Indoor Air Monitoring Plan

Thornton Shopping Center
EPA#COR000212639

Compliance Order on Consent #24-02-01-01

July 17, 2024

Thornton Shopping Center

Prepared for:

Thornton Development Authority (TDA)
9500 Civic Center Drive
Thornton, Colorado 80229

Prepared by:

TRC
1526 Cole Boulevard, Suite 150
Lakewood, Colorado 80401

Prepared by:

Eric Jacobs, P.G.

Reviewed and Approved by:

Jason Jayroe, Senior Geologist

Table of Contents

Figures

Appendices

Acronyms and Abbreviations

CAS#	Chemical Abstract Services Number
CDPHE	Colorado Department of Public Health and Environment
COC	Chain of Custody
HASP	Health and Safety Plan
Hg	Mercury
IAMP	Indoor Air Monitoring Plan
JSA	Job Safety Analysis
PID	Photo Ionization Detector
PCE	Tetrachloroethylene
SIM	Select Ion Monitoring
Facility	Thornton Shopping Center at 88th Avenue and Washington Street
TDA	Thornton Development Authority
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

Units of Measure

atm	Atmospheres
cc/min	Cubic centimeters per minute
g	Grams
K	Temperature in Kelvin (°C + 273)
kPa	Kilopascal
L	Liter
$\mu g/m^3$	Micrograms per Cubic Meter
ml	Milliliters
mol	Mole (standard scientific measuring unit = 6.02214076 x 10^{23} units)
ppbv	Parts per Billion by Volume
psi	Pounds per Square Inch

1.0 Introduction

TRC Companies (TRC), in consultation with ERO Resources (ERO) has prepared this Indoor Air Monitoring Plan (IAMP) on behalf of the Thornton Development Authority (TDA) for the Thornton Shopping Center located at the northeast corner of 88th Avenue and Washington Street in Thornton, Colorado (the Facility) (**Figure 1**). The Thornton Shopping Center property is currently owned by the TDA. This IAMP presents the methodology for the collection and analysis of indoor air samples to assess indoor air quality in the properties located downgradient of the Facility to assess the potential vapor intrusion pathways in association with the historic release of the dry-cleaning chemical tetrachloroethylene (PCE) to the subsurface. This sampling is being performed to satisfy terms agreed to between the TDA and the Colorado Department of Public Health and Environment (CDPHE) in Paragraph 23 of the Compliance Order on Consent (Order #24-02-01-01) executed on February 15, 2024. This IAMP provides the details for activities described in CDPHE's July 3, 2024 letter titled *Approval – Remedial Investigation and Corrective Measures Work Plan; Thornton Shopping Center, NE Corner East 88th Avenue and Washington Street, Thornton, CO 80229; EPA ID# COR000212639; CDPHERM HAZ COR – Corrective Action*. Activities described herein are anticipated to commence within 30 days of approval of this IAMP. Sample results will be evaluated to support future actions at the properties sampled.

1.1 Facility Description

The Thornton Shopping Center is located at the northeast corner of 88th Avenue and Washington Street in Thornton, Colorado (**Figure 1**). The Facility is currently owned by the TDA and is currently vacant. The presence of contaminated groundwater was identified during multiple investigations since 2006 and most recently documented in the 4Q23 Groundwater Monitoring Report (ERO 2024a). Review of information from prior assessments indicates that the groundwater contamination originated from historic dry-cleaning operations formerly located at 8860, 8866 and 8876 North Washington Street and one in the northeasterly building at 8946 North Washington Street, all located in the eastern portion of the Thornton Shopping Center and the groundwater plume extends to the southeast.

2.0 Indoor Air Sampling

2.1 Facility Access and Notifications

The TDA will notify the property owners regarding the proposed sampling event using a customized notice letter and informational fact sheet. Following TDA's notification to the property owners, TRC will contact property owners and request written consent for air sampling. TRC will inform TDA/ERO and CDPHE of access refusal (if any) within a minimum of seven days prior to sampling. Access denial will be documented in written correspondence with CDPHE as required by the Remedial Investigation and Corrective Measures Work Plan (ERO 2024b).

2.2 Chemical Inventory / Owner Interviews

A chemical inventory and interview will be completed with the property owner during the same day or as close as possible to air sampling. The purpose of this comprehensive chemical inventory is to determine if there are any activities, products or chemicals kept in the building that may interfere with the proposed sampling, making it difficult to distinguish the source of measured contamination (subsurface impacts vs. household products). A copy of the Example Indoor Air Building Survey that will be used for this project is included in **Appendix I**. The survey will be filled out with the property owner or operator during the assessment of the building or home and an inspection of the building will be performed to determine if there are activities, products or chemicals present that may interfere with the sampling. Photographs will be taken of any activities, products or chemicals identified in the building survey. A screen of the building will be conducted with a Photoionization Detector (PID) to gather volatile organic compounds (VOC) data in ambient air of the building.

2.3 Sample Locations

Indoor air sampling will be conducted at up to 17 single family residential structures and up to 24 residential apartments units along with two childcare facilities, and up to three commercial properties following applicable sections of the CDPHE Vapor Intrusion Guidance downloaded on July 9, 2024 (CDPHE 2024). The sampling locations will be based on accessibility and known concentrations of groundwater impacts, with the initial focus along the centerline of the groundwater plume as shown on **Figure 2**. Candidate locations are described by **Figure 2** and the indoor air quality assessment properties listed in **Appendix II**. The air sampling will be performed using individually-certified, six-liter Summa canisters for the collection of indoor air samples from the lowest occupied floor or living space and away from areas of increased air movement like vents, fans, windows, or outside doors. The canister will be placed at a height of approximately three to five feet above the floor, where possible. A 24-hour sample will be collected at the residential properties and childcare facilities (43 total). A minimum of two residential units in each of the condominium buildings will be sampled. An eight-hour sample will be collected at the commercial properties.

If more than the planned number of residential property owners request indoor air sampling of their properties, then additional units / locations may be added if determined appropriate and the final selection will be determined by or approved by the TDA and CDPHE. Additional units / locations may be added, pending results of the indoor air sampling investigation.

2.4 Health and Safety Plan

A Health and Safety Plan (HASP) will be prepared for the Facility activities. All field team members will review this IAMP and the HASP and will obtain the facility-specific health and safety training [including tailgate safety and Job Safety Analysis (JSA) briefings] in accordance with the HASP.

2.5 Sampling Approach

Sample locations within each building will be coordinated with the building owner. Selected sample locations will be located on the ground floor, three to five feet above the floor (when possible). Outdoor air samples will be located three to five feet above the ground surface and five to 15 feet away from structures that may affect air flow. All selected sample locations will avoid potential sources of VOCs. A PID will be utilized to gather VOC data at proposed sampling locations. Sample locations may be modified based on the findings of the PID screening. Field staff will ensure that the summa canisters will not be taken to zero in. Hg vacuum and instead, a small, residual vacuum will be left in the summa canisters. Summa canister set up will follow lab instructions provided, in the event that instruction is not provided the sampler will follow instructions in **Appendix III**.

2.6 Target Analyte List

The target analytes of this project are the chlorinated solvent compounds commonly associated with dry-cleaning operations including PCE as well as trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethene (1,1-DCE), and vinyl chloride (VC). The air sample will be submitted to an accredited laboratory for analysis of PCE and its degradation products using the United States Environmental Protection Agency (USEPA) Compendium Method TO-15, selected ion monitoring (SIM) mode.

2.7 Quality Assurance / Quality Control

Quality Assurance / Quality Control (QA/QC) samples will be collected at a 1:20 ratio during the sampling event to provide a check on the laboratory methodology and performance and to collect ambient air data to evaluate the potential for indoor air contamination attributable to background sources. One duplicate sample will be collected in the day care facility located at 941 East 88th Avenue. One 24-hour ambient air measurement will be collected from a secure area that is located upwind of the sampling area if possible. The QA/QC samples will be laboratory analyzed for the same constituents as the primary samples.

3.0 Sample Documentation and Handling

3.1 Field Notes and Sampling Forms

All field activities will be documented in project dedicated field books and sampling forms. Field notes and forms will be included in subsequent data results reports.

3.2 Sample Container Labels

All sample Summa canister labels will be provided by the laboratory and completed in the field. The initial and final pressure readings will also be documented on the sample container label as well as the field sampling forms.

3.3 Photographs

Any relevant photographs taken in the field will be included in subsequent data results reports as a photo log.

3.4 Shipping and Chain-of-Custody

Samples will be placed in packaging supplied by the lab and shipped to an accredited laboratory. Summa canister samples will be properly handled under chain-of-custody (COC) protocol.

All samples will be maintained under the control of the sampler from the time of collection until release to the laboratory or third-party shipping company. This will be tracked by COC forms received from the laboratory. COC forms will be included in subsequent data results reports.

4.0 Schedule

The anticipated schedule for implementing the activities described in this IAMP are based on the approved Remedial Investigation and Corrective Measures Work Plan (ERO 2024b) as follows:

- Submittal of this IAMP for approval within 15 days of the Remedial Investigation and Corrective Measures Work Plan (ERO 2024b) by CDPHE – approval date July 3, 2024.
- Start notifications in accordance with this IAMP – within 30 days of CDPHE approval of this IAMP.
- Start sampling – dependent upon access request success.
- Report initial findings (raw data reporting) – 30 days from the issue date of the laboratory report.
- Perform data comparison to previous investigations - 45 days from the issue date of the laboratory report.
- Submit a draft report in accordance with this IAMP - 60 days from the issue date of the laboratory report.
- Indoor Air and Semi-annual Reporting Updates (as needed) – Semi-annually by July 31st for the 1st and 2nd quarters of the calendar year and January 31st for the 2nd and 3rd quarters of the previous calendar year.

