Data Dictionary & Variable Construction Reference

Repo A: PA UST Combined Datasets

Analytical Engine

January 13, 2026

This document serves as the definitive technical reference for the raw datasets in Repo A (Facility/Tank Master Database). It characterizes the distributions of key variables—including tank status, substance types, and component attributes—and identifies specific data quality issues such as default installation dates. The frequency tables presented herein are intended to guide the "hotcoding" of binary variables and the treatment of missing data for downstream econometric analysis.

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1 Facility & Tank Characteristics

This section details the primary grouping variables derived from the harmonized Active (PADEP) and Inactive (SSRS) datasets.

1.1 Tank Status

[Description: Explanation of how Active vs. Inactive status is defined.]

Table 1

Table 2Tank Status Distribution

STATUS_CODE	Tank_Status_Meaning	N	Pct
W	Closed	45557	44.8%
R	Removed	24173	23.8%
C	Currently In Use	20579	20.2%
E	Exempt From State Law	7339	7.2%
UR	Unregulated Removed	1641	1.6%
T	Temporarily Out of Use	1269	1.2%
P	Permanently Closed in Place	899	0.9%
TRANS	Transferred	142	0.1%
DC	2004 Data/Fee Cleanup	80	0.1%
UC	Unsubstantiated Claim	22	0.0%

[Table Note: Verify if 'Temporarily Out of Use' tanks should be treated as active for auction eligibility.]

1.2 Substance Profile

[Description: Breakdown of fuel types stored in the tanks, mapped from raw substance codes to boolean flags.]

Table 3

Table 4Fuel Types

Fuel	N
Gasoline	51104
Diesel	20170
Other_Substance	30427

[Table Note: These counts are based on the mapping of raw substance codes (e.g., “GAS”, “DIESL”) to consolidated categories.]

1.3 Installation Date Diagnostics

[Description: Assessment of data quality for DATE_INSTALLED.]

Table 5

Table 6Top 10 Most Frequent Installation Dates

DATE_INSTALLED	N
1974-01-01	587
1981-12-01	580
1985-12-01	572
1979-12-01	565
1980-01-01	564
1980-12-01	541
1970-01-01	531
1987-12-01	529
1983-12-01	526
1978-12-01	515

[Table Note: The dates listed above are likely system defaults (e.g., 01/01/1900) and should be treated as missing values.]

1.3.1 KNN Date Imputation Diagnostics

[Description: Comparison of reported installation dates vs. KNN-imputed dates for records with suspect default values. KNN regression (k=5) uses capacity, substance type, and region as features.]

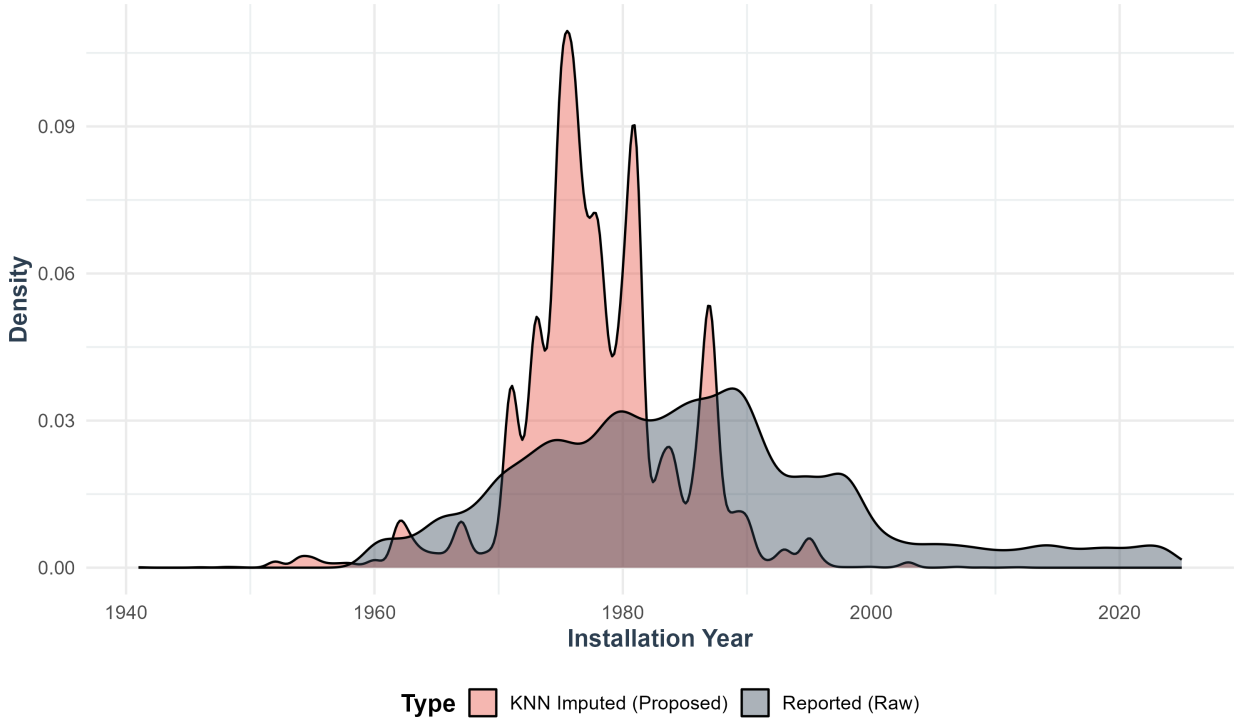

Figure 1: KNN Date Imputation Diagnostics: Reported vs. Imputed Installation Years

[Figure Note: Density comparison showing distributional plausibility of KNN-imputed dates relative to observed installation years. Imputed values should align with historical installation patterns.]

Here is the completely refactored code.

I have updated every call to `render_compliance_table()` to include an `export_path` argument. This will automatically save a clean CSV of each mapping table to an `output/mappings/` folder every time you render the document, making them immediately available for your ETL pipeline.

“‘r # Component Universe

This section details the raw attributes available in the ‘Compounds’ table. These tables help map specific attributes to what the ‘hotcoded’ variables mean. We will also use these tables to determine and build the corseined human-derired characteristics variables.

2 Tank Infrastructure

2.1 Tank Construction

2.1.1 Raw Frequency Table

Table 7

Table 8Component Universe: TANK CONSTRUCTION

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
188	OTHER (COMPLIANT)	15
199	OTHER	69
1A	UNPROTECTED STEEL (SINGLE WALL)	5368
1B	CATHODICALLY PROTECTED STEEL (GALVANIC)	7094
1C	CATHODICALLY PROTECTED STEEL (IMPRESSED CURRENT)	2284
1D	UNPROTECTED STEEL (DOUBLE WALL)	75
1E	FIBERGLASS (SINGLE WALL)	8647
1F	FIBERGLASS (DOUBLE WALL)	8272
1G	STEEL W/PLASTIC OR FIBERGLASS JACKET (DOUBLE WALL)	5378
1H	STEEL W/FRP COATING (ACT 100 OR EQUIVALENT) (SINGLE WALL)	961
1I	STEEL W/LINED INTERIOR	750
1J	CONCRETE	31
1K	BOTTOM MODIFICATION	1
1N	UNKNOWN	194
1O	CATHODICALLY PROTECTED DOUBLE WALL STEEL (GALVANIC)	3100
1P	CATHODICALLY PROTECTED STEEL WITH LINER	572
1V	STEEL W/PLASTIC OR FRP JACKET W/ ANODES (DOUBLE WALL)	445
1W	STEEL W/FRP COATING W/ ANODES (SINGLE WALL)	15

2.1.2 Coarsened Regulatory Mapping: Tank Construction

Table 9

Table 10Tank Construction: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
1D	UNPROTECTED STEEL (DOUBLE WALL)	75	Secondary Containment	Compliant (All Vintages)	§280.20(a); §280.43(g)	Compliant	§245.421
1F	FIBERGLASS (DOUBLE WALL)	8272	Secondary Containment	Compliant (All Vintages)	§280.20(a)(1); UL 1316	Compliant	§245.421
1G	STEEL W/PLASTIC OR FRP JACKET (DW)	5378	Secondary Containment	Compliant (All Vintages)	§280.20(a)(3); UL 1746	Compliant	§245.421
1O	CP DOUBLE WALL STEEL (GALVANIC)	3100	Secondary Containment	Compliant (All Vintages)	§280.20(a)(2); STI F841	Compliant	§245.421
1V	STEEL W/FRP JACKET W/ANODES (DW)	445	Secondary Containment	Compliant (All Vintages)	§280.20(a)(2)-(3)	Compliant	§245.421
1A	UNPROTECTED STEEL (SINGLE WALL)	5368	Single Wall (Legacy)	Legacy: Compliant	§280.21; §280.41(a)(1)	Legacy: Compliant	§245.421
1A	UNPROTECTED STEEL (SINGLE WALL)	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1B	CP STEEL (GALVANIC)	7094	Single Wall (Legacy)	Legacy: Compliant	§280.20(a)(2); §280.31	Legacy: Compliant	§245.421 §245.432
1B	CP STEEL (GALVANIC)	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1C	CP STEEL (IMPRESSED CURRENT)	2284	Single Wall (Legacy)	Legacy: Compliant	§280.20(a)(2); §280.31(c)	Legacy: Compliant	§245.421 §245.432
1C	CP STEEL (IMPRESSED CURRENT)	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1E	FIBERGLASS (SINGLE WALL)	8647	Single Wall (Legacy)	Legacy: Compliant	§280.20(a)(1); §280.41(a)(1)	Legacy: Compliant	§245.421
1E	FIBERGLASS (SINGLE WALL)	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1H	STEEL W/FRP COATING (ACT-100) (SW)	961	Single Wall (Legacy)	Legacy: Compliant	§280.20(a)(3); STI ACT-100®	Legacy: Compliant	§245.421
1H	STEEL W/FRP COATING (ACT-100) (SW)	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1I	STEEL W/LINED INTERIOR	750	Single Wall (Upgraded)	Legacy: Conditional	§280.21(b)(1); API 1631	Legacy: Conditional	§245.421
1I	STEEL W/LINED INTERIOR	NA	Single Wall (Upgraded)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1J	CONCRETE	31	Single Wall (Legacy)	Legacy: Conditional	§280.20(a)(5)	Legacy: Conditional	§245.421
1P	CP STEEL WITH LINER	572	Single Wall (Upgraded)	Legacy: Compliant	§280.21(b)(3)	Legacy: Compliant	§245.421
1P	CP STEEL WITH LINER	NA	Single Wall (Upgraded)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
1W	STEEL W/FRP COATING W/ANODES (SW)	15	Single Wall (Legacy)	Legacy: Compliant	§280.20(a)(2)-(3)	Legacy: Compliant	§245.421
1W	STEEL W/FRP COATING W/ANODES (SW)	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421
188	OTHER (COMPLIANT)	15	Other/Unknown	Case-by-Case	§280.20(a)(5)	Case-by-Case	§245.421
199	OTHER	69	Other/Unknown	Presumed Non-Compliant	§280.20(a)	Presumed Non-Compliant	§245.421
1K	BOTTOM MODIFICATION	1	Other/Unknown	Repair Record Only	§280.33	Repair Record Only	§245.433
1N	UNKNOWN	194	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A

2.2 Tank Release Detection Method

2.2.1 Raw Frequency Table

Table 11

Table 12Component Universe: TANK RELEASE DETECTION METHOD

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
1299	OTHER	8
12A	MONTHLY INVENTORY CONTROL	3611
12B	ANNUAL TANK TIGHTNESS TESTING	2985
12C	TANK TIGHTNESS TESTING (EVERY 5 YEARS)	535
12D	STATISTICAL INVENTORY RECONCILIATION	4683
12E	AUTOMATIC TANK GAUGING	17834
12F	MANUAL TANK GAUGING (36 HRS)	407
12G	MANUAL TANK GAUGING (44 OR 58 HRS)	383
12H	INTERSTITIAL MONITORING (2 WALLS)	13753
12I	INTERSTITIAL MONITORING (LINER)	9
12J	GROUNDWATER MONITORING	79
12K	VAPOR MONITORING	58
12L	GROOVES MADE IN THE IMPERMEABLE PAD	2
12M	SLOTTED PIPE ABOVE THE IMPERMEABLE PAD	4
12N	NONE	2833
12O	EXEMPT	953

2.2.2 Coarsened Regulatory Mapping: Tank Release Detection

Table 13

Table 14Tank Release Detection Method: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
12H	INTERSTITIAL MONITORING (2 WALLS)	13753	Secondary Containment (IM)	Compliant (All Vintages)	§280.43(g)	Compliant	§245.444
12H	INTERSTITIAL MONITORING (2 WALLS)	NA	Secondary Containment (IM)	REQUIRED: Post-4/11/16 Tanks	§280.41(a)(2)	REQUIRED: Post-12/22/18	§245.444
12I	INTERSTITIAL MONITORING (LINER)	9	Secondary Containment (IM)	Compliant (All Vintages)	§280.43(g)	Compliant	§245.444
12L	GROOVES IN IMPERMEABLE PAD	2	Secondary Containment (IM)	Compliant (All Vintages)	§280.43(g)	Compliant	§245.444
12M	SLOTTED PIPE ABOVE PAD	4	Secondary Containment (IM)	Compliant (All Vintages)	§280.43(g)	Compliant	§245.444
12E	AUTOMATIC TANK GAUGING	17834	Internal Monitoring (ATG)	Legacy: Compliant	§280.43(d); 0.2 gph	Legacy: Compliant	§245.444
12E	AUTOMATIC TANK GAUGING	NA	Internal Monitoring (ATG)	Post-4/11/16: NON-COMPLIANT	§280.41(a)(2) req IM	Post-12/22/18: NON-COMPLIANT	§245.444 IM
12D	STATISTICAL INVENTORY RECONCILIATION	4683	Internal Monitoring (SIR)	Legacy: Compliant	§280.43(h); 0.2 gph	Legacy: Compliant	§245.444
12D	STATISTICAL INVENTORY RECONCILIATION	NA	Internal Monitoring (SIR)	Post-4/11/16: NON-COMPLIANT	§280.41(a)(2) req IM	Post-12/22/18: NON-COMPLIANT	§245.444 IM
12F	MANUAL TANK GAUGING (36 HRS)	407	Internal Monitoring (MTG)	Conditional: 550 gal only	§280.43(b) Table	Conditional: 550 gal	§245.444
12F	MANUAL TANK GAUGING (36 HRS)	NA	Internal Monitoring (MTG)	Post-4/11/16: NON-COMPLIANT	§280.41(a)(2) req IM	Post-12/22/18: NON-COMPLIANT	§245.444 IM
12G	MANUAL TANK GAUGING (44/58 HRS)	383	Internal Monitoring (MTG)	Conditional: 551-1000 gal	§280.43(b) Table	Conditional: 551-1000 gal	§245.444
12G	MANUAL TANK GAUGING (44/58 HRS)	NA	Internal Monitoring (MTG)	Post-4/11/16: NON-COMPLIANT	§280.41(a)(2) req IM	Post-12/22/18: NON-COMPLIANT	§245.444 IM
12A	MONTHLY INVENTORY CONTROL	3611	Inventory Control	SUNSET: Must pair w/ TTT	§280.43(a); §280.41(a)(1)(i)	SUNSET	§245.444
12A	MONTHLY INVENTORY CONTROL	NA	Inventory Control	10-yr window expired (all)	§280.41(a)(1)(i)	10-yr window expired	§245.444
12B	ANNUAL TANK TIGHTNESS TEST	2985	Tightness Testing	SUNSET: Supplemental only	§280.43(c); 0.1 gph	SUNSET: Supplemental	§245.444
12B	ANNUAL TANK TIGHTNESS TEST	NA	Tightness Testing	10-yr window expired (all)	§280.41(a)(1)(i)	10-yr window expired	§245.444
12C	TANK TIGHTNESS TEST (5 YRS)	535	Tightness Testing	SUNSET: Supplemental only	§280.43(c)	SUNSET: Supplemental	§245.444
12J	GROUNDWATER MONITORING	79	External Monitoring	Conditional: Site Assessment	§280.43(f); GW 20 ft	Conditional: Site Assessment	§245.444
12K	VAPOR MONITORING	58	External Monitoring	Conditional: Site Assessment	§280.43(e); Porous backfill	Conditional: Site Assessment	§245.444
1299	OTHER	8	Other/Unclassified	Case-by-Case	§280.40(a)	Case-by-Case	§245.444
12N	NONE	2833	NON-COMPLIANT	VIOLATION	§280.40(a) requires RD	VIOLATION	§245.441 requires
12O	EXEMPT	953	Exempt/Deferred	Verify Exemption Basis	§280.10(b)-(c)	Verify Exemption Basis	§245.1(b

