American Radiolabeled
Chemicals, Inc.

101 ARC Drive
Saint Louis, MO 63146 USA
Phone: 314-991-4545 or 800-331-6661
Fax: 314-991-4692 or 800-999-9925
Web: http://www.arc-inc.com
Email: arcinc@arc-inc.com

3 August 2009

U.S. Nuclear Regulatory Commission, Region III
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4351

LICENSE No: 24-21362-01

CONTROL No 398219

SUBJECT: Amendment request to make a Site Characterization Survey a License Requirement

Gentlemen:

American Radiolabeled Chemicals, Inc (ARC) requests that our By-product Material License be amended to require a Site Characterization Survey.

The attached information is the result of a MARSSIM based study of the Planning phase and the Implementation Phase of the Data Life Cycle.

As can be seen from the attached information, the final sample plan was formulated using the NRC approved Visual Sample Plan (VSP) software.

In addition to the printed version of this information, we are enclosing a compact disk containing all of the files making up the document as well as all files used as input and out put for VSP.

If you have any questions or require clarification on any of the information stated above, you may contact Regis A. Greenwood, CHP at 314-991-4545.

Sincerely

AMERICAN RADIOLABELLED CHEMICALS, INC

Surendra K. Gupta, PhD
President

ATTACHMENT

1. Information Supporting Request for License Amendment.
2. Files for the above and for VSP (Compact Disk)

Information Supporting Request for License Amendment

Submitted 3 August 2009

Executive Summary

American Radiolabeled Chemicals, Inc. (ARC) headquartered at 101 ARC Drive, St. Louis, MO is planning to perform a characterization survey of the surface soil of the campus. The ARC facility is an approximately 4 acre facility engaged in the production and distribution of radiolabeled chemicals and compounds. The ARC facility consists of four buildings. Building 100 is principally used for producing ^{3}H and ^{14}C labeled chemicals. Building 200 is used for processing and storing waste resulting from facility operations. Building 300 is used for receiving radioactive material for incorporation into radiolabeled compounds and for receiving sealed unit packages of radiolabeled compounds for distribution to end users. Building 300 also includes labs for labeled compound production and an area for shipping finished products. Building 400 is a new 18,000ft^2 building that is not licensed. The ARC campus is located in an industrial park adjacent to other commercial properties. A site map is included as Appendix A.

The goal of the survey is to characterize the site to allow for future planning.

Radioactive materials used at the facility include a variety of radionuclides used in biomedical research. ARC does not produce any compounds for human use. The company commenced radiological operations in 1980 and has been licensed by the Nuclear Regulatory Commission (NRC) since. In 1983 ARC moved its operations to the present location. Active production operations involving radioactive materials are ongoing. Based on an analysis of the radioactive materials used, including the physical forms, their half-lives and the quantities used, ^{3}H and ^{14}C are the isotopes of concern.

This plan was developed using the guidance provided in NUREG 1727, "NMSS Decommissioning Standard Review Plan" and NUREG 1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)

Isotopes of Concern

Radionuclide	License Termination Criteria	Default Screening Value	
^{14}C	25 mRem/y	12 pCi/g	
^{3}H		110 pCi/g	

Upon approval of this survey plan, ARC will contract Teledyne-Brown Laboratory to analyze the samples.

The survey plan was developed using VSP and the results will be reported using COMPASS

1.0 Historical Site Assessment

The present facility was originally licensed in 1983 and began using radioactive material at that time. The quantities of ^{3}H and ^{14}C used at the facility have increased over time. Other radionuclides were added to the license over time.

1.1 License History

The facility currently operates under NRC License Number 24-21362-01, Amendment 39 with an expiration date of July 31, 2009. The license is presently under timely renewal. This license authorizes the possession and use of 12,000 Ci of ^{3}H and 400 Ci of ^{14}C. Lesser quantities of other radionuclides are also authorized. Current license limits of all nuclides are presented in Table 1.1.

