1,4-Dioxane Risk Summary
North End Sampling Results
Lowry Landfill Superfund Site

The USEPA uses standard risk assessment methodology for all sites to provide a consistent, scientifically based process to evaluate potential threats to public health and the environment. A risk assessment provides the basis for: 1) determining the need for action; 2) identification of contaminant levels that are protective of public health; 3) comparison of remedial alternatives; and 4) evaluation and documentation of public health threats. Under the National Contingency Plan [NCP, 40 CFR §300], an acceptable risk range is defined as one additional cancer case associated with the exposure to contamination in a population of one million (typically expressed as 1 in 1,000,000 or 1 x 10^{-6}) to one-in-ten-thousand (1 in 10,000, 1 x 10^{-4}). Risks greater than one-in-ten thousand (1 in 10,000, 1 x 10^{-4}) generally require some form of action to mitigate those risks. Estimated cancer risks of 1 x 10^{-6} to 1 x 10^{-4} are within the risk management range and, depending on the circumstances, do not require action.

The USEPA risk assessments traditionally evaluate two exposure scenarios: an average exposure scenario (AVG) and a reasonable maximum exposure scenario (RME). The AVG scenario uses the average exposure concentration for each media and the RME scenario uses the 95th percentile Upper Confidence Limit (UCL) on the mean exposure value to represent exposure point concentrations. The RME scenario is intended to represent high-end exposures that are reasonably expected to occur at a site.

Lowry Landfill Superfund Site evaluations indicate that the community or environmental receptors are not exposed to significant concentrations of 1,4-dioxane in groundwater north of the site. However, the USEPA assessed the potential risks to human health and the environment to provide context for the levels detected. Intermittent exposure to surface water occurs in Murphy Creek and the ponds in and around Murphy Creek Golf Course. For this evaluation, the USEPA used highly conservative exposure scenarios to illustrate the potential risks associated with the observed 1,4-dioxane concentrations in surface water and groundwater. The risk evaluation focused on cancer risk because this is the predominant health hazard from exposure to 1,4-dioxane; however, the noncancer hazard quotient was also calculated to evaluate other effects of exposure, such as damage to the liver, kidneys, or nervous system. The USEPA considers a hazard quotient less than 1 acceptable. This exercise demonstrated there is no significant exposure/risk from the concentrations detected, even under these highly conservative, unlikely, and hypothetical exposure scenarios. The exposure scenarios and calculated cancer risks and noncancer hazards associated with 1,4-dioxane in the North End Area are described below. Uncertainties associated with these calculations are described after the presentation of potential risks from groundwater and surface water.

Groundwater

The North End groundwater plume contains low levels of the organic compound 1,4-dioxane. The highest concentration of 1,4-dioxane north of Yale Avenue in the most recent sampling effort was 7.4 micrograms per liter (µg/L) at monitoring well MW129-WD in 2019. The average 1,4-dioxane concentration was calculated to be 1.4 µg/L and the 95th percentile UCL was 2.9 µg/L. The groundwater samples used in the risk evaluation were collected from the shallow,

upper aquifer (weathered Denver formation), which is not used as a drinking water source. Groundwater samples from deeper wells did not contain detectable concentrations of 1,4-dioxane.

Although the shallow aquifer is not a source of drinking water, if a future hypothetical resident utilized the shallow aquifer for drinking water at an assumed concentration of 2.9 µg/L (the RME exposure scenario), they might be exposed to an increased theoretical excess cancer risk of 6×10^{-6} – meaning 6 people out of a total population of 1,000,000 exposed in this scenario might be expected to develop cancer related to 1,4-dioxane exposure from the shallow groundwater. This calculation was based on conservative assumptions. The hypothetical future residents considered in the evaluation included a child (age 0 to 6 years, assumed to weigh 15 kg, consuming 0.78 liters per day [L/day], showering, and exposed to contaminated groundwater 350 to 365 days a year for 6 years) and an adult (age 6 to 26 years, weighing 80 kg, consuming 2.5 L/day, showering, and exposed to contaminated groundwater 350 to 365 days a year for 20 years). Using the Risk Assessment Information System (RAIS, https://rais.ornl.gov/cgi-bin/prg/RISK_search), the increased cancer risk was estimated for potential exposure pathways including ingestion, inhalation, and dermal exposure, as shown in the table below. The noncancer hazard quotient was calculated to be 0.03.