The above schedule is subject to completion of access agreements and property access.

5.0 Reporting

A report documenting all field activities will be prepared and submitted to the CDPHE, TDA, and ERO in accordance with a schedule to be determined with CDPHE and TDA following implementation of this Work Plan. All appropriate field documentation, laboratory reports, and data analysis will be included in the results report.

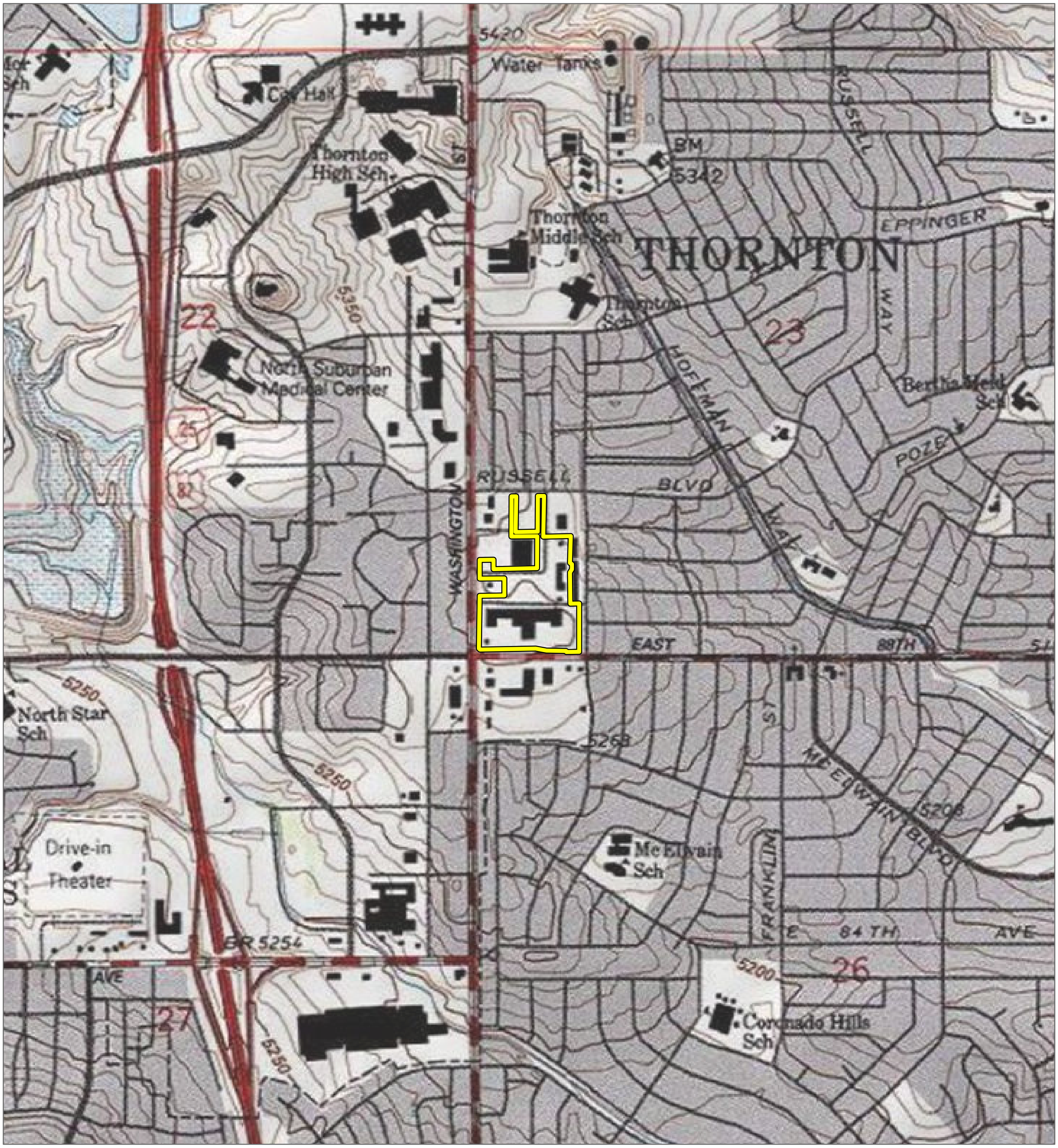
6.0 References

Colorado Department of Public Health and Environment (CDPHE). (2024). *Vapor Intrusion* Guidance. Downloaded July 9.

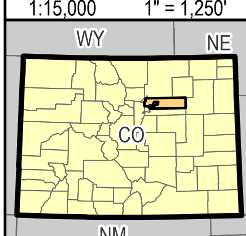
ERO Resources (ERO). (2024a). *4Q23 Groundwater Monitoring Report, Thornton Shopping Center, NE Corner East 88th Avenue and Washington Street, Thornton, Colorado*. ERO Project #10197. February 1.

ERO Resources (ERO). (2024b). *Remedial Investigation and Corrective Measures Work Plan, Compliance Order on Consent Number: 24-02-01-01, Thornton Shopping Center, East 88th Avenue and Washington Street, Thornton, Colorado 80229*. May.

FIGURES



TSC PROPERTY



0 625 1,250
FEET
1:15,000 1" = 1,250'

PROJECT: **THORNTON SHOPPING CENTER**
88TH AND WASHINGTON
THORNTON, COLORADO

TITLE: **FACILITY LOCATION MAP**

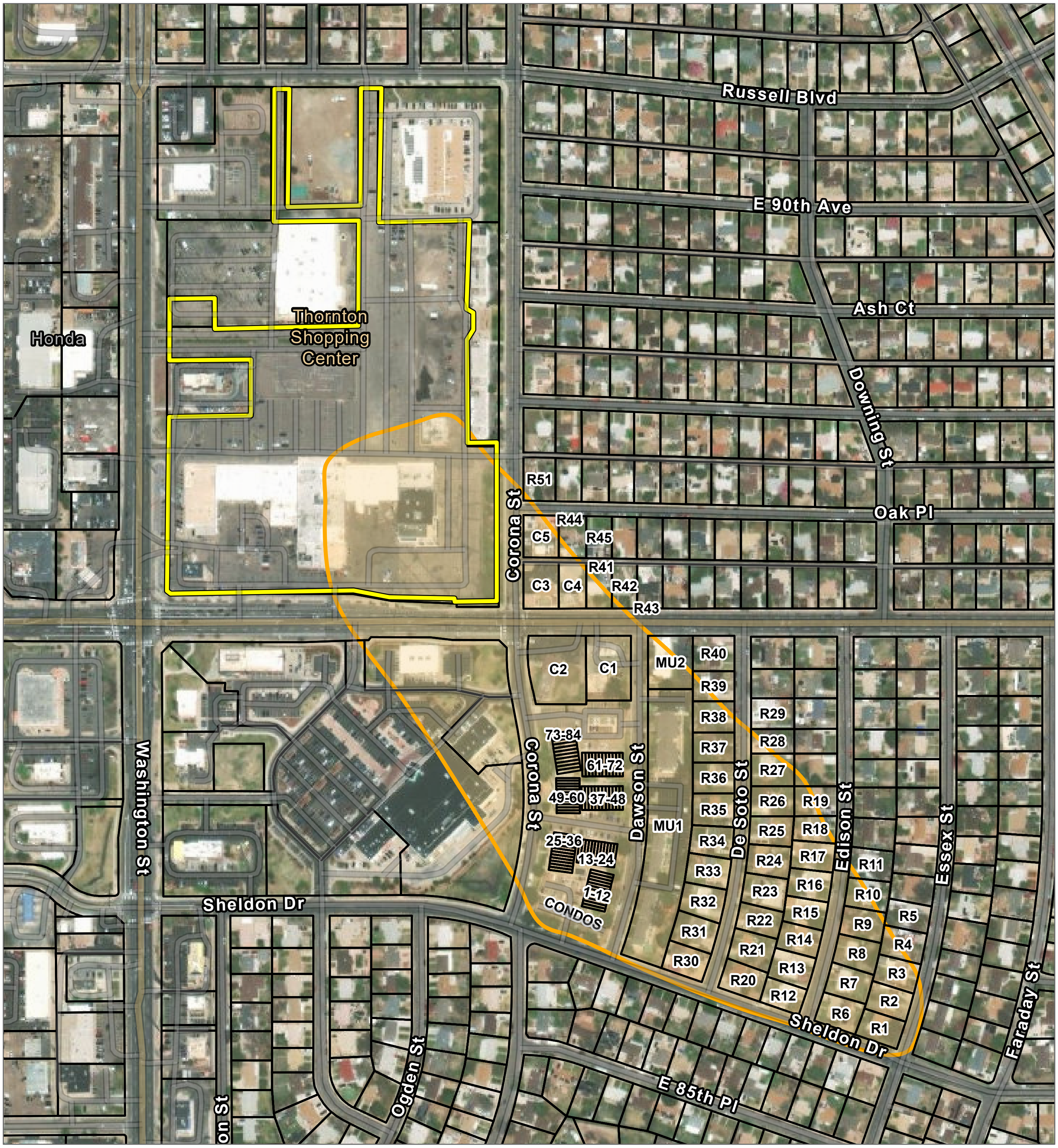
DRAWN BY:	A. CLINE	PROJ. NO.:	608455
CHECKED BY:	NAME	**FIGURE 1**	
APPROVED BY:	NAME		
DATE:	JULY 2024		