Table 1.1 ARC Current Possession Limits

Isotope	License Limit (Ci)	Form	Half-life
^{14}C	400	Any	5600 y
^{45}Ca	1	Any	165 d
^{36}Cl	0.3	Any	3E5 y
^{51}Cr	0.1	Any	28 d
^{3}H	12,000	Any	12.2 y
^{125}I	1.5	Any	60 d
^{131}I	0.1	Any	8 d
^{32}P	1	Any	14.5 d
^{33}P	1	Any	25 d
^{35}S	10	Any	88 d
Byproduct Matl..	All Above	Waste	---
^{59}Fe	0.1	Prepackaged Units	
^{85}Sr	0.1	Prepackaged Units	
Co-60	0.1	Prepackaged Units	
Fe-55	0.1	Prepackaged Units	

The license was originally granted in 1980 for ARC's operations conducted in downtown St. Louis. In 1983 operations were transferred from the downtown facility to the current location. The license has been periodically amended to add additional radionuclides and to adjust individual nuclide possession limits. A history of license over the past 15 years is included in Appendix B.

1.2 Previous Decommissioning Activities

Prior to 1983 the water supply was a groundwater well; sewage was treated through a septic field. These were abandoned and city water and sewer were brought in. This changeover was made prior any use of radioactive material The septic field was never used for radioactive material disposal.

The old Building 400 was decommissioned in 2001 and removed from the license in 2002. It was subsequently demolished with non-licensed Buildings 500 and 600. A new office building (Building 400) was constructed on that site and is home to ARC managerial and administrative functions.

2.0 Facility Description

2.1 Site Description

The ARC facility, located on ARC Drive in Maryland Heights, MO is an approximately 4 acre facility located approximately 12 miles WNW of downtown St. Louis. It is located approximately 1 mile east of exit 16 of I-270.

2.1.1 Building 100 – Production Facility

This facility is approximately 3,200 square feet with approximately 2,900 square feet dedicated to laboratory space. The balance of the floor space is used for a foyer/entry, a lunchroom, and a bathroom. The building contains a security alarm system and is equipped with a sprinkler system for fire suppression.

2.1.2 200 – Waste Handling Facility

This building is approximately 1500 square feet with approximately 600 square feet dedicated to storage of DAW and SCO. 250 square feet is devoted to liquid waste processing (designed with a fire rating and ventilation).. Approximately 650 square feet is designed as a decontamination facility. This building is equipped with security and fire alarms. This building is connected to Building 100 and is completely sprinklered.

2.1.3 Building 300 - Office, Laboratory and Shipping Facility

This building is approximately 5,800 square feet with approximately 3,000 ft^2 dedicated to laboratory space. The remaining 2,800 ft^2 is divided among office space, shipping, lunchroom, and storage.

An annex has been constructed to increase the laboratory space by approximately 3000 square feet. This addition is not yet licensed for RAM use.

2.2 Building Systems

2.2.1 General Ventilation

The general ventilation system consists primarily of filtered ventilation providing supply air to the general laboratory spaces. The laboratory spaces are maintained under negative pressure by exhaust ventilation drawn through the laboratory hoods. This creates airflow from general

lab spaces into the laboratory hoods. Ventilation is balanced to maintain flow rates of at least 100 linear fpm at the face of the laboratory hoods.

Air conditioning is supplied by individual window air conditioners and central air conditioning units. Heating is provided by a central furnace system.

2.2.2 Fume Hood Ventilation

Fume hood exhaust ventilation is the primary means of building exhaust and pressure control for the laboratory. Fume hoods for each building (100/200 and 300) have their exhaust ducts trunked together to a single high velocity fan for each building. Several of the fume hood ventilation systems are equipped with HEPA filter housings. The requirement for HEPA filters was removed by license amendment in 1999.

2.2.3 Vacuum Systems

The building does not contain a central vacuum system. Individual vacuum pumps are provided at each fume hood where a vacuum is necessary to support research and production activities.