Table 1. Risk Assessment Summary for Hypothetical Future Residents

Ingestion	Inhalation	Dermal Contact	Total Hypothetical Cancer Risk
4×10^{-6} (4 in 1,000,000)	2×10^{-6} (2 in 1,000,000)	1×10^{-8} (1 in 100,000,000)	**6×10^{-6} (6 in 1,000,000)**

The total cancer risk for hypothetical future residents is at the low end of the USEPA's risk management range and the hazard quotient is below the acceptable limit of 1, indicating that action is not required. In addition, exposure to 1,4-dioxane in groundwater is not occurring and is not expected to occur in the future. The City of Aurora does not permit installation of groundwater wells in the shallow aquifer where 1,4-dioxane has been detected and 1,4-dioxane has not been detected in deeper groundwater monitoring wells in the North End Area.

Surface Water

The surface water in Murphy Creek and ponds near and adjacent to the golf course contain low levels of 1,4-dioxane. The concentrations of 1,4-dioxane detected in surface water are presented on Figure 3.3 of the North End Investigation report. The maximum concentration of 1,4-dioxane detected in surface water was 10 µg/L at sampling location SWMC-03 in 2006; however, the highest concentration detected in recent samples was 3.1 µg/L at sampling location SWMC-04 in 2016. Using the recent surface water data collected in 2016, the average concentration of 1,4-dioxane in surface water from Murphy Creek was calculated to be 0.7 µg/L and the 95th percentile UCL on the mean surface water concentration was 1.9 µg/L. In the most recent sampling event, 1,4-dioxane was either not detected in the golf course ponds or was detected at a concentration just above the method detection limit (JPond-02/SWMC-08, 0.17 J [estimated] on May 4, 2016). Therefore, the human exposure point values used for this risk evaluation were

based on the surface water concentrations from Murphy Creek. Although risk calculations were conducted to evaluate the potential risks from exposure to 1,4-dioxane in surface water, the USEPA has no indication that significant human exposure to this water is occurring or that the 1,4-dioxane levels in these samples reflect affects from Lowry Landfill Superfund Site.

Of the potential workers in the North End Area, the golf course groundskeeper has the highest potential for exposure to surface water bodies and irrigation water from the on-site reclaimed water pond. The risk assessment assumes the groundskeeper is an adult with a body weight of 80 kg and is exposed to the surface water 252 days per year (6 days a week for 42 weeks) for 25 years. It is assumed the groundskeeper would be exposed to the contaminated surface water with a 1,4-dioxane concentration of 1.9 µg/L for 6 hours per day and would ingest 0.11 liter of surface water per hour. The skin surface area exposed would include 813 square centimeters (cm^2) of the hands, forearms, feet, and lower legs. Using the RAIS and the calculated 95th percentile UCL concentration (1.9 µg/L), the potential risks were estimated for incidental ingestion of and dermal contact with surface water, as shown below. The total cancer risk for the golf course groundskeeper is below the USEPA's risk management range and the noncancer hazard quotient was calculated to be 0.0003, which is well below the acceptable noncancer risk of 1, indicating that no action is necessary to address potential risks to groundskeepers from 1,4-dioxane in surface water.

Table 2. Risk Assessment Summary for Golf Course Groundskeeper

Ingestion	Dermal Contact	Total Cancer Risk
4×10^{-7} (4 in 10,000,000)	1×10^{-9} (1 in 1,000,000,000)	**4×10^{-7}** **(4 in 10,000,000)**

A recreational visitor (e.g., a golfer) may be exposed to surface water containing 1.9 µg/L of 1,4-dioxane through incidental ingestion or dermal contact while playing golf. Because the golf course is open for approximately half a year, the risk evaluation assumes that an 80 kg golfer visits the course 45 times a year, plays the course in 6 hours, retrieves golf balls from the surface water in Murphy Creek exposing their hands, forearms, feet, and lower legs to the surface water for one hour (total skin surface area of 813 cm^2), and incidentally ingests some of the surface water (0.11 L each hour) each visit to the golf course for a total duration of 10 years. Based on these conservative assumptions, the golfer's increased cancer risk is below the USEPA's risk management range, as shown on the table below. The noncancer hazard quotient was calculated to be 0.0005, which is below the acceptable value of 1.

