30-year Costs (NPV)	
Discount Rate	5%
Inflation Rate	3%
Year 0 Costs	$ 10,000
Year 1 - 30 Costs	$ -
Net Present Value (NPV)	**$ 10,000**

Vapor Intrusion Alternative D - Excavation

CAPITAL COSTS				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
Delineation Sampling	1	LS	$ 89,000	$ 89,000
Design, permitting	1	LS	$ 50,000	$ 50,000
Excavation	1	LS	$ 360,000	$ 360,000
Disposal	1	LS	$ 3,000,000	$ 3,000,000
Confirmatory Sampling	1	LS	$ 89,000	$ 89,000
Project/Construction Management			12%	$ 430,560
Contingency			10%	$ 401,856
TOTAL				**$ 4,420,420**

Land Use Restrictions				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
None	1	LS	$ -	$ -
TOTAL				**$ -**

O&M Costs				
Description	**Number of Units**	**Unit**	**Cost per Unit**	**Cost**
None	0	LS	$ -	$ -
Project Management			5%	$ -
Contingency			10%	$ -
Annual Total				**$ -**

30-year Costs (NPV)	
Discount Rate	5%
Inflation Rate	3%
Year 0 Costs	$ 4,420,420
Year 1 - 30 Costs	$ -
Net Present Value (NPV)	**$ 4,420,420**

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