2.2.4 Drain System

Fixture drains for the areas outside the laboratories are connected to the sanitary sewer system, for example one sink in the kitchen area, one hand basin in the restroom, one restroom commode, one hand sink in the personnel access alcove to the laboratory,
Inside the laboratories are industrial/hand sinks connected to hold-up tanks. These sinks are used by personnel for washing hands on egress from the laboratory and as the discharge point for waste liquids. The waste liquids in the hold-up tanks are sampled and analyzed prior to disposal through the sanitary sewer system.

3.0 Radiological Status of Facility

3.1 Overview

The radiological status of the surface soil within the bounds facility is to be determined by characterization surveys.

3.2 Accumulation of Activity Over Time

The facility has been in operation for twenty-six years at the present location. During this time, Radio active effluents have been discharged to the atmosphere. These discharges have been within all applicable limits and guidelines. Over this period, fall out from the plume(s); wash out of water soluble components due to weather could cause deposition on the adjacent soil surface and the roofs with subsequent wash down via the gutter and drain pipes to the surface soil.

It is to determine the amount and extent of this possible deposition that this characterization is being performed.

4.0 Determination of Derived Concentration Guideline Levels (DCGL)

NUREG 1727 states in part: "In light of the conservatism in the building surface and surface soil generic screening levels developed by the NRC staff, the staff presumes, absent information to the contrary, that licensees or responsible parties that remediate building surfaces or soil to the generic screening levels do not need to demonstrate that these levels are ALARA. "

For this reason ARC will use the default DCGLs found in NUREG 1727 Table C2.3

Table 4.1 Surface Soil Screening Levels

Nuclide	Symbol	Surface Soil Screening Value (pCi/g)
Hydrogen-3	H-3	110
Carbon-14	C-14	12

These values represent surficial soil concentrations of individual radionuclides hat would be deemed in compliance with the 25 mrem/y (0.25 mSv/y) unrestricted release dose limit in 10CFR20.1402. For radionuclides in a mixture, the "sum of fractions" rule applies; see Part 20, App B, Note 4.

5.0 Determination of Gross DCGL for Multiple Nuclides

As ARC proposes to contract the sample analysis to a laboratory capable of performing individual analyses for the two nuclides, no Gross DCGL is required.

6.0 Determination of Adjusted DCGL for Surrogate Nuclides

As ARC proposes to contract the sample analysis to a laboratory capable of performing individual analyses for the two nuclides, no adjustment for surrogate nuclides is required.

7.0 Determination of Estimated Maximum Concentration DCGL ($DCGL_{EMC}$)

As this survey will be the first detailed survey of the site, little knowledge of potential hot spots is in hand. Part of the one known spill, on the driveway surface, would have washed down due to melting snow to the low spot of the site. This area is approximately 3 meters by 3 meters. Using table 8.1 of NUREG 1505, Example Outdoor Area Factors, yields an AF of 65.7 for C-14 and 16.4 for H-3..
Using the methodology of NUREG 1505 Chapter 8:

$DCGL_{EMC} = DCGL_W$ x AF, or
$DCGL_{EMC}$ = 110 pCi/g x 16.4 = 1804 pCi/g for Tritium; and

$DCGL_{EMC}$ = 12 pCi x 65.7 = 788.4 pCi/g for Carbon 14.

8.0 Classification of the Site According to Contamination Potential

8.1 The site will be divided into survey units. Of these, only the unit with the known spill has the potential for individual measurements significant ly above the DCGL, and are therefore Class 1.

8.2 The remaining survey units, due to the stack effluents over 25 years, have a potential for contamination at a significant fraction of the DCGL. These areas will be classified as Class 2

9.0 Establishment of Survey Units

9.1 The site has been divided into 10 areas of similar contamination potential. These areas are the survey units According to MARSSIM 4.6, the maximum recommended area of a survey unit for outdoor land area is 2000 m^2 for Class 1 areas, and 10,000 m^2 for class 2 areas. A map showing the survey units will be found as Appendix C.

9.2 All of the areas designated as Survey Units for the ARC site are less than 2000 m^2.

Table 9.2 Area of Survey Units

Unit ID	*Area, m^2*
1	1082
2	1732
3	247
4	1075
5	277
6	550
7	428
8	933
9	401
10	530
Total	7256

10.0 Establishment of Scenario

Scenario A is the only approach employed in MARSSIM for final status surveys.
The object is to demonstrate that the mean/median level of residual radioactivity in a survey unit is less than the DCGL.