TRC
1526 COLE BOULEVARD
BUILDING 3, SUITE 150
LAKEWOOD, CO 80401
PHONE: 303.792.5555

FILE: 608455_THORTONSHOPPINGCENTER

BASE MAP: USGS TOPOGRAPHIC SERVICE LAYER
QUAD: COMMERCE CITY, CO
DATA SOURCES: TRC

COORDINATE SYSTEM: NAD 1983 STATEPLANE COLORADO NORTH FIPS 0501 FEET; MAP ROTATION: 0
-- SAVED BY: ACLINE ON 7/15/2024, 09:44:28 AM; FILE PATH: T:\1-PROJECTS\CITY_OF_THORTON\608455_THORTONSHOPPINGCENTER\2-APRX\608455_THORTONSHOPPINGCENTER.APRX; LAYOUT NAME: FIGURE 1 SITE LOCATION MAP



PCE PLUME

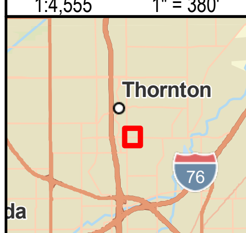
TSC PROPERTY

PARCEL

BASE MAP: ESRI 'WORLD IMAGERY' SERVICE LAYER, 5/2023
DATA SOURCES: TRC

N

0 190 380
FEET
1:4,555 1" = 380'



PROJECT: **THORNTON SHOPPING CENTER**
88TH AND WASHINGTON
THORNTON, COLORADO

TITLE:
AERIAL BASEMAP

DRAWN BY:	A. CLINE	PROJ. NO.:	608455
CHECKED BY:	NAME		
APPROVED BY:	NAME	**FIGURE 2**	
DATE:	JULY 2024		

TRC

1526 COLE BOULEVARD
BUILDING 3, SUITE 150
LAKEWOOD, CO 80401
PHONE: 303.792.5555

FILE: 608455_THORTONSHOPPINGCENTER

COORDINATE SYSTEM: NAD 1983 STATEPLANE COLORADO NORTH FIPS 0501 FEET; MAP ROTATION: 0
-- SAVED BY: ACLINE ON 7/15/2024, 09:44:28 AM; FILE PATH: T:\1-PROJECTS\CITY_OF_THORNTON\608455_THORTONSHOPPINGCENTER\2-APRX\608455_THORTONSHOPPINGCENTER.APRX; LAYOUT NAME: FIGURE 2 AERIAL BASEMAP

Appendix I

Field Forms

EXAMPLE INDOOR AIR SAMPLING BUILDING SURVEY

DATE:_______________ ID #_____________

ADDRESS ____
____
____

Residential Contact ____

Phone: Home ( )_____________ Work: ( )______________

Move in date ______________________

Length of residence in area: _____________________

List of Current Occupants/Occupation

AGE (IF UNDER 18)	SEX (M/F)	OCCUPATION

BUILDING CONSTRUCTION CHARACTERISTICS

What type of building do you have? (Please circle appropriate type)

Single Family Multiple Family School Commercial

Ranch
Raised Ranch
Cape
Colonial
Split Level
Adobe
Mobile Home
Other (Please specify) ____________________________________

2-family
Duplex
Apartment house
 # of units ________
Condominium
 # of units _________
Other (please specify) _______________________________

General description of building construction methods

____

____

____

How many occupied stories does the building have? ____________________

Has the building been weatherized with any of the following? (please circle all that apply)

Insulation Storm Windows Energy-efficient Windows
Other (specify)____

What type of foundation does the building have?

Full basement crawl space Slab-on-Grade
Other (please specify)____

What are the basement characteristics? (please circle all that apply)

Finished	Basement Floor:	Foundation Walls:	Moisture:
Unfinished	concrete	poured concrete	wet
	Dirt	block	damp
	Other_________	stone	dry

Is a basement sump present? YES NO

Heating & Ventilation System(s) Present:

What type of heating system(s) are used in this building? (Please circle all that apply)

Hot air circulation Heat pump Steam radiators Wood stove
Hot air radiation Unvented kerosene heater Electric baseboard

Other (please specify) ____

What type(s) of fuel are used in this building? (please circle all that apply)

Natural gas	Electric	Coal	Other (specify)__________
Fuel oil	Wood	Solar	

What types of mechanical ventilation systems are present and/or currently operation in the building? (please circle all that apply)

Central air conditioning	Mechanical fans	Bathroom vent fan
Individual air conditioning units	Kitchen range hood	Air-to air heat exchanger
Open windows	Other (please specify) __________________________	

SOURCES OF CHEMICAL CONTAMINANTS:

Which of these items are present or recently present in the building? (Please check all that apply)

Potential Chemical Source	Location of Chemical	Was Removed 48 hours prior to sampling? (Y/N)
Paints or thinners		
Gasoline-powered equipment		
Gasoline storage cans		
Cleaning solvents		
Air fresheners		
Oven cleaners		
Carpet/upholstery cleaners		
Hairspray		
Nail polish or remover		
Bathroom cleaner		
Appliance cleaner		
Furniture/floor polish		
Moth balls		
Fuel tank		
Wood stove		
Fireplace		
Hobby Supplies like solvents, paints, lacquers, glues, photographic darkroom supplies, etc.		
Scented trees, wreaths, potpourri, etc		
Other		
Other		

Do one or more smokers occupy this building on a regular basis?

Has any body smoked in the building in the last 48 hours?

Does the building have an attached garage?

If so, is a car usually parked in the garage?

Do the occupants of the building frequently have their clothes dry-cleaned?

Was there any recent remodeling of painting done in the building?

Are there any pressed wood products in the building e.g., hardwood plywood wall paneling, particle board, fiber board?

Are there any new upholstery, drapes, shower curtains, or other textiles in the building?
Has the building been treated with any insecticides/pesticides? If so, what chemicals are used and how often are they applied.

Do any of the occupants apply pesticides/herbicides in the yard or garden? If so, what chemicals are used and how often are they applied?

WEATHER CONDITIONS DURING SAMPLING

Outside Temperature (^oF) ___________________
Prevailing wind direction and speed ______________________________
Describe the general weather conditions (i.e. sunny, cloudy, rain, snow) _____________
Was there any significant precipitation (0.1 inches) within 12 hours of the sampling event? ____
Type of ground cover (e.g. grass, asphalt, concrete, dirt, etc.) outside building. _______________

GENERAL COMMENTS

Is there any other information about the structural features of this building, the habits of its occupants or potential sources of chemical contamination to the indoor air that may be of importance in facilitating the evaluation of the indoor air quality of the building?

Appendix II

Indoor Air Quality Assessment Properties

Indoor Air Quality Assessment Properties

Location ID	Parcel Number	Property (Address)	Owner Name	Owner Address	Location Description
R1	*# 0171926203014*	8631 ESSEX ST	CASILLAS MARIA A AND RODRIGUEZ MARIA G	8631 ESSEX ST	CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:14
R2	#0171926203015	8641 ESSEX ST	WOLFE LINDA C AND WALKER KENNETH H/NOSBISH MARILYN K	2000 W 92ND AVE LOT 682 DENVER CO 80260-5372	CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:15
R3	*#171926203016*	8651 ESSEX ST	SCADDEN BRIAN A AND SCADDEN VERONICA N	8651 ESSEX ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:16
R4	#0171926203017	8661 ESSEX ST	ESPINOZA WILLIAM R AND ESPINOZA LISA	8661 ESSEX ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:17
R5	#0171926203018	8671 ESSEX ST	KRAUSE PAUL B AND KRAUSE VIVIAN D	8671 ESSEX ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:18
R6	#0171926203013	8640 EDISON ST	FLORES VERONICA	4462 LINCOLN ST DENVER CO 80216-3521	CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:13
R7	*#0171926203012*	8650 EDISON ST	LAMB KAREN K	10323 FOX CT DENVER CO 80221-6040	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:12
R8	#0171926203011	8660 EDISON ST	HILL JAMES C AND HILL MARIE J EXEMPT TRUST A	9110 WASHINGTON ST DENVER CO 80229-4305	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:11
R9	*#0171926203010*	8670 EDISON ST	MOLTER DIANE MARIE	8670 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:10
R10	*#0171926203009*	8680 EDISON ST	LINENBERGER CHARITY M	8680 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:9
R11	*#0171926203008*	8700 EDISON ST	MEDINA JUAN	8700 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:5 LOT:8
R12	*#0171926204013*	8641 EDISON ST	CHUMBA JORGE EDDIE PACHECO AND ADINETT ESTELA CARRANZA	8641 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:13
R13	*#0171926204014*	8651 EDISON ST	BARKER STEVEN DONALD	8651 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:14
R14	*#0171926204015*	8661 EDISON ST	ALONZO LEONARD AND ALONZO ISABEL	8661 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:15
R15	*#0171926204016*	8671 EDISON ST	CRUZ JOHN E AND CRUZ EMERLINDA	8671 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:16
R16	*#0171926204017*	8681 EDISON ST	KING JEANNE M	8681 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:17
R17	*#0171926204018*	8701 EDISON ST	HARRISON BEN T TRUST UA THE	8701 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:18
R18	*#0171926204019*	8711 EDISON ST	HOWLETT KENNETH D AND HOWLETT STEPHANIE D	8711 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:19
R19	*#0171926204020*	8721 EDISON ST	STEELE CHELSEA A AND STEELE SHANNON M	8721 EDISON ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:20
R20	*#0171926204012*	8650 DE SOTO ST	KIHM MICHAEL	8650 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:12
R21	*#0171926204011*	8660 DE SOTO ST	LECHEMINANT KENNETH	8660 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:11
R22	*#0171926204010*	8670 DE SOTO ST	GARCIA JESUS MANUEL LOPEZ	8670 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:10
R23	*#0171926204009*	8680 DE SOTO ST	PACHECO-LACAN VICTORIANO L	8680 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:9
R24	*#171926204008*	8700 DE SOTO ST	8700 DE SOTO STREET TRUST	8700 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:8
R25	*#171926204007*	8710 DE SOTO ST	LOPEZ DAVID R AND TIEDEKEN JENNIFER ANN	8710 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:7
R26	*#0171926204006*	8720 DE SOTO ST	CROGHAN KATHY A CROGHAN JADE LUI	8720 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:6