Table 3. Risk Assessment Summary for Recreational User (Adult Golfer)

Ingestion	Dermal Contact	Total Cancer Risk
5×10^{-9} (5 in 1,000,000,000)	2×10^{-11} (2 in 100,000,000,000)	**5×10^{-9}** **(5 in 1,000,000,000)**

If an adolescent recreational user were exposed to 1.9 µg/L of 1,4 dioxane in the surface water bodies near the golf course, the estimated cancer risks are slightly lower than for the adult golfer described above. This risk exposure scenario assumes that an adolescent (age 6 to16 years) weighing 44.3 kg would be playing in the surface water 45 days per year over a period of 10 years. Each time the individual plays in the water, it is assumed they will incidentally ingest small amounts of surface water (0.12 L/hr) and also will be exposed through the skin (assuming a skin surface area of 13,350 cm^2). The estimated cancer risks for an adolescent recreational user through incidental ingestion and dermal contact are shown below. The noncancer hazard quotient was calculated to be 0.00002. The total hypothetical cancer risk and noncancer hazard are below the USEPA's acceptable risk management levels.

Table 4. Risk Assessment Summary for Recreational User (Adolescent)

Ingestion	Dermal Contact	Total Cancer Risk
9×10^{-9} (9 in 1,000,000,000)	6×10^{-10} (6 in 10,000,000,000)	**1×10^{-8}** **(1 in 100,000,000)**

Ecological Risk

The aquatic toxicity of 1,4-dioxane has been estimated at 201 milligrams per liter (mg/L) for algae to 666 mg/L for fish based on the EPA's Ecological Structure Activity Relationships estimation program (EPA 2019). In the United States, only Michigan has a chronic water quality value for mammals, set at 22 mg/L (2,200 µg/L) (Michigan Department of Environment, Great Lakes, and Energy, 2019). In contrast, the highest concentration of 1,4-dioxane detected in surface water in the North End Area was 10 µg/L (that is, 0.01 mg/L) at SWMC-03 in 2006. Therefore, ecological risk is not expected from surface water exposures in the North End Area.

Risk Assessment Uncertainty

This section describes uncertainties in the exposure assumptions and calculations that may impact the risk assessment conclusions.

Reasonable Maximum Versus Maximum Exposure Scenarios

As mentioned previously, standard USEPA risk assessment methodology uses RME assumptions to calculate potential risks to health and the environment. Under the RME scenario, the risk to potential receptors is calculated using the 95th percentile UCL to represent the high-end concentration receptors are reasonably expected to be exposed to at a site. However, risks to potential receptors may be higher if the maximum detected concentration is used in the risk evaluation, rather than the 95th percentile UCL. For example, if a future, hypothetical resident utilized the shallow aquifer for drinking water and installed a well in the vicinity of MW129-WD, they may be exposed to 7.4 µg/L of 1,4-dioxane, which is the maximum concentration of 1,4-dioxane detected in the North End Area during the 2018/2019 sampling event. The estimated cancer risk to a hypothetical future resident would increase if the resident was exposed to the maximum concentration of 1,4-dioxane, rather than the 95th percentile UCL

concentration (Table 5). However, the probability that a future user would place a drinking water well in the area of maximum plume concentration is very low (as this well is on the northern boundary of the Denver Arapahoe Disposal Site along Yale) which is why the USEPA methodology uses the 95th percentile UCL on the mean contaminant concentration to estimate a high-end exposure.