11.0 Unity Rule Used

The unity rule is used as there are two nuclides in each soil sample

$$\text{Combined Concentration} = 1 = \frac{\text{Conc H-3}}{DCGL_{H-3}} + \frac{\text{Conc C-14}}{DCGL_{C-14}}$$

12.0 Selection of Detection Equipment

12.1 As the nuclides in question are H-3 and C-14 and the potential contamination is in soil with ground cover:

12.1.1 The emitted beta particles are of extreme low level;

12.1.2 The ground cover prevents any consistent scanning distance;

12.1.3 Scanning with a survey type detector is impractical and likely misleading

12.2 ARC will rely on surface soil sampling with analysis by a third party. The third party is Teledyne-Brown Engineering of Oak Ridge, TN.

12.3 Once permission is given to start sampling, ARC will contract with the third party for the analyses

13.0 Determination of Instrument Minimum Detectable Concentration

ARC will rely on the third party analysis laboratory for the MDC of the soil analyses.

14.0 Measurement Protocols

14.1 Class 1 Survey Units (only unit 3) samples collected in a systematic (triangular Pattern)

14.2 Class 2 Survey Units – all remaining Units, samples collected in a systematic (triangular Pattern)

15.0 Measurement Investigation Levels, Direct Scan

As ARC has shown (see 12.1 above) that a direct scan is impractical and may be misleading, scan investigation levels are not required.

16.0 Determination of the acceptability of Type I and Type II Errors

ARC suggests that the acceptable probability of both types of error be set at 0.05

17.0 Determination of Number of Sample Points

ARC is relying on the professional judgment of our Radiation Protection staff.

17.1 A minimum number was chosen for each Sample Unit based on the area of the Unit. At least one sample point for each 150 m^2.

17.2 For Unit 3, the only Class 1 unit, the minimum was set as above, and then increased by 50%.

17.3 For Unit 10, composed of isolated patches of soil, the minimum was set as above with the constraint that each "patch" have at least 1 sample.

17.4 The above information was entered into Visual Sample Plan and a systematic plan specified. The final result is shown in Table 17.4 below

Table 17.4 Sample Units

Sample Unit	*Area m^2*	*Number Of Samples initially specified*	*Number of Samples determined by VSP*
1	1082	7	8
2	1732	12	13
3	247	5	6
4	1075	7	8
5	277	2	3
6	550	4	4
7	428	3	5
8	933	6	6
9	401	3	6
10	530	5	5
Total	7256	54	64

18.0 Establish Reference Grid and locate sample points

Visual Sample plan was used with the following constraints: See Appendix D

19.0 Collect Soil Samples

Soil Samples will be collected in accordance with Section 8.1 of NUREG 1575 and the ORISE/IEAV Laboratory Procedures Manual. See Appendix E.

Actual samples will be taken only after approval of the amendment request by the NRC.