Indoor Air Quality Assessment Properties

Location ID	Parcel Number	Property (Address)	Owner Name	Owner Address	Location Description
R27	*#0171926204005*	8730 DE SOTO ST	MORGAN SAMUEL E AND MORGAN COLLEEN A	8730 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:5
R28	*#0171926204004*	8740 DE SOTO ST	PEREZ-RASCON ZULEMA AND TORRES PEREZ ERICK U	8740 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:4
R29	*#0171926204003*	8750 DE SOTO ST	LOMME MARIA GLORIBEL	8750 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:4 LOT:3
R30	*#0171926205013*	8661 DE SOTO ST	DANIELS JULIE A	8661 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:12
R31	*#0171926205014*	8671 DE SOTO ST	ZERR JOVETA	8671 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:13
R32	*#0171926205015*	8681 DE SOTO ST	HILL JAMES J AND HILL KATHLEENA	13830 FRANKLIN ST BRIGHTON CO 80602-6358	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:14
R33	*#0171926205016*	8701 DE SOTO ST	GARDUNIO BEN AND GARDUNIO LEVDA	8701 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:15
R34	*#0171926205017*	8711 DE SOTO ST	TAFOYA JOSE	8711 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:16
R35	*#0171926205018*	8721 DE SOTO ST	AGUIRRE ANDREW AND AGUIRRE SHERRY JO	8721 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:17
R36	*#0171926205019*	8731 DE SOTO ST	AYALA ELENA	8731 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:18
R37	*#0171926205020*	8741 DE SOTO ST	MUNIZ FRED AND MUNIZ NANCY C	8741 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:19
R38	*#0171926205021*	8751 DE SOTO ST	PHILLIPS CHRIS L	8751 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:20
R39	*#0171926205022*	8761 DE SOTO ST	GARDUNIO AMOS GUADALUPE	8761 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:21
R40	*#0171926205023*	8791 DE SOTO ST	BAYLESS DENNIS D	8791 DE SOTO ST	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:22
R41	*#0171923326004*	971 E 88TH AVE	THE LOIS STONE TRUST	1051 ASH CT THORNTON CO 80229-4574	SUB:THORNTON BLK:13 LOT:24
R42	*#0171923326005*	991 E 88TH AVE THORNTON CO	88TH ST LLC	7887 E BELLEVIEW AVE STE 1100 ENGLEWOOD CO 80111-6097	SUB:THORNTON BLK:13 LOT:23
R43	*#0171923326006*	1011 E 88TH AVE THORNTON CO	GIL RAMON	1011 E 88TH AVE THORNTON CO	SUB:THORNTON BLK:13 LOT:22
R44	*#0171923326026*	950 OAK PL THORNTON CO	KANZ WENDY J	950 OAK PL THORNTON CO	SUB:THORNTON BLK:13 LOT:2
R45	*#0171923326025*	970 OAK PL THORNTON CO	ZEPEDA EFREN	970 OAK PL THORNTON CO	SUB:THORNTON BLK:13 LOT:3
R46	*#0171923323002*	941 OAK PL THORNTON CO	WAGNER MATTHEW JOSEPH	941 OAK PL THORNTON CO	SUB:THORNTON BLK:12 LOT:26
MU1 (8 ground units per building, thrid building different)	*#0171926205024*	8670 DAWSON ST	*EW GP ASSOCIATES LLC*	15301 VENTURA BLVD STE B570 SHERMAN OAKS CA 91403	*SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 DESC: S 32/72 FT OF LOT 2 ALL OF LOTS 3 THRU 11 INC*
MU2 (18 Bedrooms)	*#0171926205001*	8780 DAWSON ST	*HAVEN HILLS LLC*	510 E 51ST AVE STE 203 DENVER CO 80216-2004	*SUB:CITY VIEW HEIGHTS FIRST FILING BLK:3 LOT:1 DESC: AND N 43/28 FT OF LOT 2*
CONDO9	*#0171926206008*	8731 DAWSON ST #104	GUERRIERO GARY ANTHONY	898 W TAMARISK ST LOUISVILLE CO 80027-1050	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:104 DESC:BLDG 1
CONDO10	*#0171926206007*	8731 DAWSON ST #103	MARTINEZ LEO AND MARTINEZ ALITA M	8731 DAWSON ST #103	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:103 DESC:BLDG 1
CONDO11	*#0171926206006*	8731 DAWSON ST #102	ROUSE ANDREA ANNE	13328 MISTY ST BROOMFIELD CO 80020-5279	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:102 DESC:BLDG 1

Indoor Air Quality Assessment Properties

Location ID	Parcel Number	Property (Address)	Owner Name	Owner Address	Location Description
CONDO12	#0171926206005	8731 DAWSON ST #101	BILSBORROW STEWART	8731 DAWSON ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:101 DESC:BLDG 1
CONDO13	*#0171926206017*	8741 DAWSON ST #101	GEBHART KAREN M	8741 DAWSON ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:101 DESC:BLDG 2
CONDO14	*#0171926206018*	8741 DAWSON ST #102	CERDA ADAN	8741 DAWSON ST #102	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I DESC:CONDO UNIT 102 BLDG 2
CONDO15	*#0171926206019*	8741 DAWSON ST #103	GANDARA KAREN E	8741 DAWSON ST #103	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:103 DESC:BLDG 2
CONDO16	*#0171926206020*	8741 DAWSON ST #104	JAVERY KELLIE J	8741 DAWSON ST #104	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:104 DESC:BLDG 2
CONDO25	*#0171926206029*	8740 CORONA ST #101	PARDO ANNA RENE	8740 CORONA ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:101 DESC:BLDG 3
CONDO26	*#0171926206030*	8740 CORONA ST #102	LIGHTCAP ROGER	8740 CORONA ST #102	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:102 DESC:BLDG 3
CONDO27	*#0171926206031*	8740 CORONA ST #103	BALES CINDY A	8740 CORONA ST #103	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I DESC:CONDO UNIT 103 BLDG 3
CONDO28	*#0171926206032*	8740 CORONA ST #104	CUI WEI AND YANG XUEMEI	684 GLENARBOR CIR LONGMONT CO 80504-2333	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE I UNIT:104
CONDO37	*#0171926206054*	8761 DAWSON ST #101	OLSON JAKE PATRICK	8761 DAWSON ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE III UNIT:101 DESC:BLDG 5
CONDO38	*#0171926206055*	8761 DAWSON ST #102	FROST EMILY	8761 DAWSON ST #102	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE III UNIT:102 DESC:BLDG 5
CONDO39	*#0171926206056*	8761 DAWSON ST #103	QUINTANA-ESPARZA JAYLEENE AND CASILLAS ARACELY	8761 DAWSON ST #103	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE III UNIT:103 DESC:BLDG 5
CONDO40	*#0171926206057*	8761 DAWSON ST #104	MC CLERKIN FREDDY G AND MC CLERKIN ANNETTE S	8761 DAWSON ST #104	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE III UNIT:104 DESC:BLDG 5
CONDO49	*#0171926206042*	8760 CORONA ST #101	LIU FENG YI	8760 CORONA ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE II UNIT:101 DESC:BLDG 4
CONDO50	*#0171926206043*	8760 CORONA ST #102	WILLIAMS CHARLES	8760 CORONA ST #102	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE II UNIT:102 DESC:BLDG 4
CONDO51	*#0171926206044*	8760 CORONA ST #103	ACOSTA FRANCISCO J	8760 CORONA ST #103	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE II UNIT:103 DESC:BLDG 4
CONDO52	*#0171926206045*	8760 CORONA ST #104	HOBART RICHARD	8760 CORONA ST #104	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE II UNIT:104 DESC:BLDG 4
CONDO61	*#0171926206078*	8771 DAWSON ST #101	HONG STEVEN	8771 DAWSON ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE V UNIT:101 DESC:BLDG 6
CONDO62	*#0171926206079*	8771 DAWSON ST #102	FARRELL NOAH	8771 DAWSON ST #102	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE V UNIT:102 DESC:BLDG 6