3 Piping Infrastructure

3.1 Underground Piping Construction

3.1.1 Raw Frequency Table

Table 15

Table 16Component Universe: UG PIPING CONSTRUCTION

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
288	OTHER (COMPLIANT)	31
299	OTHER	39
2A	BARE STEEL	5870
2B	CATHODICALLY PROTECTED, METALLIC	2137
2C	COPPER	213
2D	FIBERGLASS	6331
2E	FLEXIBLE NON-METALLIC	488
2F	UNKNOWN	218
2G	NONE	793
2H	MODIFICATION OF PIPING	15
2I	Double wall, metallic primary	490
2J	Double wall, rigid (FRP) primary	1623
2K	Double wall, flexible primary	2756
2L	TRENCH LINER	16
2M	JACKETED	15

3.1.2 Coarsened Regulatory Mapping: UG Piping Construction

Table 17

Table 18UG Piping Construction: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
2I	Double wall, metallic primary	490	Secondary Containment	Compliant (All Vintages)	§280.20(b); §280.43(g)	Compliant	§245.422
2J	Double wall, rigid (FRP) primary	1623	Secondary Containment	Compliant (All Vintages)	§280.20(b)(1); UL 971	Compliant	§245.422
2K	Double wall, flexible primary	2756	Secondary Containment	Compliant (All Vintages)	§280.20(b)(1)	Compliant	§245.422
2L	TRENCH LINER	16	Secondary Containment	Compliant (All Vintages)	§280.43(g)	Compliant	§245.422
2M	JACKETED	15	Secondary Containment	Compliant (All Vintages)	§280.20(b)	Compliant	§245.422
2A	BARE STEEL	5870	Single Wall (Legacy)	Legacy: HIGH RISK	§280.21(c) req CP upgrade	Legacy: HIGH RISK	§245.422
2A	BARE STEEL	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.422
2B	CATHODICALLY PROTECTED, METALLIC	2137	Single Wall (Legacy)	Legacy: Compliant	§280.20(b)(2); 3-yr CP test	Legacy: Compliant	§245.422 §245.432
2B	CATHODICALLY PROTECTED, METALLIC	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.422
2C	COPPER	213	Single Wall (Legacy)	Legacy: Conditional	§280.20(b)(3) site assess	Legacy: Conditional	§245.422
2D	FIBERGLASS	6331	Single Wall (Legacy)	Legacy: Compliant	§280.20(b)(1); UL 971	Legacy: Compliant	§245.422
2D	FIBERGLASS	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.422
2E	FLEXIBLE NON-METALLIC	488	Single Wall (Legacy)	Legacy: Compliant	§280.20(b)(1)	Legacy: Compliant	§245.422
2E	FLEXIBLE NON-METALLIC	NA	Single Wall (Legacy)	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.422
288	OTHER (COMPLIANT)	31	Other/Unknown	Case-by-Case	§280.20(b)(4)	Case-by-Case	§245.422
299	OTHER	39	Other/Unknown	Presumed Non-Compliant	§280.20(b)	Presumed Non-Compliant	§245.422
2F	UNKNOWN	218	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A
2G	NONE	793	No Piping	N/A - Direct Fill/Gravity	§280.41(b) exemption	N/A	§245.445 exemptio
2H	MODIFICATION OF PIPING	15	Maintenance Record	Repair Record Only	§280.33(d)	Repair Record Only	§245.433

3.2 UG Single / Inner Wall Piping

3.2.1 Raw Frequency Table

Table 19

Table 20Component Universe: UG SINGLE / INNER WALL PIPING

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
2899	OTHER	34
28A	BARE STEEL	465
28B	CP PROTECTED	712
28C	COPPER	167
28D	FRP	8859
28E	FLEX	12507
28F	UNKNOWN	10
28G	NO DISPENSING PIPING	373
28I	STAINLESS STEEL	47

Table 21

Table 22UG Single/Inner Wall Piping: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
28D	FRP	8859	Non-Corrodible	Compliant (Inner Wall)	§280.20(b)(1); UL 971	Compliant	§245.422
28E	FLEX	12507	Non-Corrodible	Compliant (Inner Wall)	§280.20(b)(1)	Compliant	§245.422
28I	STAINLESS STEEL	47	Non-Corrodible	Compliant (Inner Wall)	§280.20(b)(1)	Compliant	§245.422
28A	BARE STEEL	465	Metallic (Requires CP)	Legacy: HIGH RISK	§280.21(c) req CP	Legacy: HIGH RISK	§245.422
28B	CP PROTECTED	712	Metallic (CP Protected)	Legacy: Compliant	§280.20(b)(2)	Legacy: Compliant	§245.422
28C	COPPER	167	Metallic (Site-Specific)	Legacy: Conditional	§280.20(b)(3)	Legacy: Conditional	§245.422
2899	OTHER	34	Other/Unknown	Case-by-Case	§280.20(b)(4)	Case-by-Case	§245.422
28F	UNKNOWN	10	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A
28G	NO DISPENSING PIPING	373	No Piping	N/A	N/A	N/A	N/A

3.2.2 Coarsened Regulatory Mapping: UG Single/Inner Wall Piping

3.3 UG Outer Wall Piping

3.3.1 Raw Frequency Table

Table 23

Table 24Component Universe: UG OUTER WALL PIPING

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
2999	OTHER, OUTER	263
29A	BARE STEEL, OUTER	204
29B	CP PROTECTED, OUTER	51
29D	FRP, OUTER	3985
29E	FLEX, OUTER	12227
29F	UNKNOWN, OUTER	14
29I	POLY-ENCASED STAINLESS STEEL, OUTER	19
29N	NONE	6295

Table 25

Table 26UG Outer Wall Piping: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
29D	FRP, OUTER	3985	Secondary Containment	Compliant Outer Wall	§280.20(b)(1); §280.43(g)	Compliant	§245.422
29E	FLEX, OUTER	12227	Secondary Containment	Compliant Outer Wall	§280.20(b)(1); §280.43(g)	Compliant	§245.422
29I	POLY-ENCASED SS, OUTER	19	Secondary Containment	Compliant Outer Wall	§280.20(b); §280.43(g)	Compliant	§245.422
29A	BARE STEEL, OUTER	204	Metallic Outer	Requires CP if ground contact	§280.20(b)(2)	Requires CP	§245.422
29B	CP PROTECTED, OUTER	51	Metallic Outer (CP)	Compliant Outer Wall	§280.20(b)(2)	Compliant	§245.422
29N	NONE	6295	Single Wall System	Legacy: Acceptable	§280.41(b)(1)	Legacy: Acceptable	§245.445
29N	NONE	NA	Single Wall System	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.422
2999	OTHER, OUTER	263	Other/Unknown	Case-by-Case	§280.20(b)(4)	Case-by-Case	§245.422
29F	UNKNOWN, OUTER	14	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A

3.3.2 Coarsened Regulatory Mapping: UG Outer Wall Piping

3.4 Piping Release Detection Method

3.4.1 Raw Frequency Table

Table 27

Table 28Component Universe: PIPE RELEASE DETECTION METHOD

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
5A	AUTOMATIC LINE LEAK DETECTOR	15109
5B	ANNUAL LINE TIGHTNESS TESTING (PRESSURE)	12413
5C	LINE TIGHTNESS TEST - 3 YEARS (SUCTION)	1646
5D	INTERSTITIAL MONITORING	10888
5E	GROUNDWATER MONITORING	63
5F	VAPOR MONITORING	33
5G	VISUAL INSPECTION	62
5H	NONE	2796
5I	EXEMPT	11903
5J	STATISTICAL INVENTORY RECONCILIATION	2558
5K	ELECTRONIC LINE LEAK DETECTOR	4762
5L	INTERSTITIAL MONITORING W/CONTINUOUS ALARM/SHUT OFF	7686

3.4.2 Coarsened Regulatory Mapping: Piping Release Detection

Table 29

Table 30Piping Release Detection Method: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
5D	INTERSTITIAL MONITORING	10888	Secondary Containment (IM)	Compliant (All Vintages)	§280.43(g); §280.44(c)	Compliant	§245.445
5D	INTERSTITIAL MONITORING	NA	Secondary Containment (IM)	REQUIRED: Post-4/11/16 Piping	§280.41(b)(2)	REQUIRED: Post-12/22/18	§245.445
5L	IM W/CONTINUOUS ALARM/SHUTOFF	7686	Secondary Containment (IM+)	Compliant (All Vintages)	§280.43(g); §280.44(a)	Compliant	§245.445
5A	AUTOMATIC LINE LEAK DETECTOR	15109	Line Leak Detection	Legacy Pressurized: Required	§280.44(a); 3 gph @ 10 psi	Required: Pressurized	§245.445
5A	AUTOMATIC LINE LEAK DETECTOR	NA	Line Leak Detection	Post-4/11/16: Required + IM	§280.41(b)(2)(i)	Post-12/22/18: + IM	§245.445
5K	ELECTRONIC LINE LEAK DETECTOR	4762	Line Leak Detection	Legacy Pressurized: Required	§280.44(a)	Required: Pressurized	§245.445
5K	ELECTRONIC LINE LEAK DETECTOR	NA	Line Leak Detection	Post-4/11/16: Required + IM	§280.41(b)(2)(i)	Post-12/22/18: + IM	§245.445
5B	ANNUAL LTT (PRESSURE)	12413	Tightness Testing	Legacy Pressurized: Annual	§280.44(b); 0.1 gph @ 1.5× OP	Annual	§245.445
5B	ANNUAL LTT (PRESSURE)	NA	Tightness Testing	Post-4/11/16: NON-COMPLIANT alone	§280.41(b)(2) req IM	Post-12/22/18: + IM	§245.445
5C	LTT - 3 YEARS (SUCTION)	1646	Tightness Testing	Legacy Suction: Every 3 yrs	§280.44(b); §280.41(b)(1)(ii)	Every 3 yrs	§245.445
5C	LTT - 3 YEARS (SUCTION)	NA	Tightness Testing	Safe Suction: No RD required	§280.41(b)(1)(ii)(A)-(E)	Safe Suction Exempt	§245.445
5J	STATISTICAL INVENTORY RECONCILIATION	2558	SIR	Legacy: Conditional	§280.44(c); §280.43(h)	Conditional	§245.445
5E	GROUNDWATER MONITORING	63	External Monitoring	Conditional: Site Assessment	§280.44(c); §280.43(f)	Conditional	§245.445
5F	VAPOR MONITORING	33	External Monitoring	Conditional: Site Assessment	§280.44(c); §280.43(e)	Conditional	§245.445
5G	VISUAL INSPECTION	62	Visual Only	Supplemental Only	Not standalone per §280.44	Supplemental Only	§245.445
5H	NONE	2796	NON-COMPLIANT	VIOLATION (Unless Safe Suction)	§280.41(b) requires RD	VIOLATION	§245.445 requires
5I	EXEMPT	11903	Exempt	Verify: Safe Suction or Exempt	§280.41(b)(1)(ii) or §280.10	Verify Basis	§245.1(b §245.445

3.5 Line Leak Detector Shuts Off Pump

3.5.1 Raw Frequency Table

Table 31

Table 32Component Universe: LINE LEAK DETECTOR SHUTS OFF PUMP

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
23N	NO	17043
23Y	YES	10425

Table 33

Table 34Line Leak Detector Pump Shutoff: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
23Y	YES	10425	Automatic Shutoff	Compliant: Best Practice	§280.44(a) shutoff OR alarm	Compliant	§245.445
23N	NO	17043	Alarm Only / Manual	Compliant: If alarm triggers	§280.44(a) shutoff OR alarm	Compliant if alarm	§245.445

3.5.2 Coarsened Regulatory Mapping: LLD Pump Shutoff

3.6 Pump/Delivery System

3.6.1 Raw Frequency Table

Table 35

Table 36Component Universe: PUMP/DELIVERY SYSTEM

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
4A	SUCTION: CHECK VALVE AT PUMP	11641
4B	SUCTION: CHECK VALVE AT TANK	3899
4C	PRESSURE	25845
4D	GRAVITY FED	201
4E	NONE	1110

Table 37

Table 38Pump/Delivery System: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
4C	PRESSURE	25845	Pressurized	Requires: ALLD + LTT or IM	§280.41(b)(1)(i); §280.44(a)	Requires ALLD	§245.445
4C	PRESSURE	NA	Pressurized	Post-4/11/16: ALLD + IM	§280.41(b)(2)(i)	Post-12/22/18: + IM	§245.445
4A	SUCTION: CHECK VALVE AT PUMP	11641	Suction (Safe Suction Eligible)	May qualify Safe Suction	§280.41(b)(1)(ii)(C)-(D)	May qualify	§245.445
4B	SUCTION: CHECK VALVE AT TANK	3899	Suction (NOT Safe Suction)	Does NOT meet Safe Suction	Fails §280.41(b)(1)(ii)(D)	Does NOT meet	§245.445
4B	SUCTION: CHECK VALVE AT TANK	NA	Suction (NOT Safe Suction)	Requires: LTT every 3 yrs OR monthly	§280.41(b)(1)(ii)	LTT or monthly	§245.445
4D	GRAVITY FED	201	Gravity	No pumping = Limited RD options	§280.41(b)	Limited RD options	§245.445
4E	NONE	1110	No Delivery System	N/A - Verify tank use	N/A	N/A	N/A

3.6.2 Coarsened Regulatory Mapping: Pump/Delivery System

3.7 Piping Flexible Connectors

3.7.1 Raw Frequency Table

Table 39

Table 40Component Universe: Piping Flexible Connectors

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
88	Other (Compliant)	225
99	Other (Noncompliant)	4
PFLXA	Unprotected Metallic Components (incl wrapped or coated)	478
PFLXB	Cathodically Protected, Metallic	2465
PFLXC	Flexible Coupling w/ Protected Metallic Ends	53
PFLXD	Completely Inside Containment Sump, Secondary Pipe or Liner	4816
PFLXE	Completely Jacketed w/ Sealed Boot	1596
PFLXF	Not in Contact w/ Ground	976
PFLXX	None	197
UNK	Unknown	336

Table 41

Table 42Piping Flexible Connectors: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
PFLXD	Completely Inside Containment Sump/Secondary	4816	Secondary Containment	Compliant (All Vintages)	§280.20; §280.43(g)	Compliant	§245.422
PFLXE	Completely Jacketed w/ Sealed Boot	1596	Secondary Containment	Compliant (All Vintages)	§280.20(b)	Compliant	§245.422
PFLXF	Not in Contact w/ Ground	976	Above Ground	N/A - Not UG piping	§280.20(b) applies to UG	N/A	§245.422
PFLXB	Cathodically Protected, Metallic	2465	Metallic (CP)	Legacy: Compliant	§280.20(b)(2)	Legacy: Compliant	§245.422
PFLXC	Flexible Coupling w/ Protected Metallic Ends	53	Metallic (CP)	Legacy: Compliant	§280.20(b)(2)	Legacy: Compliant	§245.422
PFLXA	Unprotected Metallic (incl wrapped/coated)	478	Metallic (Unprotected)	Legacy: HIGH RISK	§280.21(c) req CP	Legacy: HIGH RISK	§245.422
PFLXA	Unprotected Metallic (incl wrapped/coated)	NA	Metallic (Unprotected)	Post-4/11/16: NON-COMPLIANT	§280.20(b)(2) req CP	Post-12/22/18: NON-COMPLIANT	§245.422
88	Other (Compliant)	225	Other/Unknown	Case-by-Case	§280.20(b)(4)	Case-by-Case	§245.422
99	Other (Noncompliant)	4	Other/Unknown	Presumed Non-Compliant	§280.20(b)	Presumed Non-Compliant	§245.422
PFLXX	None	197	No Flex Connectors	N/A	N/A	N/A	N/A
UNK	Unknown	336	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A

3.7.2 Coarsened Regulatory Mapping: Piping Flexible Connectors

3.8 Flex - Tank End

3.8.1 Raw Frequency Table

Table 43

Table 44Component Universe: FLEX - TANK END

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
2699	OTHER	343
26A	UNPROTECTED METALLIC COMPONENTS (INCL WRAPPED OR COATED)	51
26B	CATHODICALLY PROTECTED, METALLIC	1676
26F	UNKNOWN	338
26I	COMPLETELY INSIDE CONTAINMENT SUMP, SECONDARY PIPE OR LINER	17133
26M	COMPLETELY JACKETED W/ SEALED BOOT	876
26N	NOT IN CONTACT W/ GROUND	1355
26X	NONE	476

Table 45

Table 46Flex - Tank End: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
26I	COMPLETELY INSIDE CONTAINMENT SUMP/SECONDARY	17133	Secondary Containment	Compliant (All Vintages)	§280.20; §280.43(g)	Compliant	§245.422
26M	COMPLETELY JACKETED W/ SEALED BOOT	876	Secondary Containment	Compliant (All Vintages)	§280.20(b)	Compliant	§245.422
26N	NOT IN CONTACT W/ GROUND	1355	Above Ground	N/A - Not UG component	§280.20(b) applies to UG	N/A	§245.422
26B	CATHODICALLY PROTECTED, METALLIC	1676	Metallic (CP)	Legacy: Compliant	§280.20(b)(2)	Legacy: Compliant	§245.422
26A	UNPROTECTED METALLIC (INCL WRAPPED/COATED)	51	Metallic (Unprotected)	Legacy: HIGH RISK	§280.21(c) req CP	Legacy: HIGH RISK	§245.422
2699	OTHER	343	Other/Unknown	Case-by-Case	§280.20(b)(4)	Case-by-Case	§245.422
26F	UNKNOWN	338	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A
26X	NONE	476	No Tank-End Flex	N/A	N/A	N/A	N/A