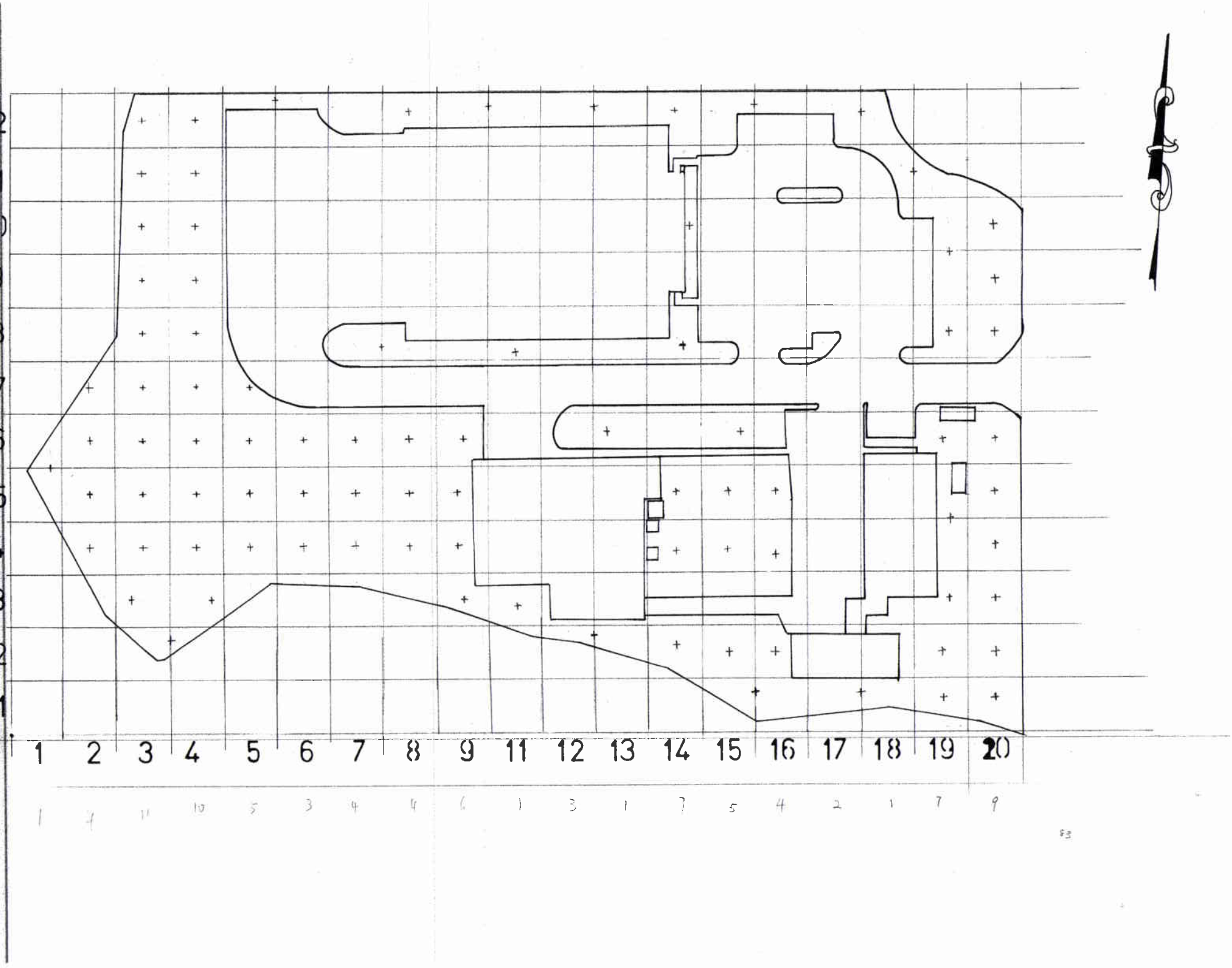
20.0 Assessment Phase

Performed after samples have been analyzed and data returned to ARC

21.0 Decision Making Phase

This phase is the responsibility of NRC Region III

APPENDIX A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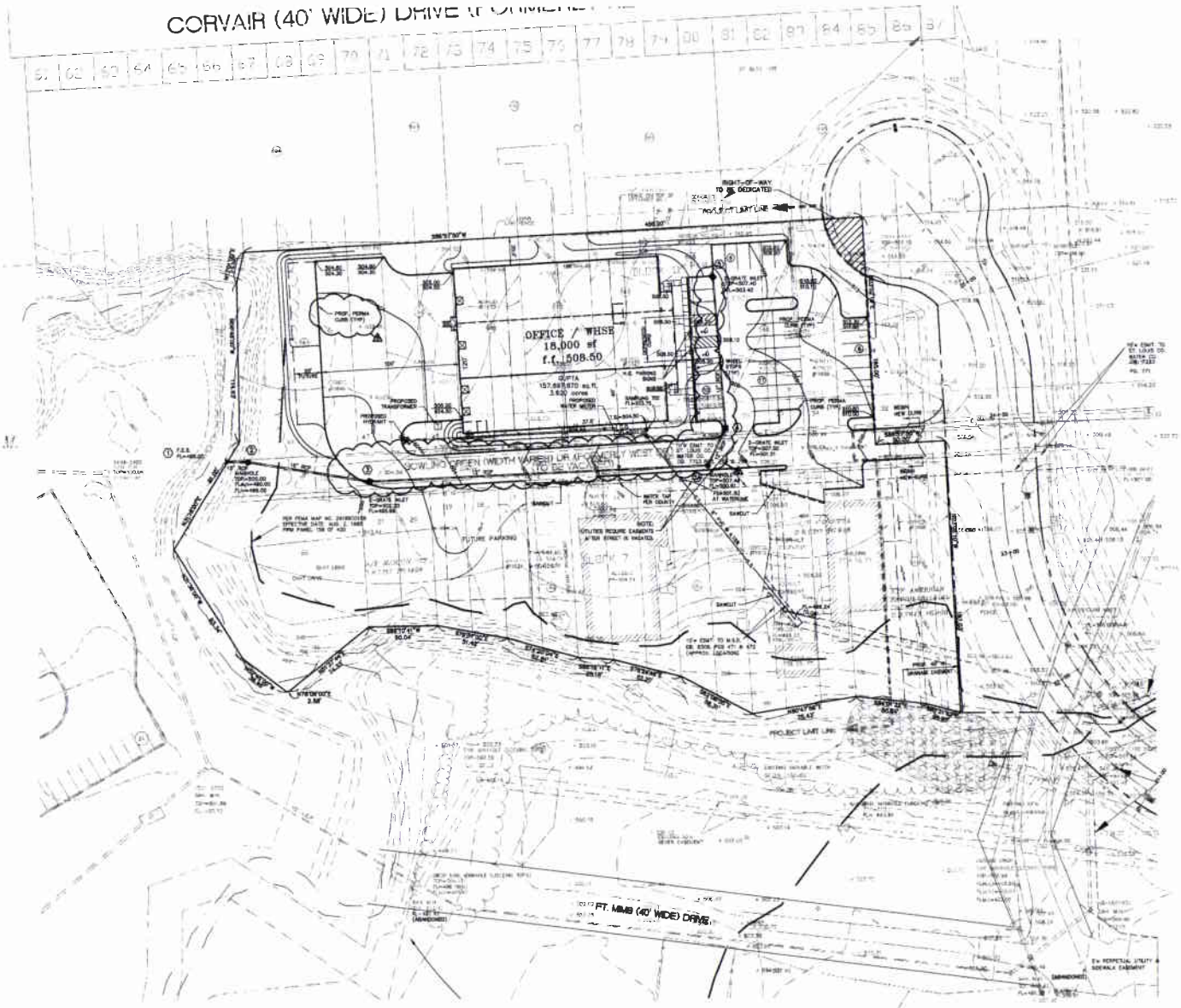


SITE & GRADING PLAN

M.S.D.-P No.: 24748
M.S.D. BASE MAP No.: 16-N

Duke REALTY CORPORATION
630 Maryville Centre Drive
Suite 205
St. Louis, MO 63141
Phone (314) 813-8000
Fax (314) 813-8057

Civil Engineer:
STOCK & ASSOCIATES CONSULTING ENGINEERS, INC.

SCOPE DOCUMENT

Revisions:
REVISED PER DWG 3/14/02
REVISED 4/29/02
REVISED PER M.S.D. 6/14/02
REVISED PER M.S.D. 8/14/02
REVISED PER OWNER 9/17/02
REVISED PER DWG 9/17/02

Scale: 1"=30'
Date: 10/08/02
Drawn By: K.S.K.
Checked By: G.S.S.

ARC, INC.