Indoor Air Quality Assessment Properties

Location ID	Parcel Number	Property (Address)	Owner Name	Owner Address	Location Description
CONDO63	*# 0171926206080*	8771 DAWSON ST #103	MAESTAS SALLY B	8771 DAWSON ST #103	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE V UNIT:103 DESC:BLDG 6
CONDO64	*#0171926206081*	8771 DAWSON ST #104	MARTINEZ CONNIE I	8771 DAWSON ST #104	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE V UNIT:104 DESC:BLDG 6
CONDO73	*#0171926206066*	8770 CORONA ST #101	GARCIA MARIO E AND GARCIA GLORIA A	8770 CORONA ST #101	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE IV UNIT:101 DESC:BLDG 7
CONDO74	*#0171926206067*	8770 CORONA ST #102	PATEL HEENA K	8770 CORONA ST #102	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE IV UNIT:102 DESC:BLDG 7
CONDO75	*#0171926206068*	8770 CORONA ST #103	MAY RODNEY GENE AND MAY BARBARA JEAN	9926 JULIAN CT WESTMINSTER CO 80031-6749	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE IV UNIT:103 DESC:BLDG 7
CONDO76	*#0171926206069*	8770 CORONA ST #104	HENKEL JOYCE	8770 CORONA ST #104	CONDO: CORONA VILLAGE CONDOMINIUMS PHASE IV UNIT:104 DESC:BLDG 7
C1	*#0171926206003*	1066 E 88TH AVE	SHELDON HERMAN GRANDCHILDRENS LP ET AL C/O TAX DEPT 24856 - 7-11 INC (7/11)	PO BOX 2440 SPOKANE WA 99210-2440	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:2 DESC: BEG AT A PT WHICH IS THE INTERSEC OF S LN OF 88TH AVE AND W LN OF N DAWSON ST TH SLY 165 FT ALG W LN SD ST TH WLY 115/93 FT TH NLY 165 FT TO A PT ON S LN OF 88TH AVE TH ELY 115/93 FT TO POB
C2	*#0171926206001*	8796 CORONA ST	HUH TAE NAM AND HUH WOONG BOK (Together Liquors)	400 BEAUMONT AVE PACIFIC GROVE CA 93950	SUB:CITY VIEW HEIGHTS FIRST FILING BLK:2 DESC: PARC IN BLK 2 BEG AT A PT ON N LN 115/93 FT W OF NE COR TH S 175 FT TH W 132/39 FT TO PT ON W LN SD BLK TH N 11D 22M W ALG WLY LN SD BLK 59/89 FT TO PT OF CURVE TH NLY ALG WLY LN SD BLK ON CURVE TO RT HAVING A RAD OF 325/8 FT 58/55 FT TO PT OF TANGENT THE LONG CHD OF WHICH BRS N 05D 41M W 58/48 FT TH N ALG WLY LN SD BLK 57/94 FT TO NW COR SD BLK TH E ALG N LN SD BLK 150 FT TO POB
C3	*#0171923326002*	941 E 88TH AVE THORNTON CO	BUNDLES OF BABIES LLC	941 E 88TH AVE THORNTON CO	SUB:THORNTON BLK:13 LOT:26
C4	*#0171923326003*	951 E 88TH AVE THORNTON CO	LIU FENG YI (Ancient Arts Massage)	7334 WASHINGTON ST DENVER CO 80229-6302	SUB:THORNTON BLK:13 LOT:25
C5	*#0171923326001*	940 OAK PL THORNTON CO	BUNDLES OF BABIES LLC	941 E 88TH AVE THORNTON CO 80229	SUB:THORNTON BLK:13 LOT:1

Notes

R = Residential or single-family home
CONDO= Condominium housing
MU - Multi-unit/Apartment style
C = Commercial
Yellow highlight *= Property and owner address are different*

Appendix III

Summa Canister Setup Instructions

AIR CANISTERS

Instructions for Canister Grab Sampling

(Tools needed: one ended 9/16” wrench)

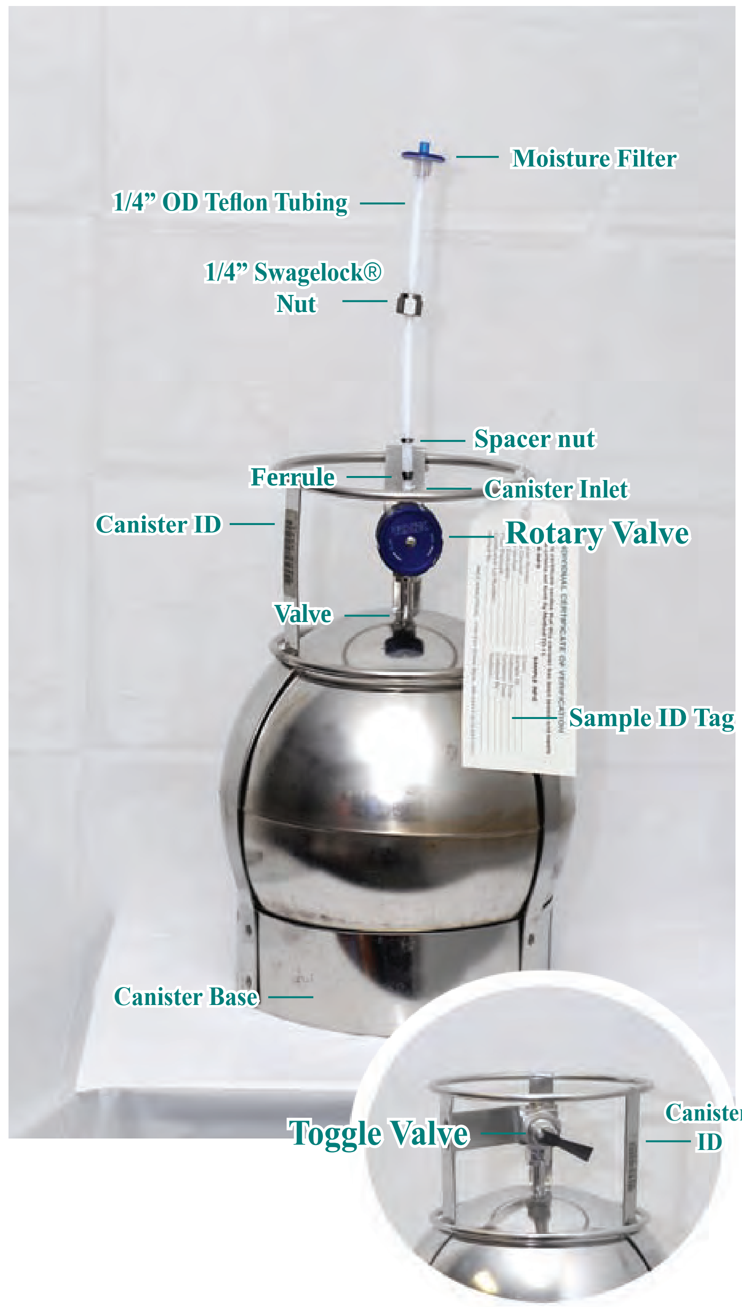
1. INSPECTION – Inspect your canister shipment upon arrival. Compare the contents with the packing slip and notify Pace Analytical of any discrepancy or damage. Familiarize yourself with the contents you received by comparing them to the pictures on the right. Do not open the valve until you are ready to sample. Even a small loss of vacuum will compromise your sample.

2. CONNECTION – Remove the brass cap from the top of the can with a 9/16” wrench. If you are connecting to a predetermined sampling point you may have received the following: 6 inches of ¼ inch OD Teflon tubing, ¼ inch Swagelock® nut, ferrule, spacer nut and moisture filter (if requested). Connect these items in series using the pictures on the right as a guide. The spacer fits between the nut and the ferrule. The ferrule must be pointed down toward the canister. Please note the connection to the canisters utilizes Swagelock® threading. For a proper connection, it’s important that no cross-threading occurs. The canister connection is made by hand-tightening the Swagelock® nut. Once connected, use an open ended (9/16”) wrench to further tighten the connection. Make sure that the connection is firmly tightened. The final connection must be leak tight recognizing also that over-tightening can cause leaks as well. Do not use pliers or adjustable-end wrenches to tighten this Swagelock® connection. Use only open ended wrenches for tightening. The canister is now ready for sampling.

3. SAMPLING – To begin sampling simply open the canister valve (you may have either a rotary valve or a toggle valve). One full turn counter clockwise for the rotary valve is sufficient. The toggle valve will open by flipping upward. During the initial sampling process you will hear a rush of air. Without a flow restriction the canister will fill in approximately 30-45 seconds.

4. COMPLETION – After sampling is complete, close the canister valve. Disassemble the components and return them in the original shipping package they were received in. Verify the contents for return to the laboratory. Complete the Chain-of-Custody form and return with the samples to the laboratory. Be sure to reference the canister ID on the Chain-of-Custody.

Grab Sample Configuration



www.pacelabs.com

Questions? Please call the Air Technical phone number 612-607-6386

Guide to Air Sampling and Analysis

by EPA Method TO-15

Third Edition

7/9/2009

ACCREDITED IN ACCORDANCE WITH nelac

IAL
Integrated Analytical Laboratories LLC

For more information about air sampling and analysis, you can contact Integrated Analytical Laboratories by:

Phone:
Client Services – (973) 361-4252 x104
Air Department – (973) 361-4252 x273

Mail:
Integrated Analytical Laboratories, LLC
273 Franklin Road
Randolph, New Jersey 07869

Fax:
Client Services – (973) 989-5288
Air Department – (973) 366-5613

On the web:
http://www.ialonline.com

TABLE OF CONTENTS

TABLES AND FIGURES

AIR SAMPLING AND ANALYSIS

INTRODUCTION

We at Integrated Analytical Laboratories want to ensure that you receive the best results possible for your air sampling needs. Our hope is that this guide will provide you with all of the information you require. If, after reading this guide, you still require assistance, please contact us at (973) 361-4252 x273.

THE PURPOSE OF AIR SAMPLING AND ANALYSIS

The indoor air quality of homes, office buildings, child-care centers, etc is impacted by the presence of volatile organic compounds (VOCs) in contaminated soil or ground water. Chemical vapors migrate through subsurface soils and/or favored pathways (e.g. underground utilities, foundation cracks, or through foundation drainage/sump systems) which impacts indoor air quality. Temporal variations (i.e. changes in temperature and pressure) can cause VOC levels to fluctuate in a confined space.

The term “vapor intrusion” refers to this migration of VOCs from the subsurface into overlying buildings. The accumulation of VOCs in confined spaces can result in health concerns associated with varying levels of contaminants. Higher levels can have acute or immediate effects, while the potential for chronic health effects is associated with lower levels of contaminants.

EPA METHOD TO-15

EPA Method TO-15 is used for detection of VOCs in most indoor air quality applications such as odor identification and remedial investigations. Soil gas samples (i.e. sub-slab or near-slab samples) are used to assess the pathway of VOCs into a structure. The location and depth of these samples are determined at the discretion of the case or project manager.