3.8.2 Coarsened Regulatory Mapping: Flex - Tank End

3.9 Flex - Dispenser End

3.9.1 Raw Frequency Table

Table 47

Table 48Component Universe: FLEX - DISPENSER END

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
2799	OTHER	190
27A	UNPROTECTED METALLIC COMPONENTS (INCL WRAPPED OR COATED)	27
27B	CATHODICALLY PROTECTED, METALLIC	1788
27F	UNKNOWN	34
27I	COMPLETELY INSIDE CONTAINMENT SUMP, SECONDARY PIPE OR LINER	16280
27M	COMPLETELY JACKETED W/ SEALED BOOT	1926
27N	NOT IN CONTACT W/ GROUND	1344
27X	NONE	763

Table 49

Table 50Flex - Dispenser End: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
27I	COMPLETELY INSIDE CONTAINMENT SUMP/SECONDARY	16280	Secondary Containment	Compliant (All Vintages)	§280.20(f); UDC	Compliant	§245.422
27M	COMPLETELY JACKETED W/ SEALED BOOT	1926	Secondary Containment	Compliant (All Vintages)	§280.20(b)	Compliant	§245.422
27N	NOT IN CONTACT W/ GROUND	1344	Above Ground	N/A - Not UG component	§280.20(b) applies to UG	N/A	§245.422
27B	CATHODICALLY PROTECTED, METALLIC	1788	Metallic (CP)	Legacy: Compliant	§280.20(b)(2)	Legacy: Compliant	§245.422
27A	UNPROTECTED METALLIC (INCL WRAPPED/COATED)	27	Metallic (Unprotected)	Legacy: HIGH RISK	§280.21(c) req CP	Legacy: HIGH RISK	§245.422
2799	OTHER	190	Other/Unknown	Case-by-Case	§280.20(b)(4)	Case-by-Case	§245.422
27F	UNKNOWN	34	Data Gap	UNKNOWN - Verify	N/A	UNKNOWN - Verify	N/A
27X	NONE	763	No Dispenser-End Flex	N/A	N/A	N/A	N/A

3.9.2 Coarsened Regulatory Mapping: Flex - Dispenser End

3.10 AG Piping Construction & Corrosion Protection

3.10.1 Raw Frequency Table

Table 51

Error: Table file not found: 004_comp_ag_piping_construction_corrosion_prot____

Table 52

Table 53AG Piping Construction: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
3I	DOUBLE WALL METALLIC PRIMARY	19	Secondary Containment	Compliant	§280.20(b)	Compliant	§245.422
3J	DOUBLE WALL RIGID (FRP) PRIMARY	11	Secondary Containment	Compliant	§280.20(b)(1)	Compliant	§245.422
3K	DOUBLE WALL FLEXIBLE PRIMARY	8	Secondary Containment	Compliant	§280.20(b)(1)	Compliant	§245.422
3A	CARBON STEEL	615	Single Wall (AG)	AG: Not subject to §280.20(b)	AG piping different reqs	AG: PA Ch. 245 Subchap F	§245.501
3B	CATHODICALLY PROTECTED, METALLIC	72	Single Wall (CP)	AG: Best Practice	AG piping different reqs	AG: Best Practice	§245.501
3C	COPPER	30	Single Wall (AG)	AG: Acceptable	AG piping different reqs	AG: Acceptable	§245.501
3D	FIBERGLASS	40	Single Wall (AG)	AG: Non-corrodible	AG piping different reqs	AG: Acceptable	§245.501
3E	FLEXIBLE NON-METALLIC	29	Single Wall (AG)	AG: Non-corrodible	AG piping different reqs	AG: Acceptable	§245.501
3F	PVC	10	Single Wall (AG)	AG: Non-corrodible	AG piping different reqs	AG: Acceptable	§245.501
3L	STAINLESS STEEL	9	Single Wall (AG)	AG: Corrosion resistant	AG piping different reqs	AG: Acceptable	§245.501
388	OTHER (COMPLIANT)	156	Other/Unknown	Case-by-Case	N/A	Case-by-Case	§245.501
399	OTHER	21	Other/Unknown	Case-by-Case	N/A	Case-by-Case	§245.501
3G	NONE	448	No AG Piping	N/A	N/A	N/A	N/A
3H	PIPING MODIFICATION	5	Maintenance Record	Repair Record Only	§280.33	Repair Record	§245.433

3.10.2 Coarsened Regulatory Mapping: AG Piping Construction

4 Spill & Overfill Prevention

4.1 Spill Prevention

4.1.1 Raw Frequency Table

Table 54

Table 55Component Universe: SPILL PREVENTION

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
6D	DOUBLE WALL SPILL PREV	2564
6E	EXEMPT	512
6N	NO	5543
6S	SINGLE WALL SPILL PREV	4680
6Y	YES	29689

Table 56

Table 57Spill Prevention: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
6Y	YES	29689	Spill Prevention Installed	Compliant	§280.20(c)(1)(i)	Compliant	§245.421
6D	DOUBLE WALL SPILL PREV	2564	Double Wall (Best Practice)	Compliant + Enhanced	§280.35(a)(1)(i)	Compliant + Enhanced	§245.437
6S	SINGLE WALL SPILL PREV	4680	Single Wall	Compliant	§280.20(c)(1)(i)	Compliant	§245.421
6N	NO	5543	NO Spill Prevention	NON-COMPLIANT	§280.20(c)(1)(i) required	NON-COMPLIANT	§245.421 required
6E	EXEMPT	512	Exempt	Verify Exemption Basis	§280.20(c)(2)-(3)	Verify Basis	§245.421

4.1.2 Coarsened Regulatory Mapping: Spill Prevention

4.2 Overfill Prevention

4.2.1 Raw Frequency Table

Table 58

Table 59Component Universe: OVERFILL PREVENTION

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
7A	OVERFILL ALARM	9490
7B	BALL FLOAT VALVE	2598
7E	EXEMPT	885
7N	NO	6183
7S	DROP TUBE SHUTOFF DEVICE	24814
7Y	YES	3550

Table 60

Table 61Overfill Prevention: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
7S	DROP TUBE SHUTOFF DEVICE	24814	Automatic Shutoff (95%)	Compliant (All Vintages)	§280.20(c)(1)(ii)(A)	Compliant	§245.421
7A	OVERFILL ALARM	9490	High-Level Alarm (90%)	Compliant (All Vintages)	§280.20(c)(1)(ii)(B)	Compliant	§245.421
7Y	YES	3550	Overfill Prevention Installed	Compliant - Verify Type	§280.20(c)(1)(ii)	Compliant - Verify Type	§245.421
7B	BALL FLOAT VALVE	2598	Ball Float (Vent Restrictor)	Pre-10/13/15: GRANDFA-THERED	§280.20(c)(3)	Pre-12/22/18: GRANDFA-THERED	§245.421
7B	BALL FLOAT VALVE	NA	Ball Float (Vent Restrictor)	Post-10/13/15: PROHIBITED	§280.20(c)(3) prohibits	Post-12/22/18: PROHIBITED	§245.421
7B	BALL FLOAT VALVE	NA	Ball Float (Vent Restrictor)	Replacement: PROHIBITED	§280.20(c)(3)	Replacement: PROHIBITED	§245.421
7N	NO	6183	NO Overfill Prevention	NON-COMPLIANT	§280.20(c)(1)(ii) required	NON-COMPLIANT	§245.421 required
7E	EXEMPT	885	Exempt	Verify Exemption Basis	§280.20(c)(2)-(3)	Verify Basis	§245.421

4.2.2 Coarsened Regulatory Mapping: Overfill Prevention

5 Containment Systems

5.1 UST Total Secondarily Contained

5.1.1 Raw Frequency Table

Table 62

Table 63Component Universe: UST TOTAL SECONDARILY CONTAINED

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
18N	NO	20287
18Y	YES	12244

Table 64

Table 65UST Secondarily Contained: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
18Y	YES	12244	Secondarily Contained	Compliant (All Vintages)	§280.20; §280.43(g)	Compliant	§245.421
18Y	YES	NA	Secondarily Contained	REQUIRED: Post-4/11/16	§280.20 intro para	REQUIRED: Post-12/22/18	§245.421
18N	NO	20287	NOT Secondarily Contained	Legacy: Acceptable	§280.41(a)(1); §280.21	Legacy: Acceptable	§245.421
18N	NO	NA	NOT Secondarily Contained	Post-4/11/16: NON-COMPLIANT	§280.20 intro para	Post-12/22/18: NON-COMPLIANT	§245.421

5.1.2 Coarsened Regulatory Mapping: UST Secondarily Contained

5.2 Tank-Top Containment Sumps

5.2.1 Raw Frequency Table

Table 66

Table 67Component Universe: TANK-TOP CONTAINMENT SUMPS

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
21A	AT ALL PENETRATIONS	18857
21N	NONE	7554
21S	AT SOME PENETRATIONS	1127

Table 68

Table 69Tank-Top Containment Sumps: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
21A	AT ALL PENETRATIONS	18857	Full Coverage	Compliant (Best Practice)	§280.35; §280.12 def	Compliant	§245.437
21S	AT SOME PENETRATIONS	1127	Partial Coverage	Conditional: Legacy acceptable	§280.35	Conditional	§245.437
21S	AT SOME PENETRATIONS	NA	Partial Coverage	Post-4/11/16: May not satisfy IM	§280.43(g) req IM all penetrations	Post-12/22/18: Verify	§245.444
21N	NONE	7554	No Tank-Top Sumps	Legacy: Acceptable	Not required for legacy	Legacy: Acceptable	Not requ legacy
21N	NONE	NA	No Tank-Top Sumps	Post-4/11/16: Verify IM method	§280.43(g) options	Post-12/22/18: Verify	§245.444

5.2.2 Coarsened Regulatory Mapping: Tank-Top Containment Sumps

5.3 Under-Dispenser Containment

5.3.1 Raw Frequency Table

Table 70

Table 71Component Universe: UNDER-DISPENSER CONTAINMENT

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
22A	AT ALL DISPENSERS	18566
22N	NONE	8667
22S	AT SOME DISPENSERS	253

Table 72

Table 73Under-Dispenser Containment: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
22A	AT ALL DISPENSERS	18566	Full UDC Coverage	Compliant (Best Practice)	§280.20(f)	Compliant	§245.421
22A	AT ALL DISPENSERS	NA	Full UDC Coverage	REQUIRED: New dispensers post-4/11/16	§280.20(f)(1)	REQUIRED: Post-12/22/18	§245.421
22S	AT SOME DISPENSERS	253	Partial UDC Coverage	Conditional: Legacy acceptable	§280.20(f)	Conditional	§245.421
22S	AT SOME DISPENSERS	NA	Partial UDC Coverage	Post-4/11/16 dispensers: Require UDC	§280.20(f)(1)	Post-12/22/18: Require UDC	§245.421
22N	NONE	8667	No UDC	Legacy: Acceptable	Not required pre-4/11/16	Legacy: Acceptable	Not requ pre-12/2
22N	NONE	NA	No UDC	Post-4/11/16 dispensers: NON-COMPLIANT	§280.20(f)(1) requires	Post-12/22/18: NON-COMPLIANT	§245.421

5.3.2 Coarsened Regulatory Mapping: Under-Dispenser Containment

6 Vapor Recovery Systems

6.1 Vapor Recovery (Summary)

6.1.1 Raw Frequency Table

Table 74

Table 75Component Universe: VAPOR RECOVERY

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
11A	STAGE I INSTALLED	3693
11B	STAGE II INSTALLED	89
11C	STAGE I AND STAGE II INSTALLED	774
11D	NONE	4494

Table 76

Table 77Vapor Recovery: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
11A	STAGE I INSTALLED	3693	Stage I Only	Clean Air Act (not 40 CFR 280)	42 U.S.C. §7511a(b)(3)	25 Pa. Code Ch. 129	§129.82
11B	STAGE II INSTALLED	89	Stage II Only	Clean Air Act (not 40 CFR 280)	42 U.S.C. §7511a(b)(3)	25 Pa. Code Ch. 129	§129.82
11C	STAGE I AND STAGE II INSTALLED	774	Stage I + II	Clean Air Act (not 40 CFR 280)	42 U.S.C. §7511a(b)(3)	25 Pa. Code Ch. 129	§129.82
11D	NONE	4494	No Vapor Recovery	May be acceptable - check area	Air quality area-dependent	Check county status	§129.82

6.1.2 Coarsened Regulatory Mapping: Vapor Recovery

6.2 Stage I Vapor Recovery

6.2.1 Raw Frequency Table

Table 78

Table 79Component Universe: STAGE I VAPOR RECOVERY

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
19A	COAX	8099
19B	2 POINT	13101
19N	NONE OR INCOMPLETE	12382
2I	Double wall, metallic primary	1

Table 80

Table 81Stage I Vapor Recovery: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
19A	COAX	8099	Coaxial System	CAA Area-Dependent	42 U.S.C. §7511a(b)(3)	§129.82 Area-Dependent	25 Pa. C §129.82
19B	2 POINT	13101	Two-Point System	CAA Area-Dependent	42 U.S.C. §7511a(b)(3)	§129.82 Area-Dependent	25 Pa. C §129.82
19N	NONE OR INCOMPLETE	12382	No/Incomplete Stage I	Check if required in area	42 U.S.C. §7511a(b)(3)	Check county status	25 Pa. C §129.82
2I	Double wall, metallic primary	1	Data Error - Piping Code	Data Quality Issue	N/A	Data Quality Issue	N/A

6.2.2 Coarsened Regulatory Mapping: Stage I Vapor Recovery

6.3 Stage II Vapor Recovery

6.3.1 Raw Frequency Table

Table 82

Table 83Component Universe: STAGE II VAPOR RECOVERY

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
20A	COMPLETE BALANCE SYSTEM	623
20B	COMPLETE ASSIST SYSTEM	2256
20C	UG PIPING ONLY	6248
20D	DECOMMISSIONED	2359
20N	NONE	21258

Table 84

Table 85Stage II Vapor Recovery: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
20A	COMPLETE BALANCE SYSTEM	623	Balance System	LARGELY OBSOLETE	EPA ORVR Waiver 2012	Decommissioning allowed	25 Pa. C §129.82
20B	COMPLETE ASSIST SYSTEM	2256	Assist System	LARGELY OBSOLETE	EPA ORVR Waiver 2012	Decommissioning allowed	25 Pa. C §129.82
20C	UG PIPING ONLY	6248	Partial Infrastructure	Infrastructure for Stage II	N/A - Equipment not active	Infrastructure only	25 Pa. C §129.82
20D	DECOMMISSIONED	2359	Decommissioned	Compliant with waiver	EPA ORVR Waiver	Compliant	25 Pa. C §129.82
20N	NONE	21258	No Stage II	Generally acceptable now	EPA ORVR Waiver	Generally acceptable	25 Pa. C §129.82

6.3.2 Coarsened Regulatory Mapping: Stage II Vapor Recovery

7 Appendix: Key Regulatory Dates Reference

Table 86: Key Regulatory Dates: Federal and Pennsylvania UST Requirements

Date	Event	Federal_Citation	PA_Citation
December 22, 1988	Original UST regulations published	53 FR 37082	Act 32 of 1989
December 22, 1998	Compliance deadline for existing tanks	53 FR 37082	25 Pa. Code Ch. 245
July 15, 2015	2015 Final Rule published	80 FR 41566	N/A
October 13, 2015	2015 Final Rule EFFECTIVE DATE	80 FR 41566	N/A
October 13, 2015	Ball float valve PROHIBITION begins	§280.20(c)(3)	§245.421(b)(7)
April 11, 2016	Secondary containment REQUIRED (new/replaced)	§280.20 intro	N/A
October 13, 2018	Walkthrough, testing, training deadlines	§280.35, §280.36, §280.243	N/A
December 22, 2018	PA adopts 2015 federal requirements	N/A	48 Pa.B. 7875
December 22, 2018	PA secondary containment effective	N/A	§245.421(a)

8 Appendix: Citation URLs

8.1 Federal Sources

- **40 CFR Part 280 (eCFR)**: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I/part-280
- **2015 Final Rule (Federal Register)**: https://www.federalregister.gov/documents/2015/07/15/2015-15914/revising-underground-storage-tank-regulations-revisions-to-existing-requirements-and-new
- **EPA UST Technical Compendium**: https://www.epa.gov/ust/underground-storage-tank-technical-compendium-about-2015-ust-regulation
- **EPA MUSTs for USTs Guide**: https://www.epa.gov/sites/default/files/2015-12/documents/musts_for_usts.pdf