Table 5. Total Cancer Risk for Hypothetical Future Residents for Varying Exposure Scenarios

Reasonable Maximum Exposure Scenario		**Maximum Concentration Scenario**	
95th UCL Concentration of 1,4-Dioxane in Groundwater	Total Cancer Risk	Maximum Concentration of 1,4-Dioxane in Groundwater	Total Cancer Risk
2.9 µg/L	6×10^{-6} (6 in 1,000,000)	7.4 µg/L	2×10^{-5} (2 in 100,000)

Similarly, if the maximum detected concentration of 1,4-dioxane in surface water (10 µg/L) was used to estimate risk for the groundskeeper, golfer, and adolescent recreational user, the cancer risks would increase. However, these risks are still at the low end or below the acceptable risk range, as shown on the table below.

Table 6. Total Cancer Risks with Maximum Concentration of 1,4-Dioxane in Surface Water

Groundskeeper	**Adult Golfer**	**Adolescent Recreational User**
2×10^{-6} (2 in 1,000,000)	3×10^{-8} (3 in 100,000,000)	5×10^{-8} (5 in 100,000,000)

The risk assessment process uses standardized exposure factors to represent potential human exposure to contaminants in soil, groundwater, surface water, and vapor. The exposure assessment includes assumptions for average body weight, ingestion rates of water and soil, inhalation rates, body surface areas, and frequency and duration of exposure, which are based on investigations of actual human exposure reported in scientific literature. As such, individuals vary their behavior and the assumptions used for exposure assessment may under- or over-estimate an individual's actual exposure.

Variations in Data

The USEPA acknowledges 1) there is a limited data set and 2) there are a number of factors that influence surface water concentrations that include sources of contamination not related to the Lowry Landfill Superfund Site. The concentrations of 1,4-dioxane in Murphy Creek may vary over time, creating some uncertainty in the assessment of potential risks to receptors exposed to surface water. The 1,4-dioxane concentrations detected in 2006 were higher than those detected at the same locations in 2016. For example, at SWMC-03, 1,4-dioxane was detected at

concentrations of 10 µg/L and 9.4 µg/L in 2006 but the concentration decreased to 0.49 µg/L (J-qualified or estimated) in 2016. Similarly, at SWMC-04, 1,4-dioxane was detected at 6.2 and 5.3 µg/L in 2006 and at 3.1 µg/L in 2016. If the shallow groundwater is the source of the surface water in Murphy Creek, the concentrations should decrease as the groundwater concentrations decrease in the shallow groundwater plume over time.

Contribution of Other Detected Constituents to Site Risk

Compounds other than 1,4-dioxane detected in groundwater and surface water may contribute to site risks. Groundwater in the North End Area contains low levels of 1,4-dioxane and six volatile organic compounds (all detected at levels below site performance standards): acetone, 1,1-dichloroethane, naphthalene, tetrachloroethene, toluene, and trichloroethene. Acetone and toluene were the only volatile organic chemicals detected in surface water. Acetone is a common laboratory contaminant and is not thought to be related to site contamination. Therefore, acetone is not included in the risk assessment calculations. Toluene is not a carcinogen so it would not contribute to the cancer risk but was evaluated for its noncancer hazards. The concentrations of the volatile organic compounds detected in North End Area groundwater are shown on Table 7.

Table 7. Detected Concentrations of Volatile Organic Compounds in North End Groundwater

Monitoring Well	Sample Date	Chemical	Concentration (µg/L)
MW129-WD	9/12/2018	1,1-Dichloroethane	**1.7**
		Tetrachloroethene	**0.63 J (estimated)**
		Trichloroethene	**0.35 J (estimated)**
MW176-DEN	3/19/2018	Tetrachloroethene	0.31 J (estimated)
MW176-UDEN	5/2/2019	Toluene	**0.23 J (estimated)**
		Naphthalene	0.76 J (estimated)
MW177-UDEN	2/19/2019	Naphthalene	0.57 J (estimated)
MW178-UDEN	2/19/2019	Naphthalene	**0.77 J (estimated)**

Note: **Bold text** indicates the maximum detected concentration of each chemical.