EPA Method TO-15 is also helpful in finding microbial VOCs (mVOCs) in damp buildings or where mold investigations are taking place. Terpenes, ethers, ketones, alcohols, aldehydes, aromatic and chlorinated hydrocarbons, sulfur-based compounds, and amines are the types of mVOCs indicative of fungal growth. Specifically, 3-methyl-1-butanol, 2-hexanone and 2-heptone (represented as tentatively identified compounds, TICs, when reported through a library search) are used as mold growth indicators.

EPA Method TO-15 is comprehensive and should be thoroughly reviewed prior to completing air sampling. Also, many states offer their own guidance documents based on EPA Method TO-15 (e.g. NJDEP Vapor Intrusion Guidance), which provide further details for sampling and analysis. These documents should be reviewed as well.

Why choose EPA Method TO-15?
TO-15 is especially designed for air samples to have low reporting limits. This method covers both non-polar (e.g. xylene, hexane) and polar (e.g. alcohols, ketones, methanol) VOCs. Special water management techniques are built into the GC/MS to prevent loss of polar (water soluble) VOCs. TO-15 offers stringent Quality Assurance/Quality Control (QA/QC) checks, assuring the best data feasible.

OVERVIEW

The "Summa® Canister"

A Summa® canister is a common (but trademarked) term used in the industry to refer to an air sampling canister. Air sampling canisters may also be referred to as a Silco™ or TO™ Canister. Canisters come in a variety of sizes – IAL carries 6-Liter, 1-Liter, and 400cc canisters (Figure 1).

Figure 1: 6-Liter Air sampling canister

Differences between Air Sampling Canisters and Tedlar® Bags

Air sampling canisters

- User-friendly in the field
- Saves time by virtually eliminating re-sampling
- Very cost effective
- Holding time for VOCs collected in a canister is 1 month
- Highly active components, at low ppbv concentrations, can be sampled and stored without loss
- Air sampling canisters are inert to active compounds

Figure 2: Flow controller with filter

Tedlar® Bags

- Lightweight, but vulnerable to puncture
- Cheap and easy to sample
- Holding time only 48-72 hours, making every project a rush
- Stability of certain compounds is compromised starting 24 hours after sampling
- Some VOCs are not compatible with Tedlar® Bags

Holding Times

There is a 15 day holding time from the date canisters have left the laboratory to date of sample collection. The holding time on a canister once it is returned to the laboratory is 30 days.

Flow Controllers

The flow controller or "regulator" is used to collect a time-integrated sample. Flow controllers are precisely calibrated by the laboratory for your project specific requirements. It is important that none of the settings are adjusted on the flow controller.

Flow Controller Settings
We can meet most sampling needs*. Table 3, Appendix 3 shows the sampling times flow controllers can set to depending on canister size.

*Though we are always happy to accommodate your sampling needs, please note that any deviation from the given flow controller times given in Table 3 may result in slight instability in sampling time. Deviating from the orifice's set flow rate is the cause of this deviation.

Figure 3: Flow controller with hose barb attachment

Filters
To prevent clogging of the flow controller with particulate matter, a 7µm filter is attached to the end of the "J hook" of the flow controller. The 7µm filter is necessary for ambient and indoor sampling as well as the 24-hour sub-slab (Figure 2). A 2µm is included inside the flow controller to further prevent clogging.

Hose Barb
A hose barb is added on the end of flow controllers intended for use in soil gas, sub-slab, or near-slab sampling. This allows the sampler to easily attach flexible ¼" Teflon® tubing to the end of the flow controller with a secure seal and obtain samples at different depths and/or hard to reach places (Figure 3).

Dust Cap
The brass dust cap prevents particulate matter from entering the canister when the canister is not in use. The brass dust cap should only be finger tightened when being placed on the canister (Figure 4).

Figure 4: Brass dust cap

Canister Identification
Every canister is given an identification number from the manufacturer. This is a 4 digit number. Sometimes the laboratory will add the letters "A" or "B" to the end of this number to aide in identification, which are to be included in the canister identification (Figure 5).

Figure 5: Canister identification number (serial #)

Tagging
IAL provides each canister and each flow controller with a white hang-tag. On the canister's hang-tag is the canister identification number and it also specifies the information pertinent to the canister cleaning process. When you receive a canister for sampling, ideally you should write the sample identification number from the field on the canister hang-tag to aide in the identification process in the field and the laboratory. Tags will also be on the canisters to indicate "expiration dates," or the date which the canister has reached holding time in the field.

How to Sample

Considerations

Fittings do not need to be over tightened. All fittings on the sampling hardware are Swagelok®, which ensures an air-tight seal if installed correctly. Adequate tightening should be finger tight plus ¼ turn with a $^{9}/_{16}$" wrench. When assembled, none of the hardware should be able to be rotated by hand.

For the field…

What will you need to bring in the field with you?

- Canisters and flow controllers (no flow controllers are required if taking grab samples)
- Chain of custody (COC) and a pen
- $^{9}/_{16}$" wrench
- A thermometer – EPA Method TO-15 recommends a Maximum-Minimum thermometer so that the high temperature and the low temperature during sampling duration are recorded.
- A barometer so that you may record barometric pressure at start and stop times
- Tubing
  - ¼" flexible Teflon® tubing (recommended). This will fit over our filters/hose barbs. The laboratory does not provide tubing.
  - If ¼" rigid tubing is being used, the laboratory can supply fittings to the flow controller. The hose barb cannot be used with rigid tubing.
  - Please let the laboratory know what type of tubing will be used for sampling so that we can best accommodate your needs!

Grab Sampling

- Remove the brass cap from the canister.
- Turn canister valve to the open position. The canister will hiss as air enters the canister.
- When hissing is barely audible, close the canister valve fully by turning clockwise until hand tight.
- Replace brass dust cap.

Time Integrated Sampling

- Remove brass dust cap from the canister.
- Attach flow controller. The flow controller should be tightened with a $^{9}/_{16}$" wrench with the flow controller at eye level and the canister on a flat surface. Tighten snugly but do not over tighten.
- If rough edges in threads are encountered, gently use the $^{9}/_{16}$" wrench for one-quarter turn to get over the rough patch. Applying too much pressure will strip the threads and compromise sample integrity.
- Place canister in desired location and open canister valve fully.
  - The flow controller should read approximately -30" Hg.
  - Record the initial pressure and start time on the COC.
- The pressure should be monitored near the end of the sampling period to ensure that the sampling is ended before the canisters reach ambient pressure (0"Hg).
- At the end of sampling period, record canister pressure and stop time on the COC.
- Close valve fully, remove flow controller, and replace brass dust cap.

After Sampling

- Always replace the brass dust cap to the air sampling canister
- Complete the COC in its entirety. Do not cross out fields on the COC that may not apply to your sampling or job.

CANISTER ANALYSIS

Canisters are analyzed on a GC/MS according EPA Method TO-15 specifications. Before samples can be run, an instrument performance check must be passed:

- Bromofluorobenzene (BFB)
- Multi-point calibration or daily calibration checks
- Laboratory control samples (2)
- Laboratory method blank*
  *A Method Blank is run everyday and will not run any samples unless the blank passes which demonstrates the instrument is free of contamination.
- Analysis of ≤20 field samples

How it works

Sample canisters are placed on an autosampler, which automatically takes a set aliquot of sample that the analyst enters into a sequence. The aliquot is taken from the canister through the use of a vacuum pump and is carried to the GC/MS. Each sample is reviewed by a highly trained analyst.

TROUBLESHOOTING

In this section, we hope to answer the questions we receive most often from our clients. Please use this as only a guide for your general knowledge; if you have a concern with your sampling, please call the Air Department at (973) 361-4252 x273.

Why did my canister fill before the allotted amount of time?

Fluctuations in flow rate may occur due to changes in ambient temperature and pressure, which could lead to a canister filling before the allotted amount of time. However, this should only provide a variation of approximately 5"Hg. If a canister were to fill extremely fast (e.g. 4 hours for a 24 hour sample), a number of problems could exist and you should contact the laboratory immediately.

Why didn't my canister fill during the allotted amount of time?

A few issues may cause this:

1. Water could be clogging the flow controller, which may have stopped sampling all together. If sampling in a moist area or in wet conditions, please indicate that when contacting the laboratory.
2. Debris, though uncommon due to use of filtration devices, could have clogged the flow controller as well.
3. The flow controller may be providing an incorrect read out or the flow rate may be slightly too slow.

If you suspect a problem, contact the laboratory immediately.

What happens if I get water in my canister and/or flow controller?

See above.

What if the pressure when starting is not at -30"Hg?
We evacuate all canisters to -29"Hg to -30"Hg (this number varies according to barometric pressure) before leaving the laboratory. Minor differences in flow controllers may show readings as high as -25"Hg. This should be regarded as an uncompromised canister. If you feel that the flow controller or air sampling canister may be compromised, please contact the laboratory and we can exchange your canister, if necessary.

What happens if I return my canister to the laboratory under vacuum?
If a canister is returned to the laboratory under vacuum, < -10"Hg, pulling the adequate sample volume from the canister may be difficult. When this occurs, the laboratory must fill the canister to ~0"Hg with clean "zero" air, resulting in a dilution (Table 2, Appendix A:Equation 1, 2).

How far should I fill the canister before I stop sampling?
Generally, you should run the canister until about -5"Hg. This ensures the sample has not been compromised and gives the laboratory an indicator to detect if leaking occurred during transport back to the lab (Table 1, Appendix A:Equation 2).