8.2 Pennsylvania Sources

- **25 Pa. Code Chapter 245**: https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/da
- **25 Pa. Code Subchapter E (UST Technical Standards)**: https://www.pacodeandbulletin.gov/Display
- **PA DEP Storage Tanks**: https://www.pa.gov/agencies/dep/programs-and-services/land/storage-tanks/underground-storage-tanks
- **USTIF**: https://ustif.pa.gov/
- **25 Pa. Code Chapter 977 (USTIF)**: https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/p

9 Tank Upgrades & Retrofits

9.1 Tank Upgrade

9.1.1 Raw Frequency Table

Table 87

Table 88Component Universe: TANK UPGRADE

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
10A	TANK WAS RETROFITTED WITH CATHODIC PROTECTION	1689
10B	TANK WAS RETROFITTED WITH LINING	859
10C	TANK WAS RETROFITTED WITH RIGID BLADDER (EX. PHOENIX SYS)	4

Table 89

Table 90Tank Upgrade: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
10A	TANK WAS RETROFITTED WITH CATHODIC PROTECTION	1689	CP Retrofit	Legacy Upgrade: Compliant	§280.21(b)(2)	Legacy Upgrade: Compliant	§245.421
10A	TANK WAS RETROFITTED WITH CATHODIC PROTECTION	NA	CP Retrofit	Must meet §280.31 monitoring	§280.31(b)-(c); 3-yr test	Must meet monitoring	§245.432
10B	TANK WAS RETROFITTED WITH LINING	859	Interior Lining	Legacy Upgrade: Compliant	§280.21(b)(1)	Legacy Upgrade: Compliant	§245.421
10B	TANK WAS RETROFITTED WITH LINING	NA	Interior Lining	Inspection: 10 yrs, then 5 yrs	§280.21(b)(1)(ii)	Inspection required	§245.421
10C	TANK WAS RETROFITTED WITH RIGID BLADDER (EX. PHOENIX SYS)	4	Bladder System	Legacy Upgrade: Conditional	§280.21(b)(1)(iii); §280.20(a)(5)	Conditional	§245.421

9.1.2 Coarsened Regulatory Mapping: Tank Upgrade

10 Emergency Generator USTs

10.1 Emergency Generator

10.1.1 Raw Frequency Table

Table 91

Table 92Component Universe: EMERGENCY GENERATOR

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
25N	NO - EMER GEN	21543
25Y	YES - EMER GEN	678

Table 93

Table 94Emergency Generator USTs: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
25Y	YES - EMER GEN	678	Emergency Generator UST	Subject to §280.10(a)(1) exemption provisions	§280.10(a)(1)(ii)	Deferred Compliance	§245.403
25Y	YES - EMER GEN	NA	Emergency Generator UST	Install 11/10/07: Comply by 12/21/2020	§280.252(a)(1)	Comply by 12/21/2020	§245.403
25Y	YES - EMER GEN	NA	Emergency Generator UST	Install 11/11/07-12/22/18: Comply by 12/22/2019	§280.252(a)(2)	Comply by 12/22/2019	§245.403
25Y	YES - EMER GEN	NA	Emergency Generator UST	Install after 12/22/18: Comply at install	§280.252(a)(3)	Comply at install	§245.403
25N	NO - EMER GEN	21543	Not Emergency Generator	Standard UST requirements apply	§280.20 et seq.	Standard requirements	§245.401

10.1.2 Coarsened Regulatory Mapping: Emergency Generator USTs

11 Administrative & Permitting

11.1 Fire Marshal Permit

11.1.1 Raw Frequency Table

Table 95

Table 96Component Universe: FIRE MARSHAL PERMIT

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
9A	ISSUED PRIOR TO AUGUST 5, 1989	3316
9B	ISSUED ON OR AFTER AUGUST 5, 1989	1288
9C	NO PERMIT OBTAINED	3709
9D	TANKS NOT REGULATED BY FIRE MARSHAL	268

Table 97

Table 98Fire Marshal Permit: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
9A	ISSUED PRIOR TO AUGUST 5, 1989	3316	Pre-Act 32 Permit	N/A (State admin)	N/A	Legacy Permit	Act 32 o
9A	ISSUED PRIOR TO AUGUST 5, 1989	NA	Pre-Act 32 Permit	N/A	N/A	May lack Ch. 245 compliance	§245.411
9B	ISSUED ON OR AFTER AUGUST 5, 1989	1288	Post-Act 32 Permit	N/A (State admin)	N/A	Standard Permit	§245.411
9C	NO PERMIT OBTAINED	3709	No Permit	Federal: NO permit req	40 CFR 280 no permit req	PA: Permit REQUIRED	§245.411
9C	NO PERMIT OBTAINED	NA	No Permit	N/A	N/A	VIOLATION if in PA jurisdiction	§245.411
9D	TANKS NOT REGULATED BY FIRE MARSHAL	268	Exempt from FM	N/A	N/A	Verify exemption basis	§245.1(b

11.1.2 Coarsened Regulatory Mapping: Fire Marshal Permit

11.2 Registration Certificate

11.2.1 Raw Frequency Table

Table 99

Table 100Component Universe: REGISTRATION CERTIFICATE

COMPONENT_ATTRIBUTE_CODE	COMPONENT_TYPE	N
8N	NO	1397
8Y	YES	11677

Table 101

Table 102Registration Certificate: Coarsened Regulatory Compliance Mapping

CODE	COMPONENT_TYPE	N	Coarsened_Category	Federal_Status	Federal_Citation	PA_Status	PA_Cita
8Y	YES	11677	Registered	Federal: Notification req	§280.22; §280.34	PA: Registration required	§245.411 §245.412
8Y	YES	NA	Registered	N/A	N/A	USTIF eligible (if current)	§977.31(
8N	NO	1397	NOT Registered	Federal: VIOLATION	§280.22 requires notification	PA: VIOLATION	§245.411
8N	NO	NA	NOT Registered	Cannot operate legally	§280.22	USTIF INELIGIBLE	§977.31(

11.2.2 Coarsened Regulatory Mapping: Registration Certificate

12 Owner & Business Intelligence

This section characterizes facility ownership structure, business model classification, and market segmentation derived from the harmonized facility linkage table.

12.1 Business Model Distribution

[Description: Classification of facilities by business category based on owner sector and facility count logic.]

Table 103

Table 104Facility Counts by Business Category

business_category	N
Unknown/Unclassified	58226
Private Firm - Non-motor fuel seller	10646
Retail Gas (Branded Commercial)	10223
Retail Gas - Single Proprietor	9258
Retail Gas - Multi-property Not Branded	6746
Non-Retail: Fleet Fuel Facility	3341
Publicly Owned	3261

[Table Note: Business categories derived from owner name pattern matching and facility count thresholds. “Publicly Owned” includes government and municipal entities; “Retail Gas (Branded Commercial)” includes major chains.]

12.2 Owner Fleet Size Distribution

[Description: Distribution of facilities and tanks across owner size classes.]

Table 105

Table 106Distribution by Owner Fleet Size

Owner_Size_Class	Facilities	Tanks	Pct_Tanks
Unknown/Unlinked	22863	58226	57.3%
Single-Site Owner (Mom & Pop)	3799	18631	18.3%
Large Fleet/Corporate (50+)	2049	10746	10.6%
Small Fleet (2-9)	1510	7913	7.8%
Medium Fleet (10-49)	1114	6185	6.1%

[Table Note: Owner size classification based on facility count per owner: Single-Site (1), Small Fleet (2-9), Medium Fleet (10-49), Large Fleet/Corporate (50+).]

12.3 Owner Sector Breakdown

[Description: Top 25 owner sectors by tank count, derived from owner name pattern classification.]

Table 107

Table 108Top 25 Owner Sectors by Tank Count

final_owner_sector	Facilities	Tanks
Unknown	22863	58226
Private Commercial/Other	3098	16004
Real Estate/Property Mgmt	1703	9437
Major Chain (Sheetz)	313	2126
Major Chain (7-Eleven)	182	1377
Local Govt/Muni	395	1324
State Govt/Agency	189	1011
Major Chain (Sunoco)	153	969
Utility/Energy	179	869
Major Chain (Wawa)	184	843
Major Chain (Speedway)	90	838
Major Chain (Turkey Hill/EG)	215	831
Education/School	168	809
Trucking/Logistics	171	806
Major Chain (United Refining)	140	802
Major Chain (GetGo/Giant)	199	695
Auto Dealership/Repair	128	694
Construction/Development	140	630
Major Chain (Rutters)	81	518
Major Chain (Other Fuel Brand)	81	467
Recreation/Hospitality	89	360
Agriculture	89	360
Utility/Telecom	166	342
Healthcare	58	262
Major Chain (Country Fair)	53	230

[Table Note: Sector classification uses regex pattern matching on owner names to identify major chains, government entities, utilities, and commercial sectors.]

12.4 Facility Operational Status

[Description: Aggregate facility-level operational status based on tank closure patterns.]

Table 109

Table 110Facility Operational Status

facility_status	N	Pct
Fully Closed	24428	78.0%
Mixed Status	4057	12.9%
Fully Active	2850	9.1%

[Table Note: “Fully Active” = all tanks in use; “Fully Closed” = all tanks closed; “Mixed Status” = some active/some closed.]

12.5 Owner Size vs Business Model Cross-Tabulation

[Description: Cross-tabulation of owner fleet size against business category to identify structural patterns.]

Table 111

Table 112Facility Counts: Owner Size vs Business Model

Owner_Size_Class	Non-Retail: Fleet Fuel Facility	Private Firm - Non-motor fuel seller	Publicly Owned	Retail Gas (Branded Commercial)	Retail Gas - Multi-property Not Branded	Retail Gas - Single Proprietor	Unknown/Unclassified
Large Fleet/Corporate (50+)	156	3	151	1667	72	0	0
Medium Fleet (10-49)	151	403	68	84	408	0	0
Single-Site Owner (Mom & Pop)	303	1166	429	41	0	1860	0
Small Fleet (2-9)	174	412	151	15	758	0	0
Unknown/Unlinked	0	0	0	0	0	0	22863

[Table Note: Cell values represent unique facility counts. Useful for identifying which business models are dominated by small vs. large operators.]

12.6 Closure Rates by Business Category

[Description: Tank closure rates stratified by business category to identify differential attrition patterns.]

Table 113

Table 114Tank Closure Rates by Business Category

business_category	Total_Tanks	Closed_Tanks	Active_Tanks	Closure_Rate
Unknown/Unclassified	58226	58226	0	100.0%
Private Firm - Non-motor fuel seller	10646	5152	5494	48.4%
Retail Gas (Branded Commercial)	10223	3372	6851	33.0%
Retail Gas - Single Proprietor	9258	5155	4103	55.7%
Retail Gas - Multi-property Not Branded	6746	3573	3173	53.0%
Non-Retail: Fleet Fuel Facility	3341	2127	1214	63.7%
Publicly Owned	3261	2248	1013	68.9%

[Table Note: Higher closure rates may indicate market exit, consolidation, or infrastructure modernization patterns specific to certain business types.]

13 Temporal Evolution & Trends

This section presents visualizations of how tank characteristics, fuel types, and facility attributes have evolved over time. These temporal patterns inform understanding of regulatory compliance trends and infrastructure modernization.

13.1 Capacity Distribution

[Description: Overall distribution of tank capacities across the fleet.]

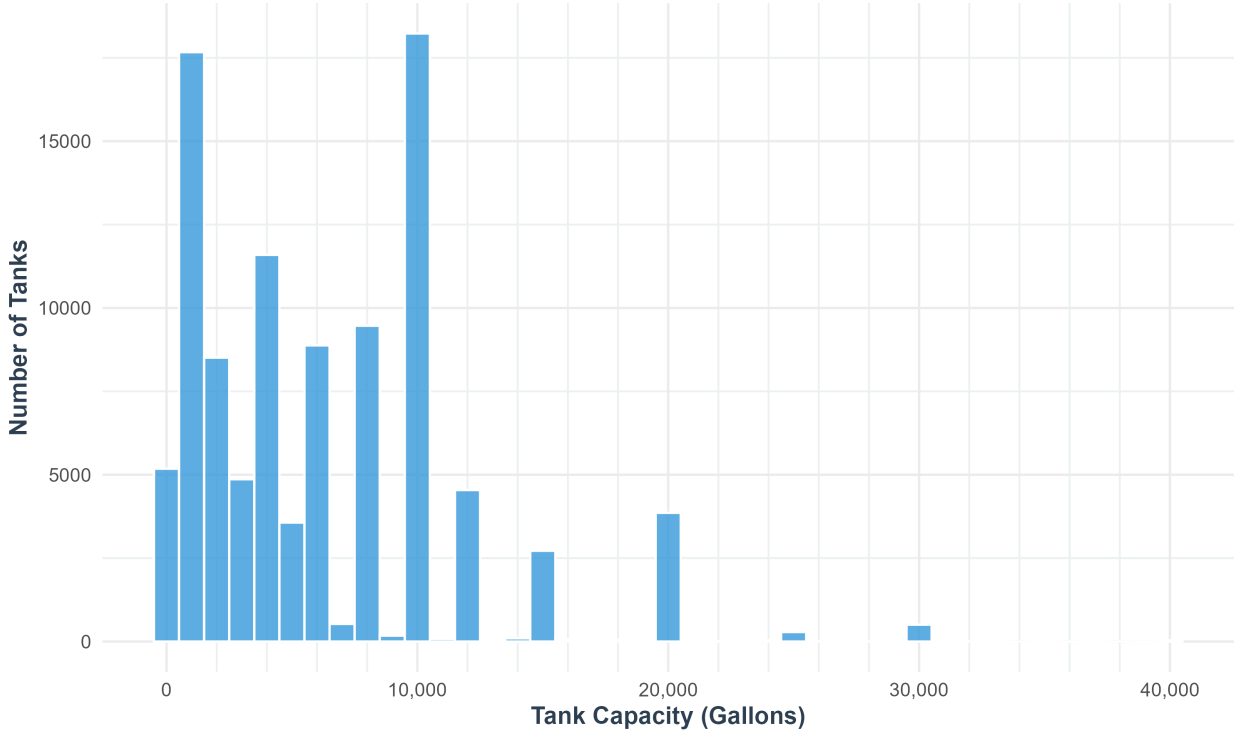

Figure 2: Distribution of Tank Capacities (Gallons)

[Figure Note: Modal peaks at standard capacities (e.g., 10,000, 12,000, 15,000 gallons) indicate industry standardization. Long right tail represents commercial/industrial facilities.]

13.2 Capacity Evolution by Decade

[Description: Distribution of tank capacities across installation decades, showing trends in tank sizing over time.]

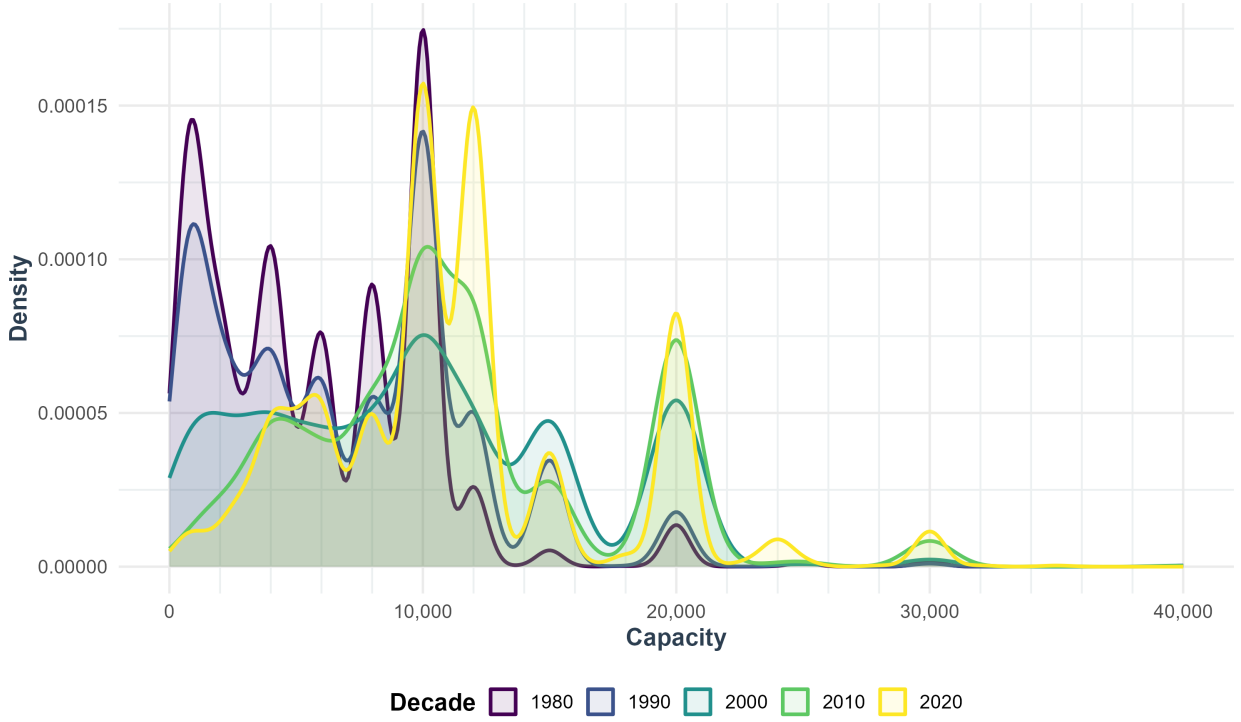

Figure 3: Evolution of Tank Capacity Distribution by Installation Decade

[Figure Note: [Placeholder: Interpretation of capacity trends—have tanks gotten larger over time? Implications for replacement costs and risk assessment.]]