The potential risks to hypothetical future residents represent the most conservative risk scenario. Therefore, potential risks to residents from other detected compounds were calculated using standard exposure assumptions. As described earlier, the assessment of risks from 1,4-dioxane in groundwater were calculated using the RME concentration (2.9 µg/L). However, due to the low frequency of detection for the other volatile organic constituents, the maximum detected concentration for each chemical (shown in bold font on Table 7) was used in the risk estimation. The maximum detected concentrations were screened with the USEPA Regional Screening

Levels (RSL) for residential tap water use; naphthalene and 1,4-dioxane were the only contaminants that exceeded the RSLs. However, as a conservative measure, the increased cancer risk for all detected compounds was estimated for potential exposure pathways including ingestion, inhalation, and dermal exposure and are shown in Table 8 below. The total noncancer hazard index from all contaminants for future residential exposure was calculated to be 0.3, which is below the acceptable level for noncancer hazards.

Table 8. Risk Assessment Summary for Hypothetical Future Residents

Compound	Ingestion	Inhalation	Dermal	Total Hypothetical Cancer Risk
1,1-Dichloroethane	1×10^{-7}	5×10^{-7}	9×10^{-9}	**6×10^{-7}**
1,4-Dioxane	4×10^{-6}	2×10^{-6}	1×10^{-8}	**6×10^{-6}**
Naphthalene	1×10^{-6}	5×10^{-6}	7×10^{-7}	**7×10^{-6}**
Tetrachloroethene	2×10^{-8}	3×10^{-8}	1×10^{-8}	**6×10^{-8}**
Toluene*	- - -	- - -	- - -	**- - -**
Trichloroethene	5×10^{-7}	4×10^{-7}	5×10^{-8}	**7×10^{-7}**
Total Risk	**5×10^{-6} (5 in 1,000,000)**	**8×10^{-6} (8 in 1,000,000)**	**8×10^{-7} (8 in 10,000,000)**	**1×10^{-5} (1 in 100,000)**

*The cancer risk for toluene was not calculated because it is not a carcinogen. The hazard quotient for toluene is 0.0001.

As shown on Table 8, the addition of other detected compounds increases the incremental cancer risks but the total cancer risk is still within the risk management range and the noncancer hazard is less than 1, indicating that no action is necessary to address potential risks to hypothetical future residents from chemicals in groundwater. In addition, these calculations were based on conservative assumptions and the total risk to potential receptors from contamination originating from the Lowry Landfill Superfund Site is likely lower than shown on Table 8.

There is uncertainty in the source of volatiles detected in the shallow groundwater in the North End plume. As shown on Table 7, the compounds 1,1-dichloroethane and trichloroethene were only detected in monitoring well MW129-WD. In addition, the maximum concentration of tetrachloroethene was detected in this well. Well MW129-WD is located at the Yale Avenue boundary, more than a mile south of the nearest residence. 1,1-Dichloroethane, tetrachloroethane, and trichloroethane were not detected in wells MW141-WD or MW141-UDEN. Therefore, it is unlikely that the compounds detected in groundwater at MW129-WD are indicative of contamination in the downgradient plume, near the residential developments. Furthermore, toluene and naphthalene were only detected in the deep monitoring wells north of East Mississippi Avenue (MW176-UDEN, MW177-UDEN, and MW178-UDEN). There were no detections of these chemicals in wells located between Yale Avenue and East

Mississippi Avenue, indicating that the constituents identified in the northern-most wells likely do not originate from the Lowry Landfill Superfund Site. Hence, the risk associated with these constituents detected north of East Mississippi Avenue may not be attributed to the Lowry site. Therefore, the inclusion of detected compounds other than 1,4-dioxane in the risk evaluation may over-estimate the actual site risks.

Evaluation of Vapor Intrusion to Indoor Air

Volatile compounds in shallow groundwater may volatilize and enter indoor air through a process called vapor intrusion. 1,4-Dioxane was the only compound detected in shallow groundwater above site performance standards. Other volatile organic compounds detected in the North End Area monitoring wells are listed in Table 7. However, these compounds were only detected in monitoring wells more than a mile away from current residences (MW129-WD) or were only detected in deep groundwater monitoring wells (i.e., MW176-UDEN, MW177-UDEN, and MW178-UDEN) and were not detected in the paired shallow groundwater monitoring wells (MW176-DEN, MW177-DEN, and MW178-DEN). Therefore, the calculation of potential risks from vapor intrusion of contamination in shallow groundwater to indoor air is focused on 1,4-dioxane.