Table 1: Sample volume based on final vacuum in a 6-liter canister

Final Vacuum ("Hg)	29"	25"	20"	15"	10"	5"	0"
Sample Volume (L)	0L	0.83L	1.86L	2.90L	3.93L	5.0L	6L

What if my final sample pressure is less than 5"Hg?
If the final pressure is less than 5"Hg, your sample should still be valid. Likely, the flow rate was slightly too high leading to your sample being skewed in favor of the beginning portion of the sampling period. These samples should still be considered valid because the sample was taken over the entire sampling interval.

FREQUENTLY ASKED QUESTIONS

How much lead time should I give the laboratory when ordering air sampling canisters?
Since a certain level of preparation goes into the organization of canister order, we have established the following recommendations for ordering canisters:

1-5 canisters………………………..2-3 days
6-10 canisters………………………1 week
10+ canisters……………………….2 weeks

Of course we understand that some projects may change at the last minute or sampling may need to occur immediately. Never hesitate to call the laboratory to check if we can fulfil your sampling needs. We strive to take all the steps we can to ensure that you can complete your sampling in a timely manner.

How much lead time should I give the laboratory when requesting a pickup of air sampling canisters?
At least one day. If you have more than 10 canisters, please call 3 or more days in advance. However, please remember the holding time for cans is 2 weeks and therefore they must return to the lab within 2 weeks of the drop off date!

Why do my reporting limits vary from sample to sample?
Dilutions change reporting limits depending on dilution factor. For example, in an ambient air sample, if a canister necessitates a (20x) dilution due to high target compounds, the reporting limits rise from 0.2ppbv to 4ppbv.

Should the canister hiss when I start to sample?
No. If the canister hisses this means there is a leak in the connection of the flow controller to the canister. Please contact the laboratory if this occurs.

Do I have to refrigerate my samples after I take them?
No, you may leave them at room temperature.

What if I don't have access to a barometer or thermometer in the field?
The temperature and barometric pressure reading may be obtained from a nearby National Weather Service station. In this case, the station value for barometric pressure (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be made at a rate of minus 2.5 mm Hg (0.1 in.) per 30 m (100 ft) elevation increase or plus 2.5 mm Hg (0.1 in) per 30 m (100 ft) elevation decrease.

What if areas of the chain of custody do not apply to my sampling?
(e.g. – Flow Regulator ID when grab samples are taken)
Please leave these areas blank. Do not cross them out or mark them in any way; doing so may lead to rejection of your data by a regulatory agency.

Does the laboratory run a Method Blank everyday?
Yes, we do.

What is standard turn-around-time (TAT)?
2 weeks or 10 business days. Expedited TAT is available upon request and will incur a surcharge.

When will I receive my data package?
3 weeks or 15 business days after receipt of samples to the laboratory. Expedited TAT is available upon request and will incur a surcharge.

Can I modify the compound list?
Yes. You may shorten the compound list to meet your sampling needs (e.g. BTEX + MTBE) or you may add compounds which are run by Method TO-15, but not typically reported (e.g. isopropyl alcohol). Please check with the laboratory before adding compounds to your list to

ensure your compounds of choice can be reported on the standard list. If they cannot, they may still be able to be detected using a library search for tentatively identified compound (TICs).

What is ppbv?
The unit of measurement, **ppbv**, means parts per billion by volume.

How does ppbv differ from ppb?
The unit of measurement, **ppb**, means parts per billion. For example, **ppb** can mean either µg/kg or µg/L. These are considered weight-to-weight or weight-to-volume ratios. The unit **ppbv** is a volume-to-volume ratio, where 1ppbv = 1 µL/m^3 or 1 µL/1000L.

Table 2 shows the differences between reporting units in different matrices.

Table 2: ppb and relationships according to matrix

Matrix	*Soil*	*Water*	*Air*
Relationship (ppb)	µg/kg = ppb	µg/L ≈ ppb	µL/m^3 ≠ ppb
Ratio Types	Weight-to-weight = Weight-to-weight	Weight-to-volume ≈ Weight-to-volume	Volume-to-volume ≠ Weight-to-volume

How does ppbv relate to ug/m^3?
These 2 units are <u>not equal</u>. Calculations must be used to convert from one unit to another (Appendix A:Equations 3 & 4).

I see the equation, but what is 24.45?
This number is derived from the ideal gas law (Appendix A:Equation 5). Using the ideal gas law, an equation can be derived which is usable in air analyses (Appendix A:Equation 6)

REFERENCES

Levine, I. Physical Chemistry, 5th edition, Peterson, K.A., ed., New York, NY: McGraw-Hill Companies, Inc. p10-11

Martinez, S. 2008. Early detection of structural mold with SilcoCan™ air sampling canisters. Restek, Bellefonte, PA

New Jersey Department of Environmental Protection (NJDEP). 2005. NJDEP vapor intrusion guidance. NJDEP, Site Remediation and Waste Management Program and the Division of Science, Research and Technology, Trenton, NJ.

New Jersey Department of Environmental Protection (NJDEP). 2005. USEPA Method TO-15 for ambient air: NJDEP regulatory reporting format. NJDEP, Site Remediation and Waste Management Program, Trenton, NJ.

Restek Corporation. 2007. Passive air sampling kits. Bellefonte, PA.

Tillman, F. 2005. Indoor Air Unit Conversion. National Research Council, U.S. Environmental Protection Agency, Athens, Georgia.

U.S. Environmental Protection Agency (USEPA). 1999. Compendium of methods for toxic air pollutants, Second Edition, Method TO-15. Center for Environmental Research Information, Office of Research and Development. Cincinnati, OH.

Winegar, E. & Pleil, J. 2002. A guide to passive air sampling using canisters. Restek, Bellefonte, PA.

Appendix A: Equations for Air Analysis

Equation 1: Dilution Factor Calculation

$$\text{Dilution Factor} = \frac{P_{\text{after diltuion}} + P_{\text{lab atomosphere}}}{P_{\text{lab atomosphere}} - P_{\text{before diltuion}}}$$

Conversions:

"Hg to psi:
$\text{psi} = \text{"Hg} \times 0.491$

psi to atm
$14.7\text{psi} = 1\text{atm}$

*Lab atmosphere = 14.7psi or 1 atm

$$\text{Dilution Factor} = \frac{((\text{"Hg} \times 0.491) + P_{\text{lab atmosphere}})}{(P_{\text{lab atmosphere}} - (\text{"Hg} \times 0.491))}$$

Example:
Sample canister diluted from 7" Hg (3.437psi) to 14.7psi (29.9"Hg).

$$\text{Dilution Factor} = \frac{(14.7 + 14.7)}{(14.7 - (7 \times 0.491))} = 2.61\,\text{dilution}$$

Explanation:
The pressure of the canister before dilution ($P_{\text{before dilution}}$) is brought from 7"Hg to 29.9"Hg after dilution ($P_{\text{after dilution}}$) with clean humidified air. This is equivalent to 14.7psi or room pressure ($P_{\text{lab atmosphere}}$) for this particular example.

Equation 2: Sample Collection Volume

$$\text{Sample Volume} = \frac{\text{initial pressure - final pressure}}{\text{atmospheric reference pressure}} \times \text{canister volume}$$

Example: A sample is collected in a 6L canister. Initial pressure gauge reading was 29"Hg and final pressure gauge reading was 5"Hg

$$\left[\left(\frac{29\text{"}Hg - 5\text{"}Hg}{29\text{"}Hg}\right)\right] \times 6L = 4.97L\ \text{collected}$$

Appendix A: Equations for Air Analysis

Equation 3: Conversion from ppbv to µg /m3

$$\frac{ppbv \times \text{molecular weight of compound}}{24.45} = {}^{\mu g}\!/\!_{m^3}$$

Example:
Toluene Molecular Weight = 92

$$\frac{0.85\,ppbv \times 92}{24.45} = 3.2\,{}^{\mu g}\!/\!_{m^3}$$

$$\frac{7.0\,ppbv \times 92}{24.45} = 26.4\,{}^{\mu g}\!/\!_{m^3}$$

Equation 4: Conversion from µg /m3 to ppbv

$$\frac{{}^{\mu g}\!/\!_{m^3} \times 24.45}{\text{molecular weight of compound}} = ppbv$$

Example:
Heptane Molecular Weight = 100

$$1.0\,\mu\text{g/m}^3 \times \frac{24.45}{100} = 0.24\,ppbv$$

$$5.0\,\mu\text{g/m}^3 \times \frac{24.45}{100} = 1.22\,ppbv$$

Equation 5: Ideal Gas Law

PV=nRT
P is the air pressure in kPa*
V is the volume the gas/contaminant occupies in L
n is the amount of gas (# of gas molecules, in moles)
T is absolute temperature in Kelvin (^{o}C + 273)**
R is the universal gas constant is:

$$8.3144\,\frac{L \cdot kPa}{mol \cdot K}$$

*Air pressure = 101.325 kPa
**Room temperature = 25^{o}C or 298K

APPENDIX A: EQUATIONS FOR AIR ANALYSIS

Equation 6: Derivation of the Ideal Gas Law

Use assumed air pressure and room temperature given in equation 5.

$$V_{contaminant}[L] = \frac{Mass_{contaminant}[g]}{MolecularWeight_{contaminant}[g/mole]} \times 8.3144\left[\frac{L \cdot kPa}{mol \cdot K}\right] \times T_{air}[K] \times \frac{1}{P_{air}[kPa]}$$

$$V_{contaminant}[L] = \frac{Mass_{contaminant}[g]}{MolecularWeight_{contaminant}[g/mole]} \times 8.3144\left[\frac{L \cdot kPa}{mol \cdot K}\right] \times 298K \times \frac{1}{101.325kPa}$$

Equation 6.1:

$$V_{contaminant}[L] = \frac{Mass_{contaminant}[g]}{MolecularWeight_{contaminant}[g/mole]} \times 24.45\frac{L}{mol}$$

Now, we have 24.45, which we can use for conversion.