13.3 Fuel Mix Evolution

[Description: Temporal shift in the proportion of gasoline, diesel, and other fuel types in new tank installations.]

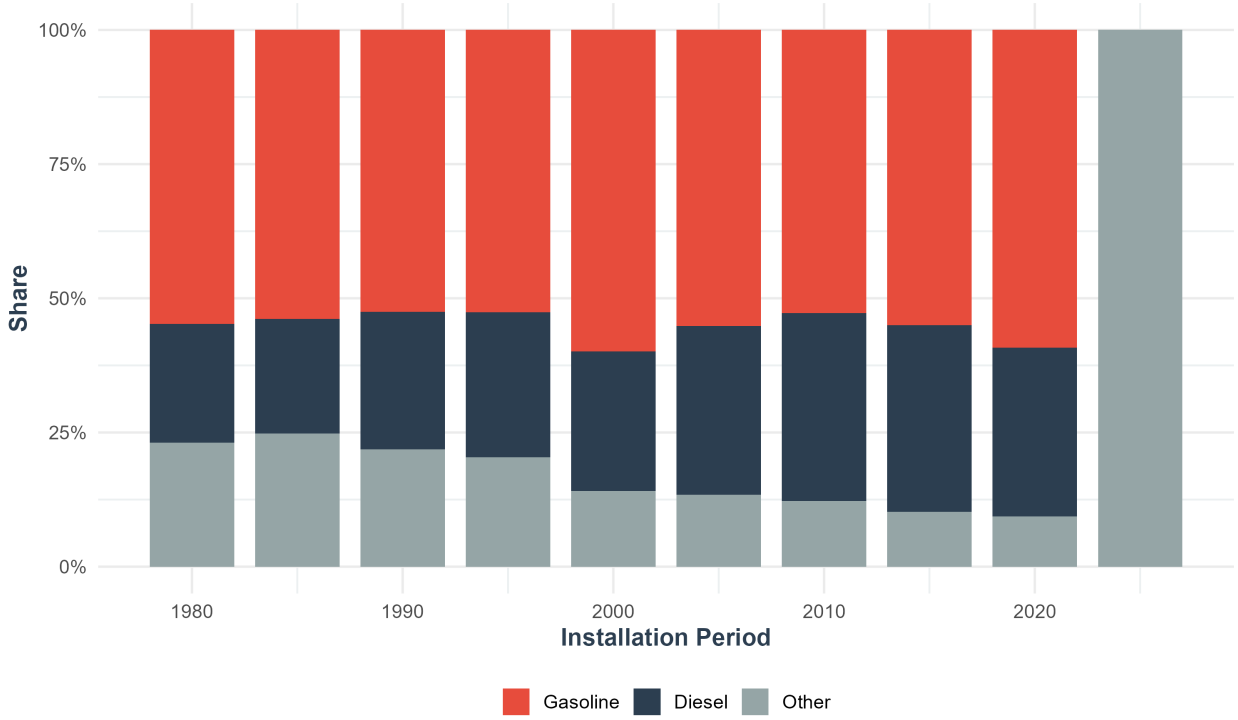

Figure 4: Evolution of Fuel Type Mix in New Installations (5-Year Periods)

[Figure Note: [Placeholder: Analysis of fuel mix shifts—decline in gasoline share? Growth in diesel? Implications for risk profiles and insurance premiums.]]

13.4 Tank Lifespan Distribution

[Description: Distribution of tank ages at closure, showing typical service life and identifying outliers.]

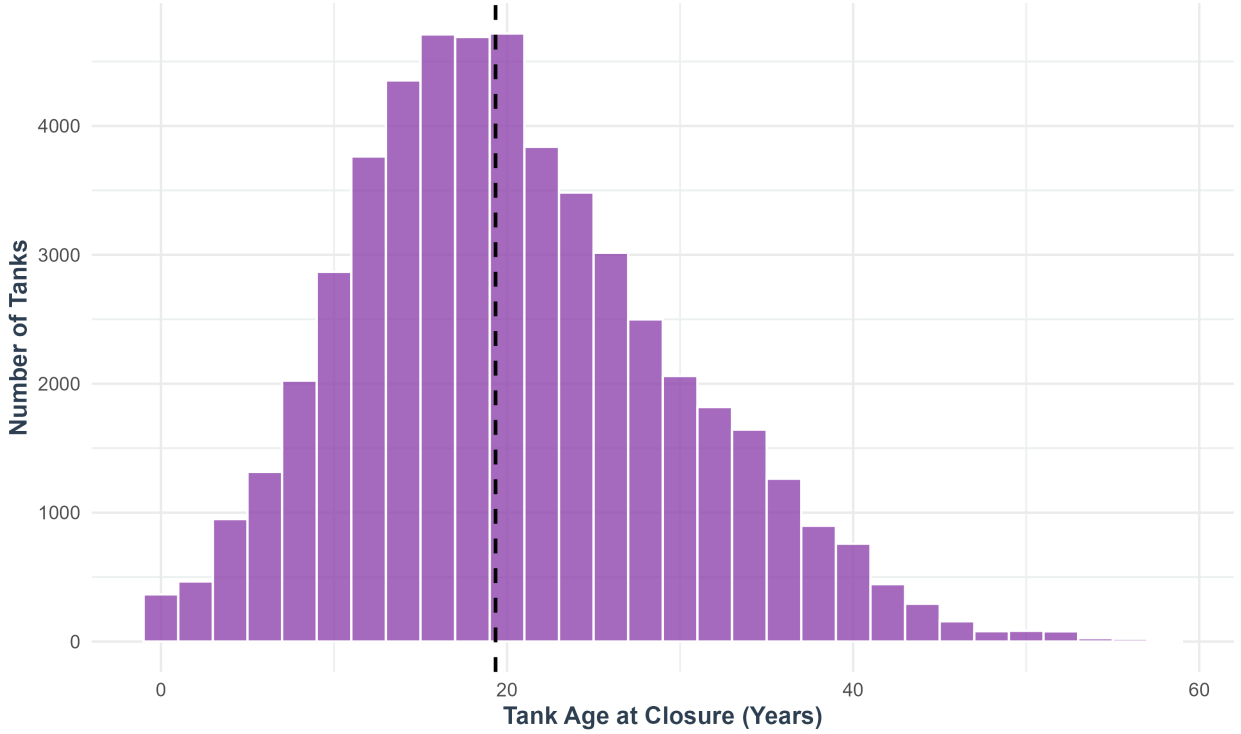

Figure 5: Distribution of Tank Age at Closure

[Figure Note: [Placeholder: Interpretation of lifespan patterns—median age, typical range, and implications for remaining useful life of active tanks.]]

14 Facility-Level Intelligence

This section examines facility-level aggregations, including size distributions, survival patterns, and relationships between facility age and complexity.

14.1 Facility Size Evolution by Decade

[Description: Distribution of facility sizes (number of tanks per facility) across facility vintage decades.]

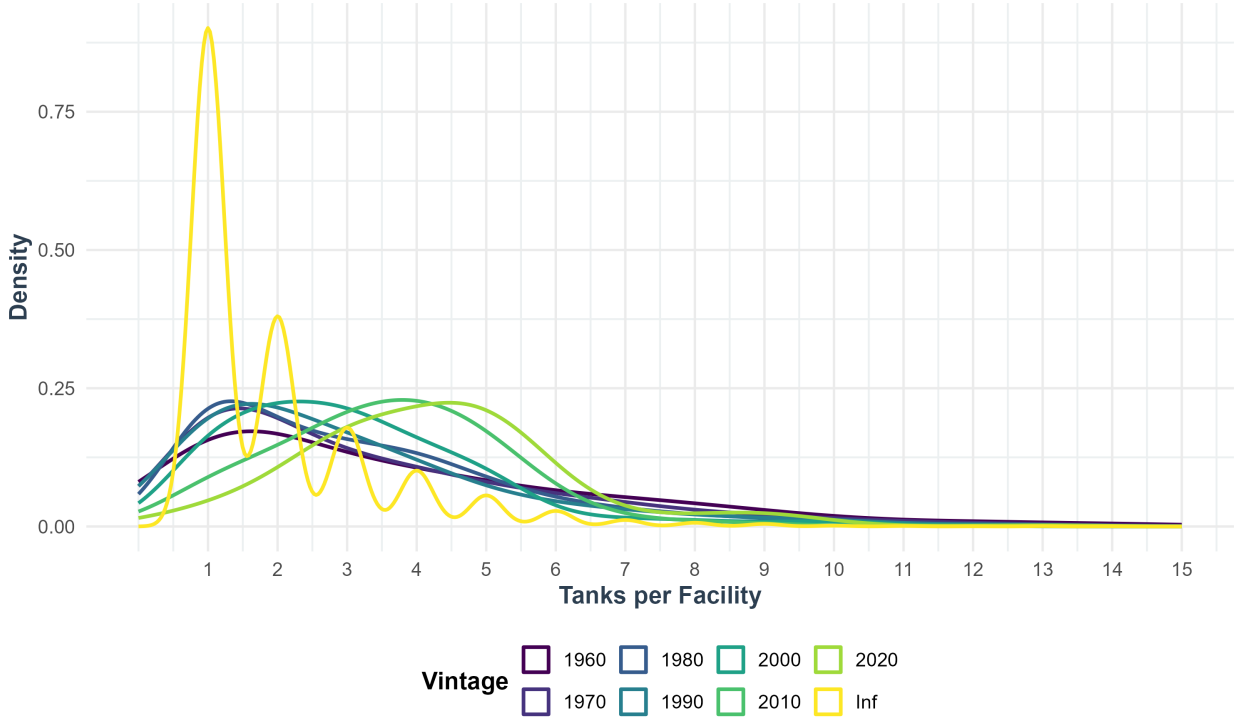

Figure 6: Evolution of Facility Size Distribution by Vintage Decade

[Figure Note: [Placeholder: Interpretation of facility size trends—are newer facilities larger or smaller? Implications for operational complexity and risk concentration.]]

14.2 Facility Status by Vintage

[Description: Proportion of facilities in different status categories (Fully Active, Fully Closed, Mixed Status) by vintage decade.]

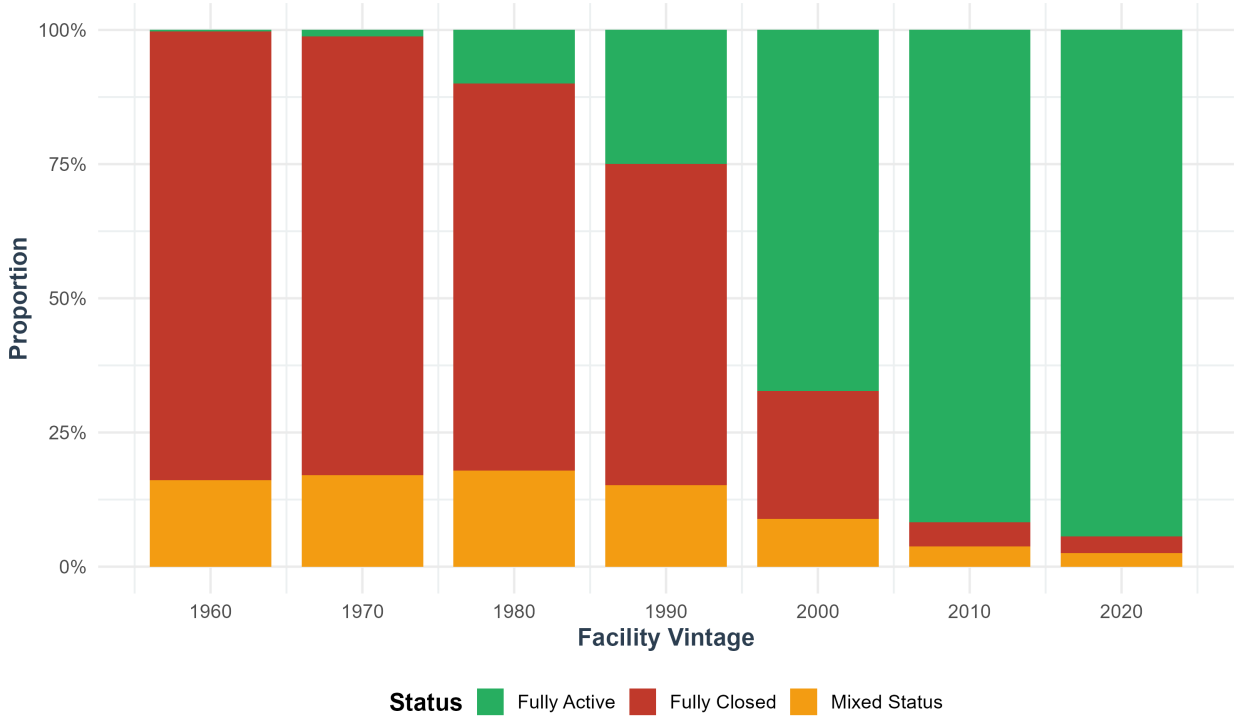

Figure 7: Facility Survival Status by Vintage Decade

[Figure Note: [Placeholder: Analysis of facility survival patterns—do older facilities show higher closure rates? Implications for portfolio risk assessment.]]

14.3 Facility Age vs. Size Relationship

[Description: Scatter plot examining the relationship between facility age and number of tanks, with smoothed trend line.]

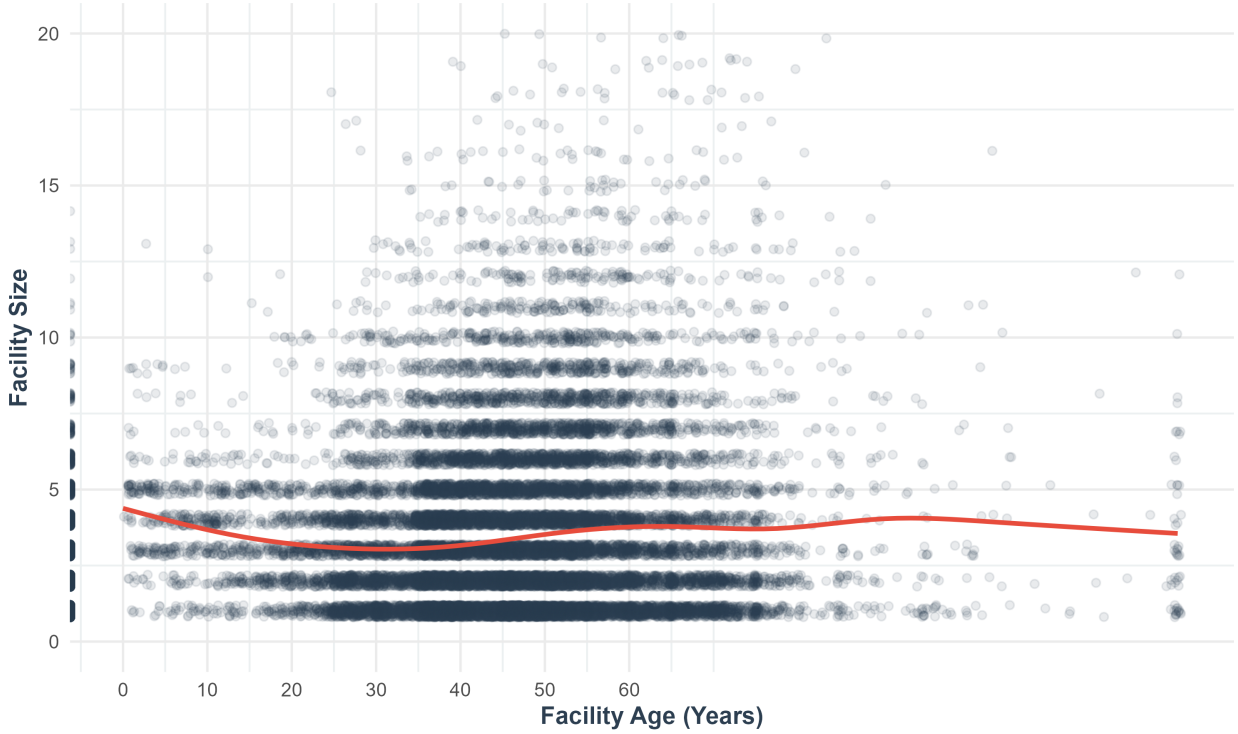

Figure 8: Relationship Between Facility Age and Size

[Figure Note: [Placeholder: Interpretation of age-size relationship—do older facilities tend to be larger? Implications for modernization costs and operational risk.]]