The USEPA Vapor Intrusion Screening Level for 1,4-dioxane in deep groundwater is 2,900 µg/L and the Michigan Vapor Intrusion Screening Level for shallow groundwater is 1,900 µg/L (MDEQ 2018). The highest concentration of 1,4-dioxane in the North End Area groundwater (7.4 µg/L) is significantly lower than these screening levels. Therefore, there is no evidence of unacceptable risk to receptors and ambient air, soil gas, or indoor air data have not been collected.

In general, vapor intrusion of the semi-volatile 1,4-dioxane is not considered a major route of exposure because of the relatively low potential of 1,4-dioxane to move from the groundwater phase to the vapor phase. Vapor intrusion and volatilization from groundwater or surface water are not considered significant sources of exposure to the general population because the Henry's Law constant 4.8 x 10^{-6} atm-m^3/mol at 25°C (approximately 77°F) and high water solubility of 1,4-dioxane (greater than 800 grams per liter) indicate that 1,4-dioxane will primarily remain in the aqueous phase and that volatilization to air will be limited (USEPA, 2018). Therefore, groundwater contaminated with 1,4-dioxane in direct contact with a building foundation or present in a dewatering sump would not result in significant exposure to residents. Furthermore, the highest concentrations of 1,4-dioxane found in the most recent sampling of monitoring wells is 7.4 µg/L (MW129-WD, February 7, 2019). Based on these factors, the vapor intrusion pathway is considered incomplete.

As a conservative evaluation of the potential risks to hypothetical future residents, the USEPA calculated the concentration of 1,4-dioxane in groundwater that would result in unacceptable risk (defined as either cancer risks higher than 1 x 10^{-4} or 1 in 10,000 or a noncancer hazard quotient above 1) from vapor intrusion to indoor air. For this scenario, the upper bound is limited by the noncancer hazard quotient of 1 instead of the upper end of the risk management cancer risk range as described below. These calculations assumed that shallow groundwater containing 1,4-dioxane was in direct contact with the foundation of a residence. However, there is no

evidence to indicate that this assumption is true. The calculations concluded that the concentration 1,4-dioxane in groundwater would need to be approximately 159,000 µg/L to result in an unacceptable hazard to residents through inhalation of indoor air (USEPA, 2019). The concentrations of 1,4-dioxane in water that correspond to the USEPA's acceptable noncancer hazard range of 0.1 to 1.0 is 15,900 to 159,000 µg/L. In contrast, the highest concentration of 1,4-dioxane detected in groundwater in the North End Area was 7.4 µg/L (in monitoring well MW129-WD in 2019). Therefore, vapor intrusion of 1,4-dioxane into indoor air would not pose an unacceptable risk to residents.

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EAST ALAMEDA AVE

13 18 17

Gun Club Estates

Highway 30 Landfill

EAST MISSISSIPPI AVE

SOUTH HARVEST RD

24 19 20

Approximate Limits of North End Study Area

EAST JEWELL AVE

E - 470

SOUTH GUN CLUB RD

Murphy Creek/ Golf Course

26 25 30 29

YALE AVE

DADS Landfill

35 36 31 32

North Boundary Barrier Wall

EAST HAMPDEN AVE

Lowry Landfill Superfund Site

02 01 06 05

EAST QUINCY AVE

Perimeter Slurry Wall

11 12 07 08

1,4-Dioxane concentration greater than site's performance standard of 0.9 µg/L using most recent sample results (dashed where inferred)

Lowry Landfill Superfund Site Boundary

N W E S

0 1,000 2,000 3,000 Feet

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
http://water.state.co.us/DWRIPub/Documents/GWCRulesAtlas.pdf, 1991.