Example: Convert 150 $\mu g / m^3$ ($150 \times 10^{-6}\, g$) of ethylbenzene (MW=106.2) to <u>ppmV</u> using equation 6.1.

$$V_{contaminant}[L] = \frac{150 \times 10^{-6}[g]}{106.2[g/mole]} \times 24.45\frac{L}{mol} = 3.45 \times 10^{-5} L \text{ or } 0.0345 mL$$

Divide this by the sample volume in m^3 (=1m^3), which gives us our result in ppmV. To convert to ppbv, multiply by 1000.

$$150\ \mu g / m^3 \text{ ethyl benzene} = 0.0345\text{ppmV or } 34.5\text{ppbV}$$

APPENDIX B: METHOD TO-15 CONVERSION TABLE

Compound	CAS #	Formula Weight	ppbv	µg/m3
Acetone	67-64-1	58.08	0.20	0.48
Acrolein	107-02-8	56.06	0.20	0.46
Allyl Chloride	107-05-1	76.53	0.20	0.63
Benzene	71-43-2	78.11	0.20	0.64
Benzyl Chloride	100-44-7	126.6	0.20	1.0
Bromodichloromethane	75-27-4	163.8	0.20	1.3
Bromoform	75-25-2	252.8	0.20	2.1
Bromomethane	74-83-9	94.94	0.20	0.78
1,3-Butadiene	106-99-0	54.09	0.20	0.44
n-Butane	106-97-8	74.12	0.20	0.61
Carbon disulfide	75-15-0	76.14	0.20	0.62
Carbon tetrachloride	56-23-5	153.8	0.20	1.3
Chlorobenzene	108-90-7	112.6	0.20	0.92
Chloroethane	75-00-3	64.52	0.20	0.53
Chloroform	67-66-3	119.4	0.20	0.98
Chloromethane	74-87-3	50.49	0.20	0.41
2-Chlorotoluene	95-49-8	126.6	0.20	1.0
Cumene	98-82-8	120.2	0.20	0.98
Cyclohexane	110-82-7	84.16	0.20	0.69
Dibromochloromethane	124-48-1	208.3	0.20	1.7
1,2-Dibromoethane	106-93-4	187.9	0.20	1.5
1,2-Dichlorobenzene	95-50-1	147.0	0.20	1.2
1,3-Dichlorobenzene	541-73-1	147.0	0.20	1.2
1,4-Dichlorobenzene	106-46-7	147.0	0.20	1.2
Dichlorodifluoromethane	75-71-8	120.9	0.20	0.99
1,1-Dichloroethane	75-34-3	98.96	0.20	0.81
1,2-Dichloroethane	107-06-2	98.96	0.20	0.81
1,1-Dichloroethene	75-35-4	96.94	0.20	0.79
1,2-Dichloroethene (cis)	156-59-2	96.94	0.20	0.79
1,2-Dichloroethene (trans)	156-60-5	96.94	0.20	0.79
1,2-Dichloropropane	78-87-5	113.0	0.20	0.92
1,3-Dichloropropene (cis)	10061-01-5	111.0	0.20	0.91
1,3-Dichloropropene (trans)	10061-02-6	111.0	0.20	0.91
1,2-Dichlorotetrafluoroethane	76-14-2	170.9	0.20	1.4
1,4-Dioxane	123-91-1	88.10	0.20	0.72

APPENDIX B: METHOD TO-15 CONVERSION TABLE

Compound	CAS #	Formula Weight	ppbv	µg/m3
Ethanol	64-17-5	46.07	0.20	0.38
Ethyl Acetate	141-78-6	88.10	0.20	0.72
Ethylbenzene	100-41-4	106.2	0.20	0.87
4-Ethyltoluene	622-96-8	120.2	0.20	0.98
n-Heptane	142-82-5	100.2	0.20	0.82
1,3-Hexachlorobutadiene	87-68-3	260.8	0.20	2.1
n-Hexane	110-54-3	86.17	0.20	0.70
Isopropyl alcohol	67-63-0	60.10	0.20	0.49
Methyl n-butyl ketone	591-78-6	100.2	0.20	0.82
Methyl ethyl ketone	78-93-3	72.11	0.20	0.59
Methyl isobutyl ketone	108-10-1	100.2	0.20	0.82
Methyl methacrylate	80-62-6	100.1	0.20	0.82
Methyl tert-butyl ether	1634-04-4	88.15	0.20	0.72
Methylene chloride	75-09-2	84.94	0.20	0.69
n-Nonane	111-84-2	128.6	0.20	1.1
n-Pentane	109-66-0	72.15	0.20	0.59
n-Propyl benzene	103-65-1	120.0	0.20	0.98
Propene	115-07-1	42.08	0.20	0.34
Styrene	100-42-5	104.1	0.20	0.85
tert-Butyl alcohol	75-65-0	74.12	0.20	0.61
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.20	1.4
Tetrachloroethene	127-18-4	165.8	0.20	1.4
Tetrahydrofuran	100-99-9	72.11	0.20	0.59
Toluene	108-88-3	92.14	0.20	0.75
1,2,4-Trichlorobenzene	120-82-1	181.5	0.20	1.5
1,1,1-Trichloroethane	71-55-6	133.4	0.20	1.1
1,1,2-Trichloroethane	79-00-5	133.4	0.20	1.1
Trichloroethene	79-01-6	131.4	0.20	1.1
Trichlorofluoromethane	75-69-4	137.4	0.20	1.1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	187.4	0.20	1.5
1,2,4-Trimethylbenzene	95-63-6	120.2	0.20	0.98
1,3,5-Trimethylbenzene	108-67-8	120.2	0.20	0.98
2,2,4-Trimethylpentane	540-84-1	114.2	0.20	0.93
Vinyl acetate	108-05-4	86.09	0.20	0.70
Vinyl bromide	593-60-2	106.9	0.20	0.87
Vinyl chloride	75-01-4	62.50	0.20	0.51
Xylenes (m&p)	179601-23-1	106.2	0.20	0.87
Xylene (o)	95-47-6	106.2	0.20	0.87

APPENDIX C: FLOW CONTROLLERS AND CANISTERS

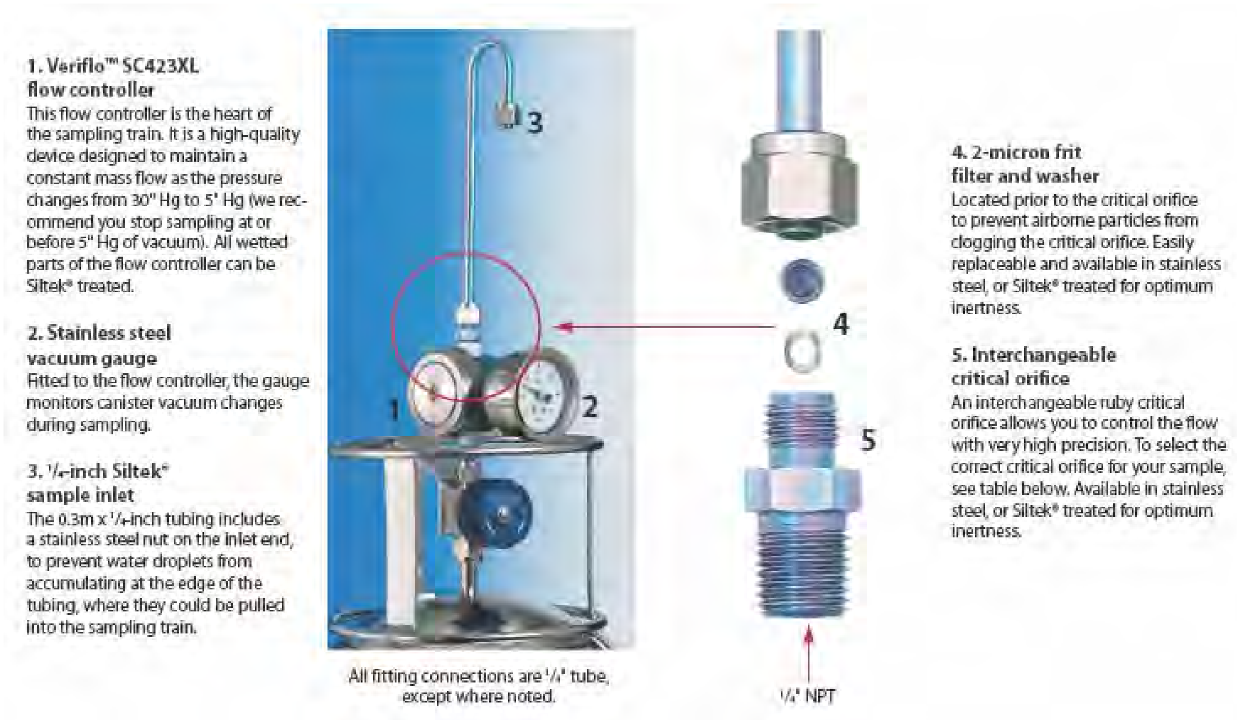


Figure 6: Flow controller system
Source: Restek® Passive Air Sampling Kits Pamphlet

Table 3: Flow controller settings and orifice sizes

	Canister Size			
Sampling Time	**1 Liter**	**6 Liter**	**Orifice Number**	**Flow Rate (cc/per minute)**
	4 hours	24 hours	12	4.17
	1 hour	8 hours	20	16.7
	30 min	3 hours	30	33.3
	10 min	1 hour	60	100
	5 min	30 min	90	200