15 Fleet Risk & Infrastructure Analytics

This section examines construction-based risk tiers and capacity standardization trends to characterize infrastructure modernization patterns.

15.1 Fleet Risk Tier Transition

[Description: Temporal evolution of tank construction risk tiers based on wall construction (single vs. double) and material type.]

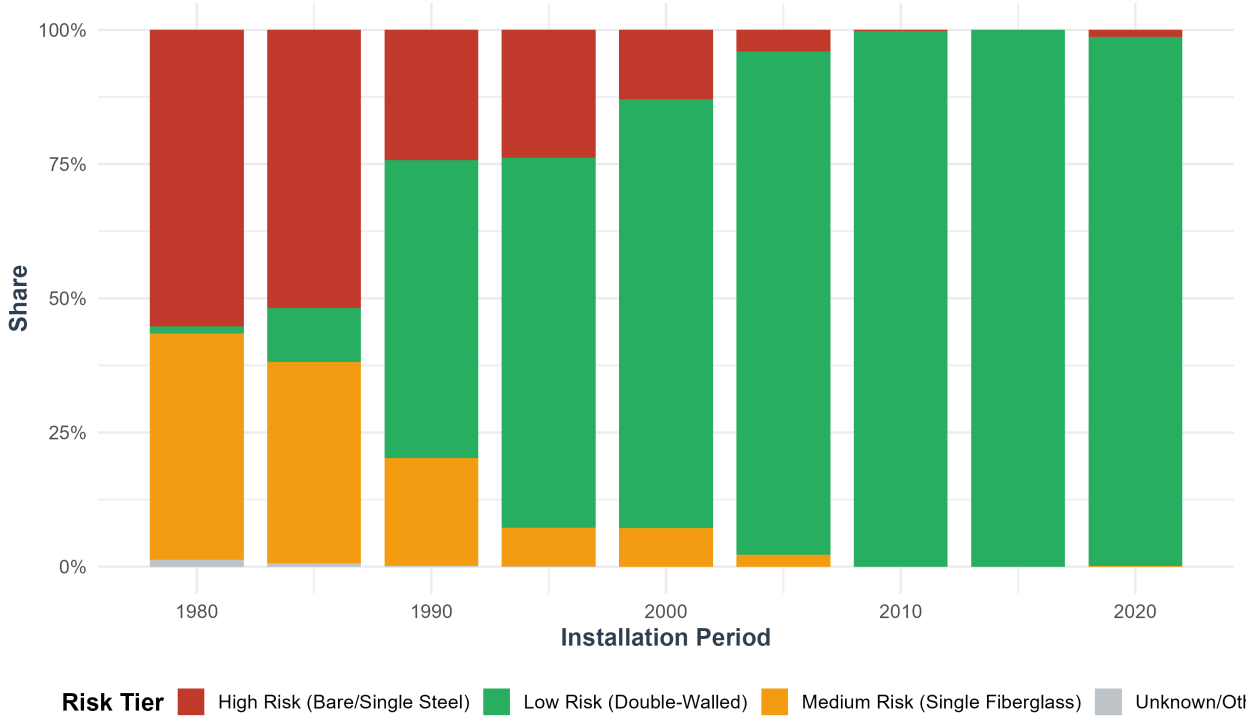

Figure 9: Fleet Risk Tier Transition by Installation Period

[Figure Note: Risk tiers derived from TANK CONSTRUCTION component: "High Risk" = bare/single-wall steel; "Medium Risk" = single-wall fiberglass; "Low Risk" = double-walled or jacketed tanks. Transition toward lower-risk construction reflects regulatory evolution (e.g., 1998 EPA deadline).]

15.2 Capacity Standardization Trends

[Description: Installation frequency of standard tank capacities over time, showing market convergence on common sizes.]

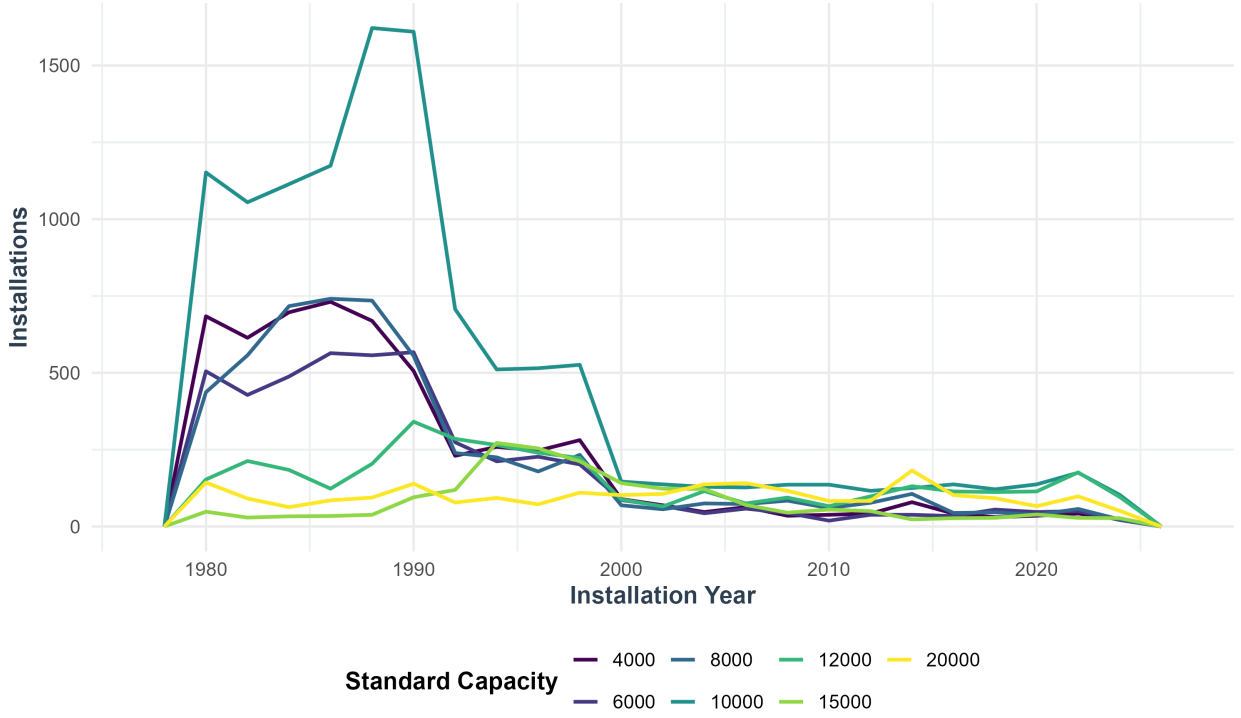

Figure 10: Installation Trends for Standard Tank Capacities (1980+)

[Figure Note: Standard capacities (4000, 6000, 8000, 10000, 12000, 15000, 20000 gallons) shown. Trends indicate market preferences and potential cost efficiencies from standardization.]

16 Owner & Market Structure Analytics

This section presents visualizations of ownership patterns, market concentration, and temporal evolution of business categories.

16.1 Owner Size Distribution

[Description: Distribution of tank counts across owner size classes.]

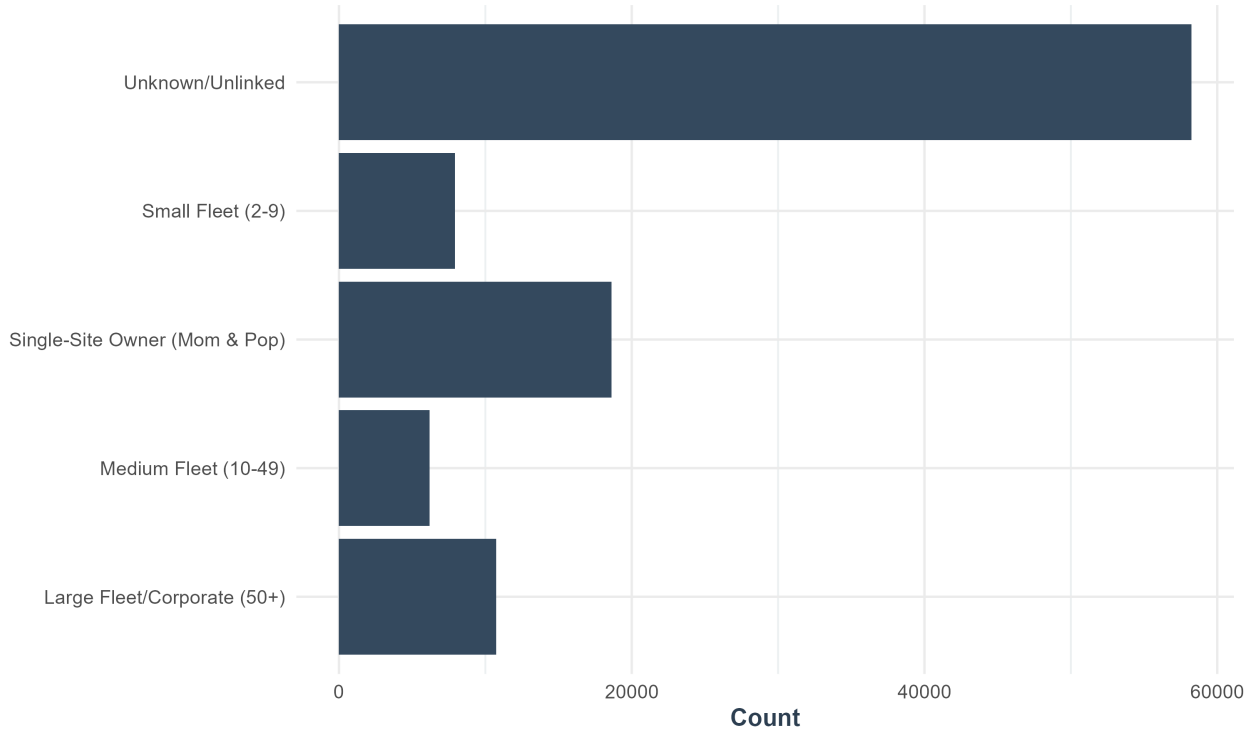

Figure 11: Tank Count Distribution by Owner Size Class

[Figure Note: Horizontal bar chart showing relative market share by owner fleet size. Single-site operators vs. corporate fleet concentration.]

16.2 Mom & Pop Sector Breakdown

[Description: Sector distribution within single-site ("Mom & Pop") owners, showing business type diversity.]

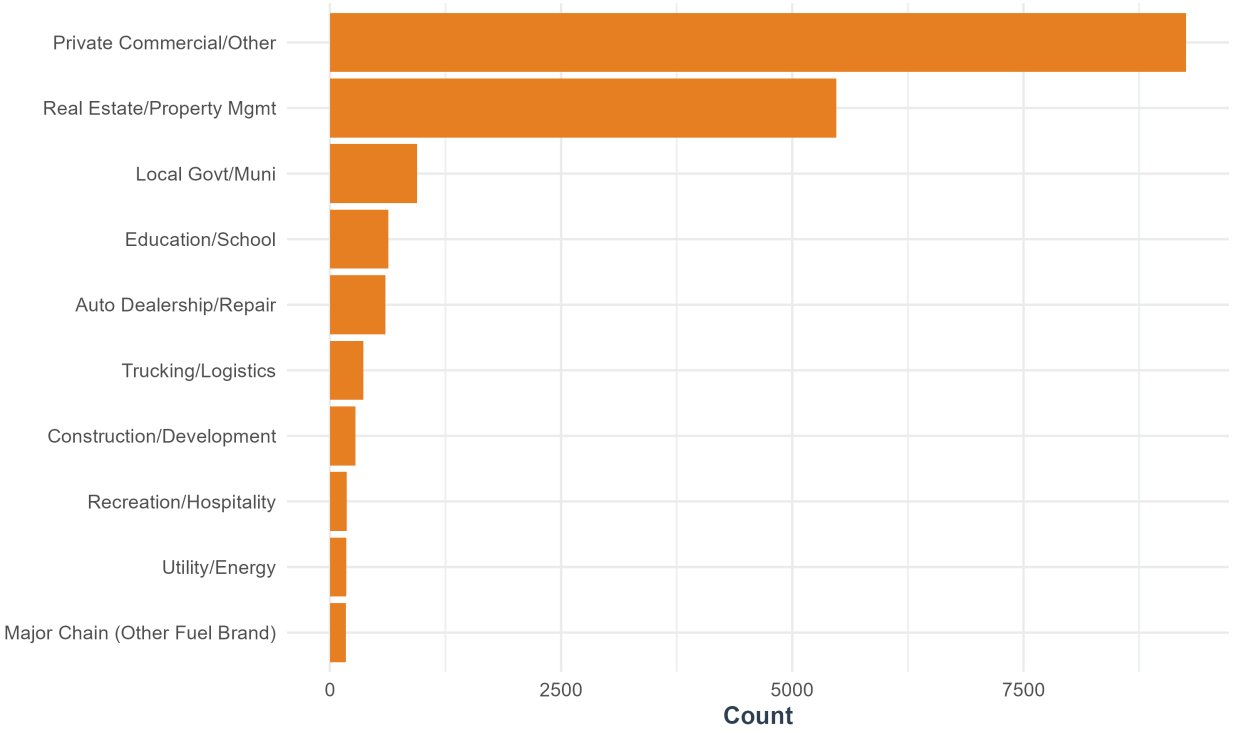

Figure 12: Top 10 Sectors Among Single-Site Owners

[Figure Note: Identifies which business sectors dominate the single-site owner segment—critical for understanding small operator vulnerability to remediation costs.]

16.3 Major Chains Market Share

[Description: Tank counts for major retail chains operating in Pennsylvania.]

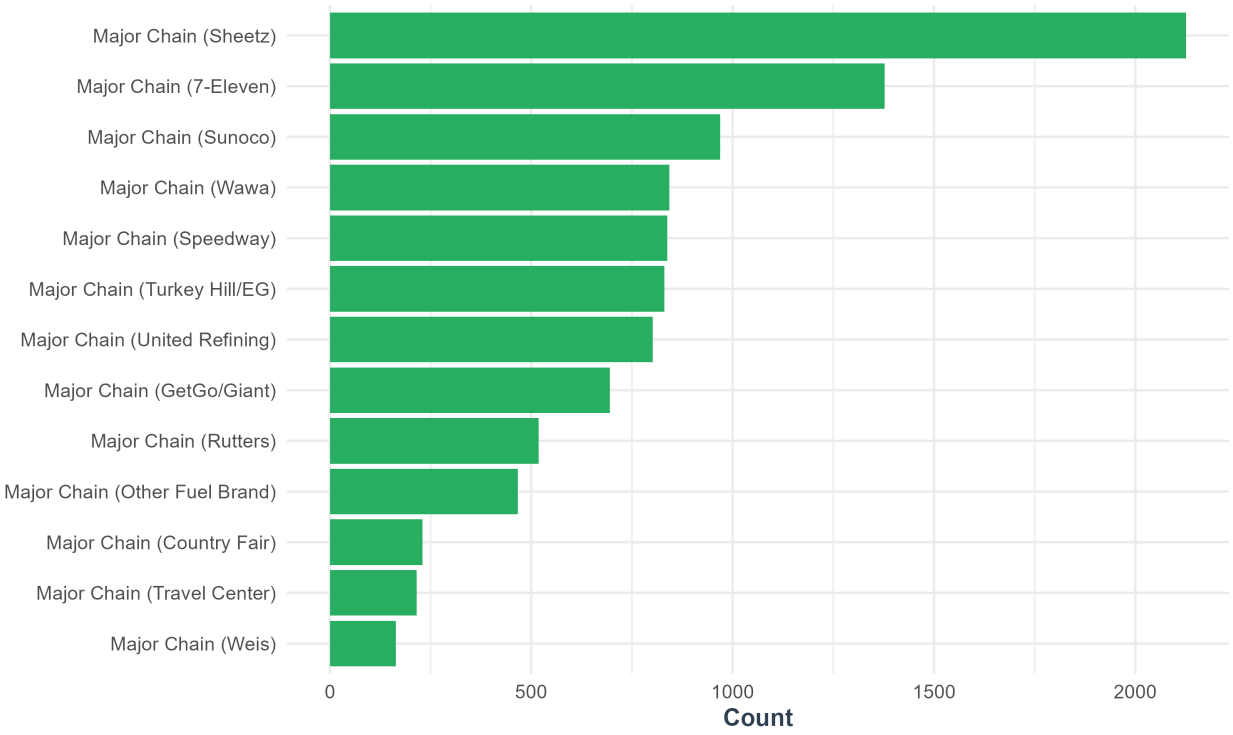

Figure 13: Major Chains Market Share by Tank Count

[Figure Note: Identifies dominant retail fuel chains (Sheetz, Wawa, GetGo, etc.) and their relative infrastructure footprints in Pennsylvania.]