Figure 2.1
Approximate Limits of North End Study Area
Phase I Technical Memorandum
Lowry Landfill Superfund Site, Colorado

CDM Smith

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MW178-UDEN
MW178-DEN
Gun Club Estates
MW176-UDEN
MW176-DEN
MW177-UDEN
MW177-DEN
EAST MISSISSIPPI AVE
Highway 30 Landfill
SOUTH HARVEST RD
E - 470
Private Well #1
Private Well #2
EAST JEWELL AVE
MW141-UDEN
MW141-WD
SOUTH GUN CLUB RD
Murphy Creek/ Golf Course
MW129-WD
MW179-UDEN
MW151-WD
YALE AVE
MW132-WD
MW180-WD
T1-4
T1-3
DADS Landfill
MW118-WD
MW118-UD
MW117-WD
MW104-WD
MW115-WD
MW116-WD
MW115-UD
North Boundary Barrier Wall
EAST HAMPDEN AVE
Lowry Landfill Superfund Site
EAST QUINCY AVE
Perimeter Slurry Wall

Existing Wells

- Shallow Well
- Deep Well

Plume

- 1,4-Dioxane concentration greater than site's performance standard of 0.9 µg/L using most recent sample results (dashed where inferred)
- Lowry Landfill Superfund Site Boundary

Notes:
1. MW179-UDEN - wells sampled during North End Investigation
2. MW129-WD - wells sampled during the 2018 Synoptic Event

N W E S

0 1,000 2,000 3,000 Feet

Figure 2.3
North End Groundwater Chemistry Monitoring Network
Phase I Technical Memorandum
Lowry Landfill Superfund Site, Colorado

CDM Smith

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13

18

24

19

25

30

31

SWMC-06
0.99 J (3/30/2006)
0.6 J (5/10/2016)

SWMC-07
4.9 J (3/30/2006)
0.53 J (5/10/2016)

MPOND-04
0.15 U (7/29/2015)

MPOND-03
0.15 U (7/29/2015)

MPOND-02
0.15 U (7/29/2015)

MPOND-01
0.15 U (7/29/2015)

SWMC-05
0.51 J (3/30/2006)
0.54 J (5/10/2016)

SWMC-03
10 (3/30/2006)
9.4 (4/19/2006)
0.49 J (5/9/2016)

Closed
Highway 30 Landfill

SWMC-04
6.2 (3/30/2006)
5.3 (4/19/2006)
3.1 (5/9/2016)

SWMC-02
0.5 U (3/30/2006)
0.49 J (5/10/2016)

JPOND-01/SWMC-09
1.9 J (4/26/2006)
0.56 U (7/29/2015)
0.15 U (5/4/2016)

JPOND-02/SWMC-08
1.6 J (4/26/2006)
0.59 U (7/29/2015)
0.17 J (5/4/2016)

SWMC-01
0.5 U (3/30/2006)
0.46 J (5/9/2016)

GWMC-01
0.5 U (11/1/2006)

SW-5
0.19 U (1/25/2006)
0.5 J (5/9/2016)

Mississippi Ave.

Yale Ave.

Gun Club Road

Coal Creek

Un-Named Murphy Creek Tributary

Murphy Creek

Murphy Creek Tributary

UNNAMED CREEK

MURPHY CREEK

STORMWATER D

Lowry Landfill
Superfund Site

North Boundary
Barrier Wall

N

0 600 1,200 2,400 Feet

1 inch = 1,200 feet

Legend

- GROUNDWATER WELL LOCATION
- DETECTED 14X > 0.9 ug/L PERFORMANCE STANDARD
- DETECTED 14X <= 0.9 ug/L PERFORMANCE STANDARD
- NO 1,4-Dioxane (14X) DETECTED
- Approximate Limits 1,4-Dioxane concentration greater than site's performance standard of 0.9 ug/L in groundwater (dashed where inferred)

J = ESTIMATED VALUE
U = UNDETECTED

FIGURE 3.3

SURFACE WATER SAMPLING LOCATIONS AND RESULTS
1,4-DIOXANE IN SURFACE WATER

North End Plume Assessment Report
Lowry Landfill Superfund Site, Colorado

PARSONS

Denver, Colorado

S:\ES\Mail\Proj\LWRYLNFL\Steven\FIGS\Tim_NEPAR_Fig3_3_14Diox_Sec1930_31_12Q16_Presentation.mxd lkh 6/18/2019

ug/L