16.4 Owner Size Evolution

[Description: Temporal evolution of installation share by owner size class.]

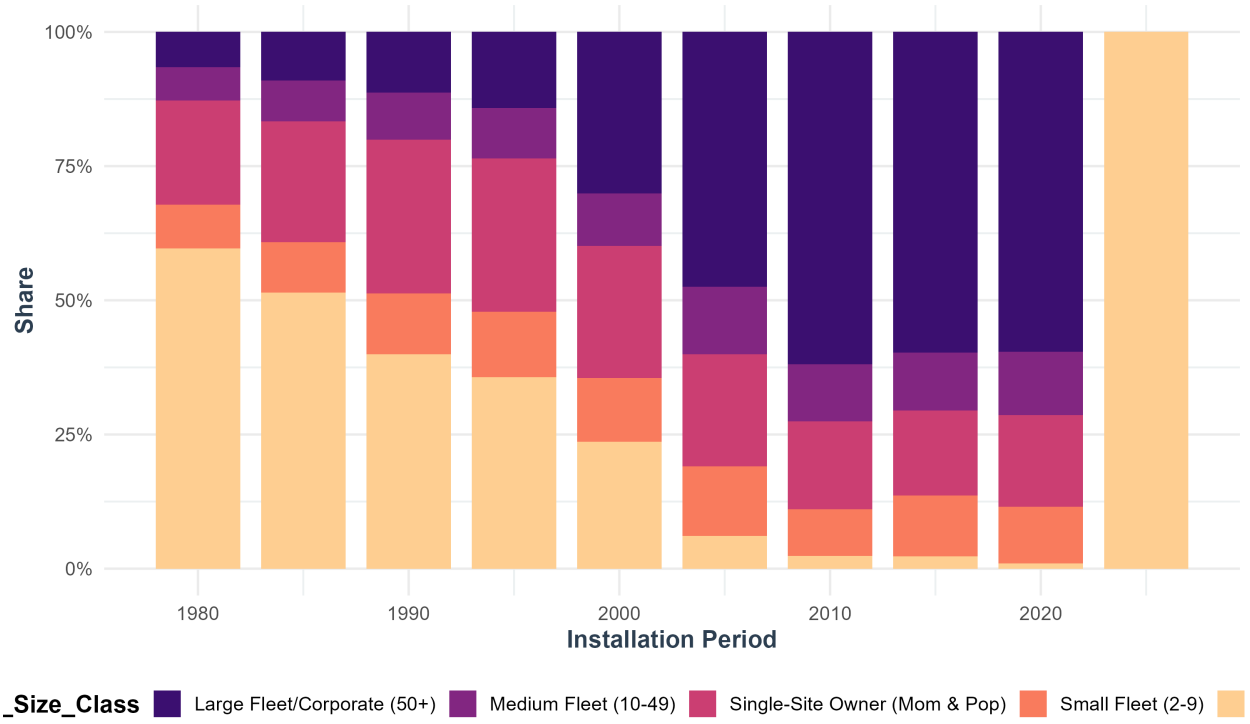

Figure 14: Evolution of Tank Installations by Owner Size Class (5-Year Periods)

[Figure Note: Stacked area showing market consolidation trends—increasing corporate share vs. declining single-site operator share over time.]

16.5 Business Category Evolution

[Description: Temporal evolution of installation share by business category classification.]

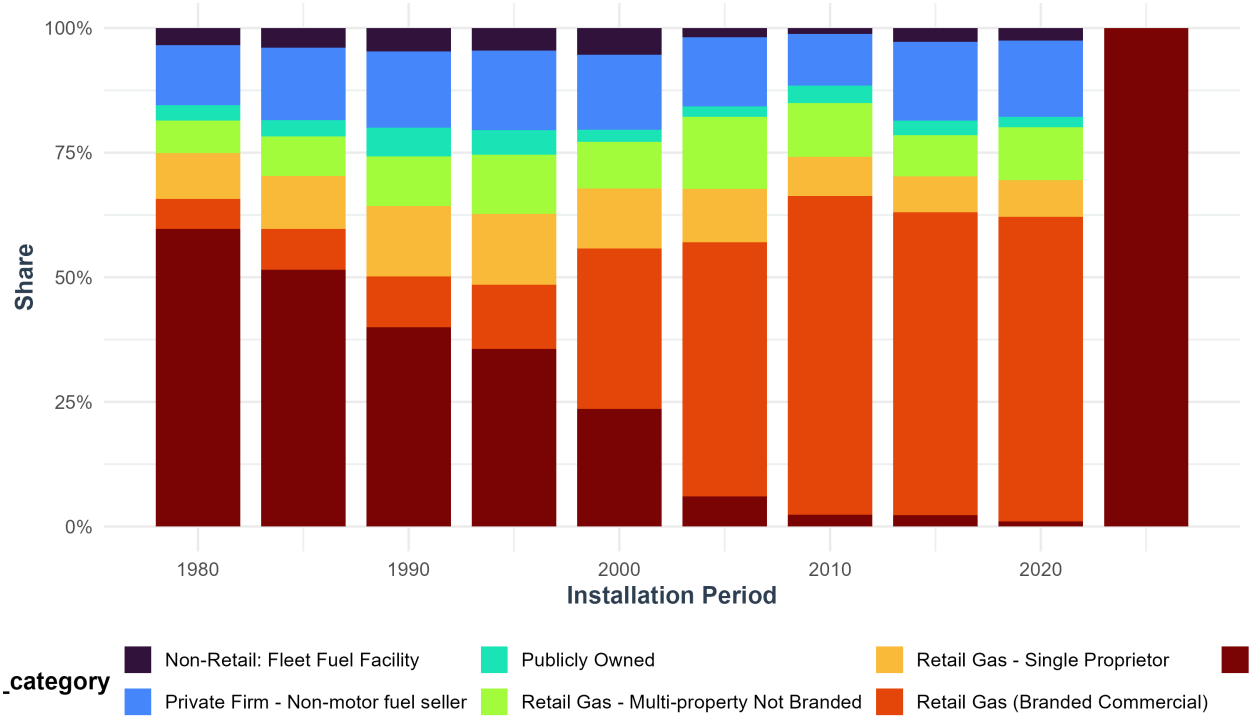

Figure 15: Evolution of Tank Installations by Business Category (5-Year Periods)

[Figure Note: Shows structural shifts in who is installing tanks—retail gas, fleet operations, public sector, etc. Useful for understanding changing composition of USTIF portfolio.]

17 Closure Dynamics

This section examines tank closure patterns over time, stratified by facility type.

17.1 Tank Closures by Facility Type Timeline

[Description: Annual tank closures by business category, showing differential exit/modernization patterns.]

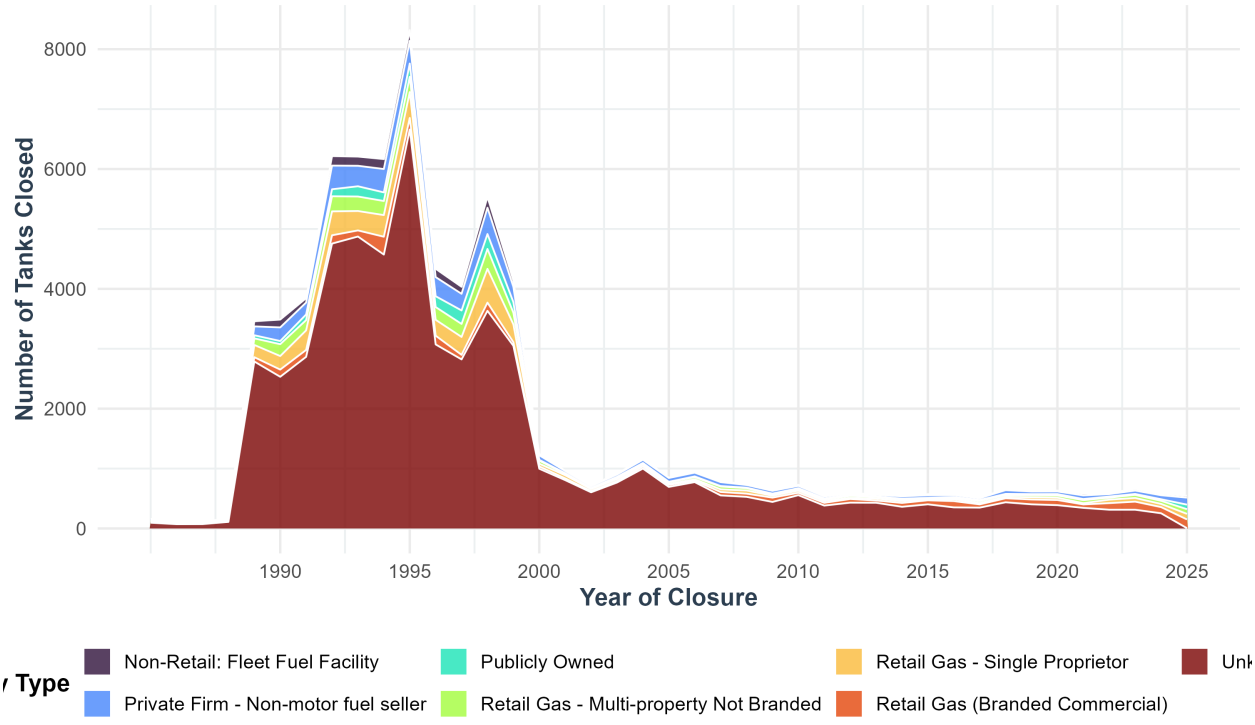

Figure 16: Tank Closures by Facility Type (1985-2025)

[Figure Note: Stacked area chart showing closure volume by business category over time. Peaks may correspond to regulatory deadlines (e.g., 1998 EPA compliance), market consolidation waves, or economic shocks. Useful for understanding historical claim volume drivers.]

18 USTIF Claims & Contracts Analysis

This section provides a summary of the USTIF claims and remediation contracts, adjusted for inflation to **2024 Real Dollars**.

18.1 Claims Overview

[Description: Operational status and financial severity of claims, adjusted for inflation.]

Table 115

Table 116USTIF Claims: Status & Real Costs

claim_status	Count	Avg_Real_Cost	Total_Real_Paid	Share
Closed Eligible	4407	$361,543	$1,593,320,744	56.6%
Closed Withdrawn	1264	$1,502	$1,898,367	16.2%
Closed Denied	1157	$5,086	$5,884,614	14.8%
Open Eligible	627	$607,121	$380,664,923	8.0%
Closed Post Remedial Care	217	$748,635	$162,453,746	2.8%
Open Pending	97	$1,058	$102,618	1.2%
Open Post Remedial Care	18	$1,176,190	$21,171,415	0.2%
Open Appealed	5	$16,303	$81,516	0.1%

[Table Note: Claims categorized by operational status with real dollar costs adjusted to 2024 base year.]

18.2 Financial Severity

[Description: Distribution of real claim costs (log scale) showing the prevalence of high-severity events.]

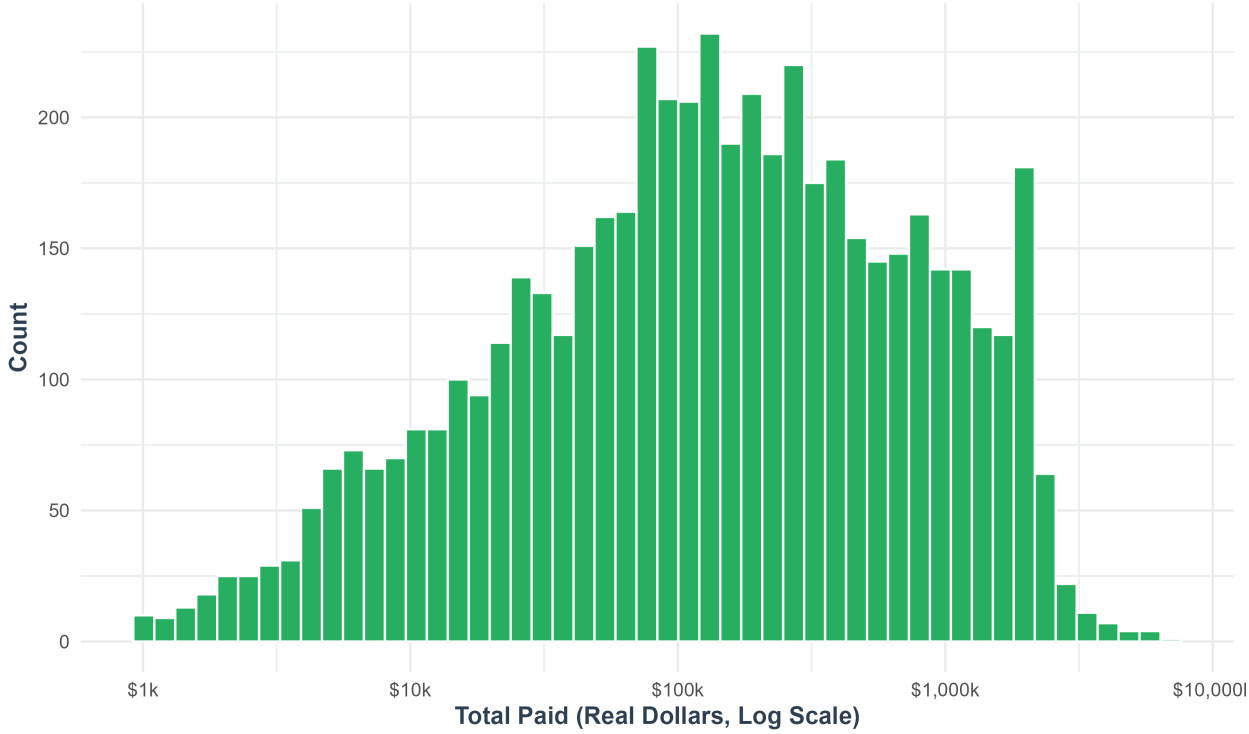

Figure 17: Distribution of Real Claim Severities (2024 Dollars)

[Figure Note: Log-scale distribution reveals long right tail characteristic of environmental remediation costs.]

18.3 Contracts & Auctions

[Description: Analysis of remediation contracts, comparing Bid-to-Result mechanisms against traditional models.]

Table 117

Table 118Contracts: Real Value by Mechanism

auction_type	Contracts	Total_Real_Value	Median_Real_Value
Other/Unknown	398	$110,541,797	$173,405
Bid-to-Result	83	$42,289,577	$438,017
Scope of Work	177	$28,650,874	$109,601

[Table Note: Contract mechanism breakdown showing PFP auction vs. T&M allocation patterns.]

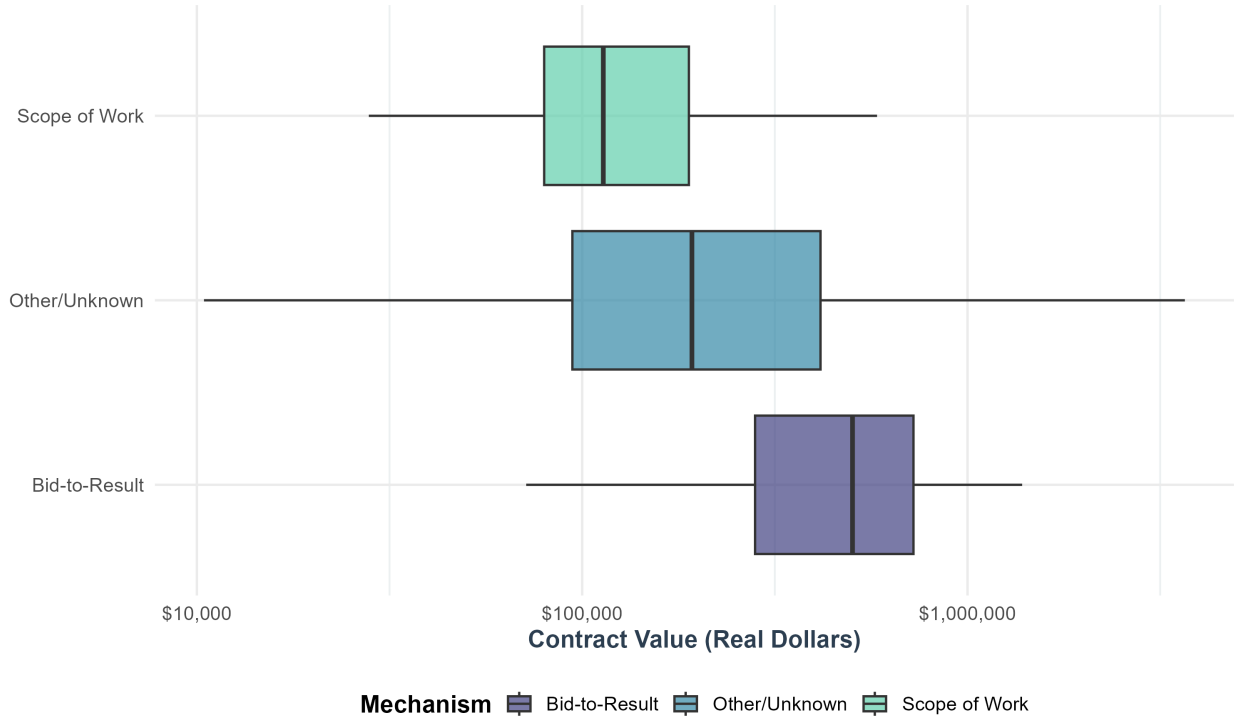

Figure 18: Contract Value Distribution by Mechanism (Real 2024 Dollars)

[Figure Note: Boxplot comparison of contract values by mechanism type. Caution: raw comparisons subject to selection bias per "naive fallacy" identified in research design.]

19 Appendix: Variable Inventory

[Description: Complete frequency dictionary for categorical variables in the Claims and Contracts datasets.]

19.1 Claims Variables

19.1.1 Claim Status

Table 119

Table 120Variable Inventory: $claim_status$ (Claims Data)

Value	N	Share
Closed Eligible	4407	56.6%
Closed Withdrawn	1264	16.2%
Closed Denied	1157	14.8%
Open Eligible	627	8.0%
Closed Post Remedial Care	217	2.8%
Open Pending	97	1.2%
Open Post Remedial Care	18	0.2%
Open Appealed	5	0.1%

[Table Note: Distribution of claim operational status (open/closed).]

19.1.2 DEP Region

Table 121

Table 122Variable Inventory: dep_region (Claims Data)

Value	N	Share
PADEP Southeast Regional Office	2018	25.9%
PADEP Southwest Regional Office	1512	19.4%
PADEP Southcentral Regional Office	1433	18.4%
PADEP Northeast Regional Office	1333	17.1%
PADEP Northwest Regional Office	907	11.6%
PADEP Northcentral Regional Office	589	7.6%

[Table Note: Geographic distribution of claims across PA DEP regional offices.]

19.1.3 County

Table 123

Table 124Variable Inventory: county (Claims Data)

Value	N	Share
Allegheny	687	8.8%
Montgomery	544	7.0%
Philadelphia	502	6.4%
Bucks	395	5.1%
Delaware	303	3.9%
Luzerne	285	3.7%
Chester	274	3.5%
Westmoreland	254	3.3%
Lancaster	254	3.3%
Erie	218	2.8%
York	212	2.7%
Berks	190	2.4%
Lehigh	188	2.4%
Dauphin	186	2.4%
Northampton	179	2.3%
Monroe	177	2.3%
Washington	171	2.2%
Lackawanna	161	2.1%
Schuylkill	133	1.7%
Beaver	113	1.5%
Mercer	106	1.4%
Fayette	105	1.3%
Butler	104	1.3%
Cumberland	104	1.3%
Blair	100	1.3%
Lycoming	95	1.2%
Clearfield	81	1.0%
Cambria	80	1.0%
Indiana	72	0.9%
Franklin	72	0.9%
Lebanon	70	0.9%
Adams	69	0.9%
Centre	68	0.9%
Somerset	64	0.8%
Northumberland	62	0.8%
Venango	61	0.8%

[Table Note: County-level claim frequency distribution.]

19.1.4 Location Description

Table 125

Table 126Variable Inventory: $location_desc$ (Claims Data)

Value	N	Share
Commercial	7292	93.6%
Local Government	251	3.2%
Private	237	3.0%
State Government	11	0.1%
	1	0.0%

[Table Note: Facility location type classification.]

19.1.5 Products

Table 127

Table 128Variable Inventory: products (Claims Data)

Value	N	Share
Unleaded Gasoline	4881	62.6%
Diesel	807	10.4%
Unleaded Gasoline, Diesel	553	7.1%
Heating Oil	329	4.2%
Unleaded Gasoline, Kerosene, Diesel	190	2.4%
Unleaded Gasoline, Other	175	2.2%
Unleaded Gasoline, Kerosene	169	2.2%
Other	142	1.8%
Kerosene	96	1.2%
Unleaded Gasoline, Heating Oil, Diesel	73	0.9%
Unleaded Gasoline, Other, Diesel	69	0.9%
Unleaded Gasoline, Kerosene, Heating Oil, Diesel	46	0.6%
Unleaded Gasoline, Heating Oil	42	0.5%
Unleaded Gasoline, Other, Heating Oil	41	0.5%
Unleaded Gasoline, Other, Heating Oil, Diesel	33	0.4%
Unleaded Gasoline, Other, Kerosene, Diesel	25	0.3%
Heating Oil, Diesel	16	0.2%
Other, Diesel	16	0.2%
Unleaded Gasoline, Other, Kerosene	15	0.2%
Kerosene, Diesel	14	0.2%
Unleaded Gasoline, Other, Kerosene, Heating Oil, Diesel	11	0.1%
Unleaded Gasoline, Kerosene, Heating Oil	9	0.1%
Other, Heating Oil	7	0.1%
Other, Heating Oil, Diesel	6	0.1%
Unleaded Gasoline, Undetermined	5	0.1%
Unleaded Gasoline, Undetermined, Kerosene, Diesel	5	0.1%
Unleaded Gasoline, Other, Kerosene, Heating Oil	4	0.1%
Unleaded Gasoline, Undetermined, Other	3	0.0%
Kerosene, Heating Oil, Diesel	2	0.0%
Unleaded Gasoline, Undetermined, Other, Heating Oil	2	0.0%
Kerosene, Heating Oil	2	0.0%
Other, Kerosene, Heating Oil	1	0.0%
Unleaded Gasoline, Undetermined, Other, Kerosene	1	0.0%
Unleaded Gasoline, Undetermined, Diesel	1	0.0%
Undetermined, Other, Diesel	1	0.0%

[Table Note: Substance/product types associated with claims.]

19.1.6 Is Closed

Table 129

Table 130Variable Inventory: is_closed (Claims Data)

Value	N	Share
TRUE	7045	90.4%
FALSE	747	9.6%

[Table Note: Binary indicator for claim closure status.]

19.1.7 Is Open

Table 131

Table 132Variable Inventory: is_open (Claims Data)

Value	N	Share
FALSE	7045	90.4%
TRUE	747	9.6%

[Table Note: Binary indicator for claim open status.]

19.2 Contracts Variables

19.2.1 Adjuster

Table 133

Table 134Variable Inventory: adjuster (Contracts Data)

Value	N	Share
Marion,Shane	83	12.6%
Mackewicz,Bonnie	81	12.3%
Aubel,Tracy	69	10.5%
Smith,Bethany	66	10.0%
Bilder,Jack	57	8.7%
Ferro,James	54	8.2%
Hawk,Gerald	48	7.3%
Headdings,Kyle	41	6.2%
Cramer,Jolene	34	5.2%
Melvin, CPCU,Linda M.	33	5.0%
Bollana,Debra	29	4.4%
Goodyear,Jennifer	23	3.5%
Condran,Patricia	14	2.1%
Moore,Ronald	12	1.8%
Kern,Beth	9	1.4%
Crabb,Linda	5	0.8%

[Table Note: ICF Claims Evaluator assignment distribution. Key variable for instrumental variable identification strategy.]

19.2.2 Consultant

Table 135

Table 136Variable Inventory: consultant (Contracts Data)

Value	N	Share
Letterle & Associates Inc,	128	19.5%
MEA, Inc.,	65	9.9%
Groundwater & Environmental Services, Inc.,	58	8.8%
Mountain Research LLC,	55	8.4%
Core Environmental Services, Inc.,	43	6.5%
Kleinfelder Eastern Merger Corporation,	20	3.0%
In-Site Group, Inc.,	18	2.7%
Converse Consultants,	17	2.6%
DMS Environmental Services LLC,	16	2.4%
B&B Diversified Enterprises Inc,	15	2.3%
Environmental Alliance,	14	2.1%
Liberty Environmental, Inc.,	14	2.1%
Austin James Associates,	13	2.0%
Environmental Remediation & Recovery, Inc.,	13	2.0%
Moody & Associates, Inc.,	9	1.4%
United Environmental Services, Inc.,	9	1.4%
American Environmental Assoc Inc,	8	1.2%
R.A.R. Engineering Group, Inc.,	8	1.2%
Chambers Environmental Group Inc,	8	1.2%
Pennsylvania Tectonics, Inc.,	7	1.1%
Cribbs & Associates, Inc.,	7	1.1%
Environmental Consulting, Inc.,	6	0.9%
Alternative Environmental Solutions Inc,	6	0.9%
Flynn Environmental, Inc.,	5	0.8%
P. Joseph Lehman, Inc.,	5	0.8%
Monridge Environmental, LLC DBA JK Environmental Services, LLC,	5	0.8%
Labella Associates DPC Labella Associates PC,	5	0.8%
EnviroTrac, LTD,	4	0.6%
Juniata Geosciences LLC,	4	0.6%
Alpha Geological Services Inc.,	4	0.6%
KU Resources Inc.,	3	0.5%
American Geosciences Inc,	3	0.5%
Synergy Environmental, Inc.,	3	0.5%
Compliance Environmental Services,	3	0.5%
Keystone Environmental Health and Safety Services,	3	0.5%
Environmental Compliance Services, Inc.,	2	0.3%

[Table Note: Environmental consulting firm assignment frequency.]

19.2.3 Brings to Closure

Table 137

Table 138Variable Inventory: $brings_to_closure$ (Contracts Data)

Value	N	Share
Yes	394	59.9%
No	264	40.1%

[Table Note: Contract scope classification regarding site closure responsibility.]

19.2.4 Contract Category

Table 139

Table 140Variable Inventory: $contract_category$ (Contracts Data)

Value	N	Share
Sole Source	409	62.2%
Competitively Bid	249	37.8%

[Table Note: High-level contract type categorization.]

19.2.5 Bid Type

Table 141

Table 142Variable Inventory: bid_type (Contracts Data)

Value	N	Share
	420	63.8%
Defined Scope of Work	177	26.9%
Bid to Result	61	9.3%

[Table Note: Procurement mechanism classification (competitive bid vs. negotiated).]

19.2.6 Contract Type Raw

Table 143

Table 144Variable Inventory: $contract_type_raw$ (Contracts Data)

Value	N	Share
Fixed Price	620	94.2%
Pay for Performance	24	3.6%
Time and Material	12	1.8%
	2	0.3%

[Table Note: Original contract type codes from source data.]

19.2.7 Auction Type

Table 145

Table 146Variable Inventory: $auction_type$ (Contracts Data)

Value	N	Share
Other/Unknown	398	60.5%
Scope of Work	177	26.9%
Bid-to-Result	83	12.6%

[Table Note: Auction mechanism subtype for PFP contracts.]

19.2.8 Is Bid to Result

Table 147

Table 148Variable Inventory: $is_bid_to_result$ (Contracts Data)

Value	N	Share
FALSE	575	87.4%
TRUE	83	12.6%

[Table Note: Binary indicator for Performance-Fixed-Price (PFP) auction contracts. Primary treatment variable for causal analysis.]

19.2.9 Is Scope of Work

Table 149

Table 150Variable Inventory: $is_scope_of_work$ (Contracts Data)

Value	N	Share
FALSE	481	73.1%
TRUE	177	26.9%

[Table Note: Binary indicator for traditional Time-and-Materials (T&M) contracts.]

19.2.10 Brings to Closure Flag

Table 151

Table 152Variable Inventory: $brings_to_closure_flag$ (Contracts Data)

Value	N	Share
TRUE	394	59.9%
FALSE	264	40.1%

[Table Note: Binary indicator for contracts responsible for achieving site closure.]

20 Appendix: USTIF Eligibility Checklist

Per 25 Pa. Code §977.31, eligibility for USTIF coverage requires ALL of the following:

Table 153: USTIF Eligibility Requirements (25 Pa. Code §977.31)

Requirement	Citation	Component_Link
Claimant is owner, operator, landowner, or certified installer/inspector	§977.31(a)(1)	N/A
Underground Storage Tank Indemnification Fund fee current at time of release	§977.31(a)(2)	Registration Certificate
Tank currently registered with DEP	§977.31(a)(3)	Registration Certificate (8Y)
Permits and certifications obtained before tank installation	§977.31(a)(4)	Fire Marshal Permit (9A/9B)
Confirmed release occurred on/after February 1, 1994	§977.31(a)(5)	N/A
Claimant cooperates with Fund and DEP	§977.31(a)(6)	N/A
Notification to Fund within 60 days of release discovery	§977.31(a)(7)	N/A

Coverage Limits (25 Pa. Code §977.33):

- Maximum per tank per occurrence: $1,500,000
- Annual aggregate: $1,500,000
- Deductible: $5,000 per tank (scales with tank count per §245.707)

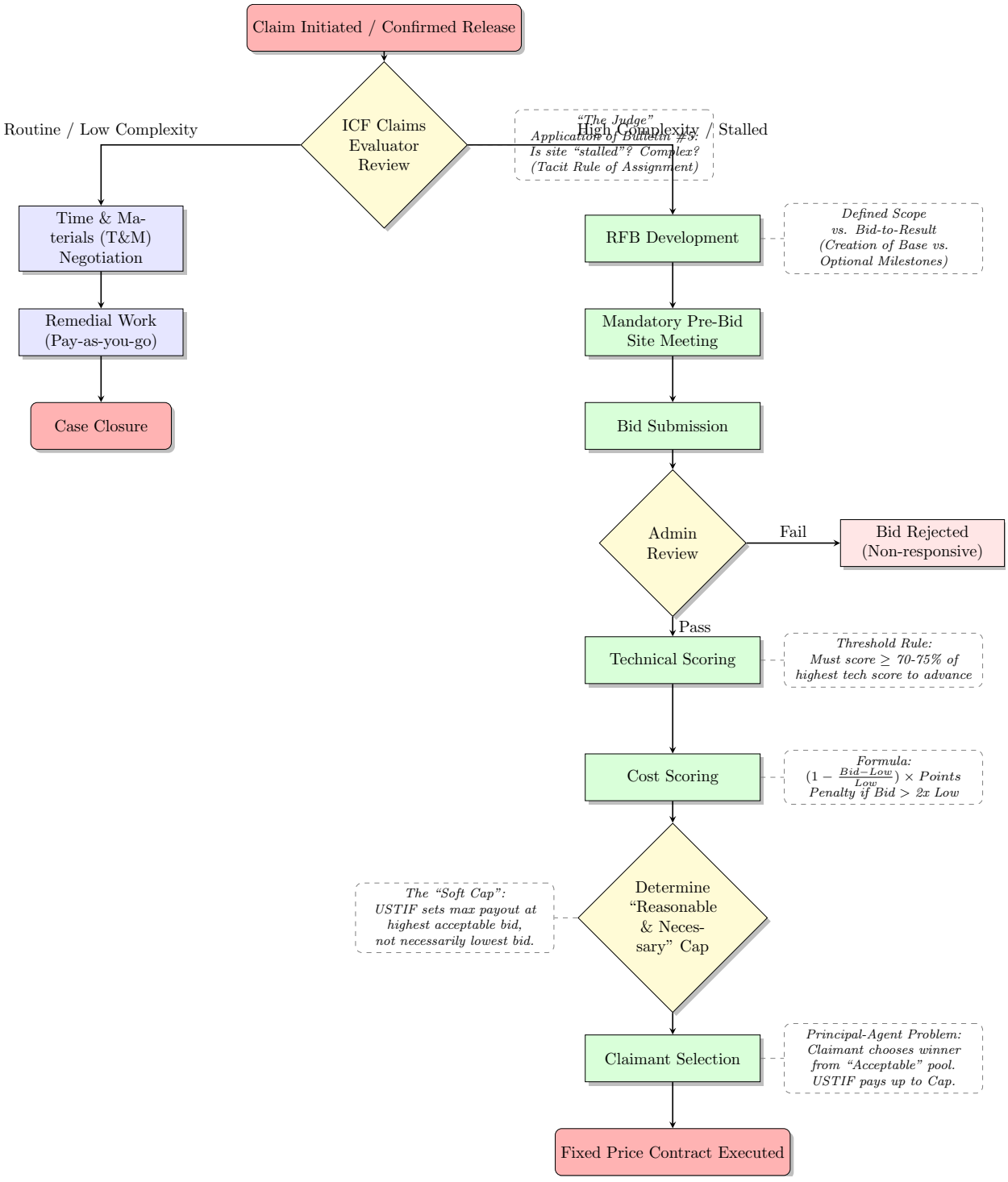

Figure 19: USTIF Claims Assignment and Auction Mechanism

Deductible Scale (25 Pa. Code §245.707):

Tanks	Deductible
1-6	$5,000
7-12	$10,000
13-18	$15,000
19-24	$20,000
25-30	$25,000