CITY OF MARYLAND HEIGHTS
MISSOURI 63146

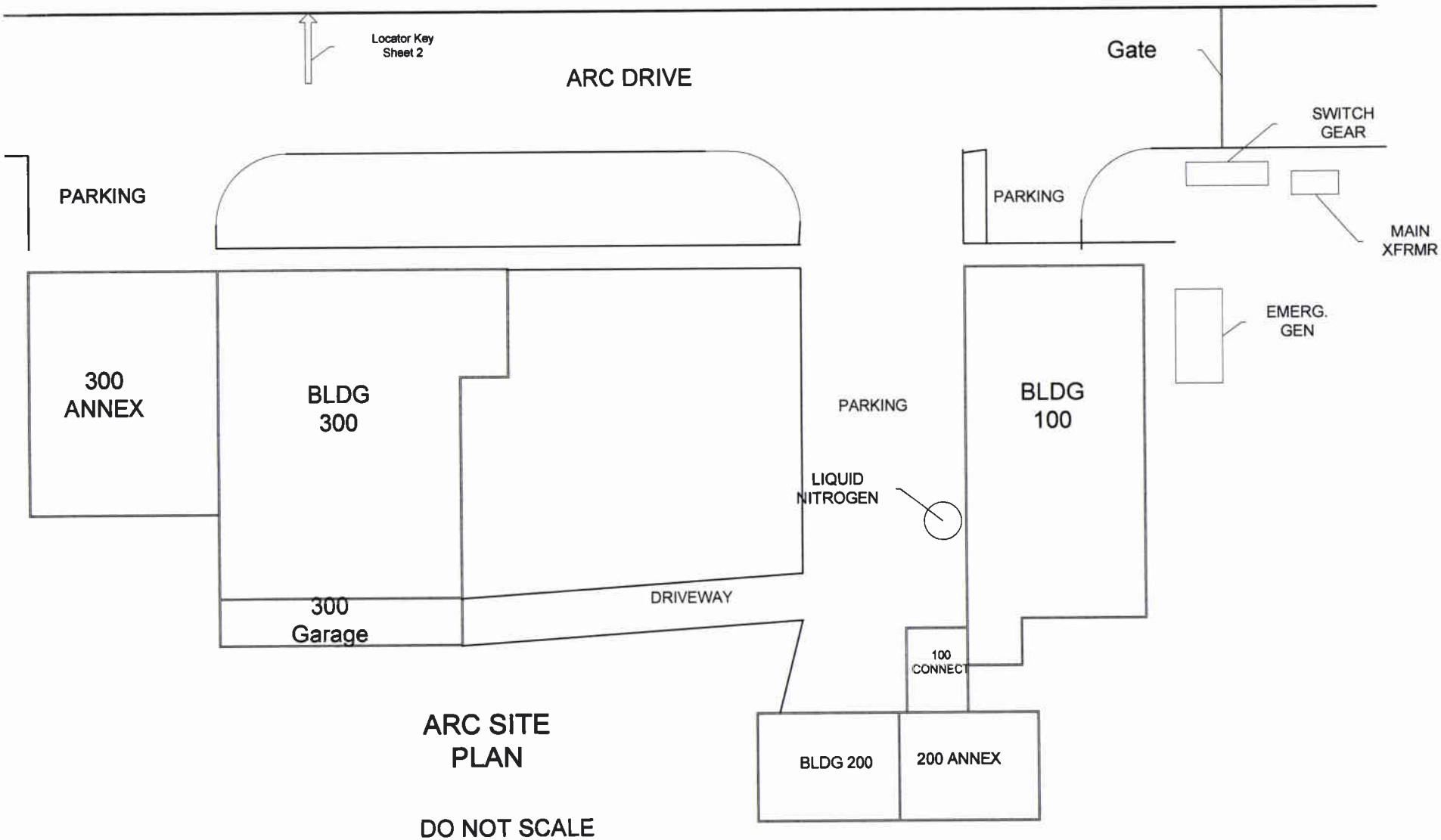
GEORGE A. STOCK E-28774

Drawing Number:
C-3
3 OF 7 Sheets

Duke Job Number:
—

A/E Job Number:
202-2727

sheet 1 -- see sheet 2 for Bldg 400



ARC SITE PLAN

DO NOT SCALE

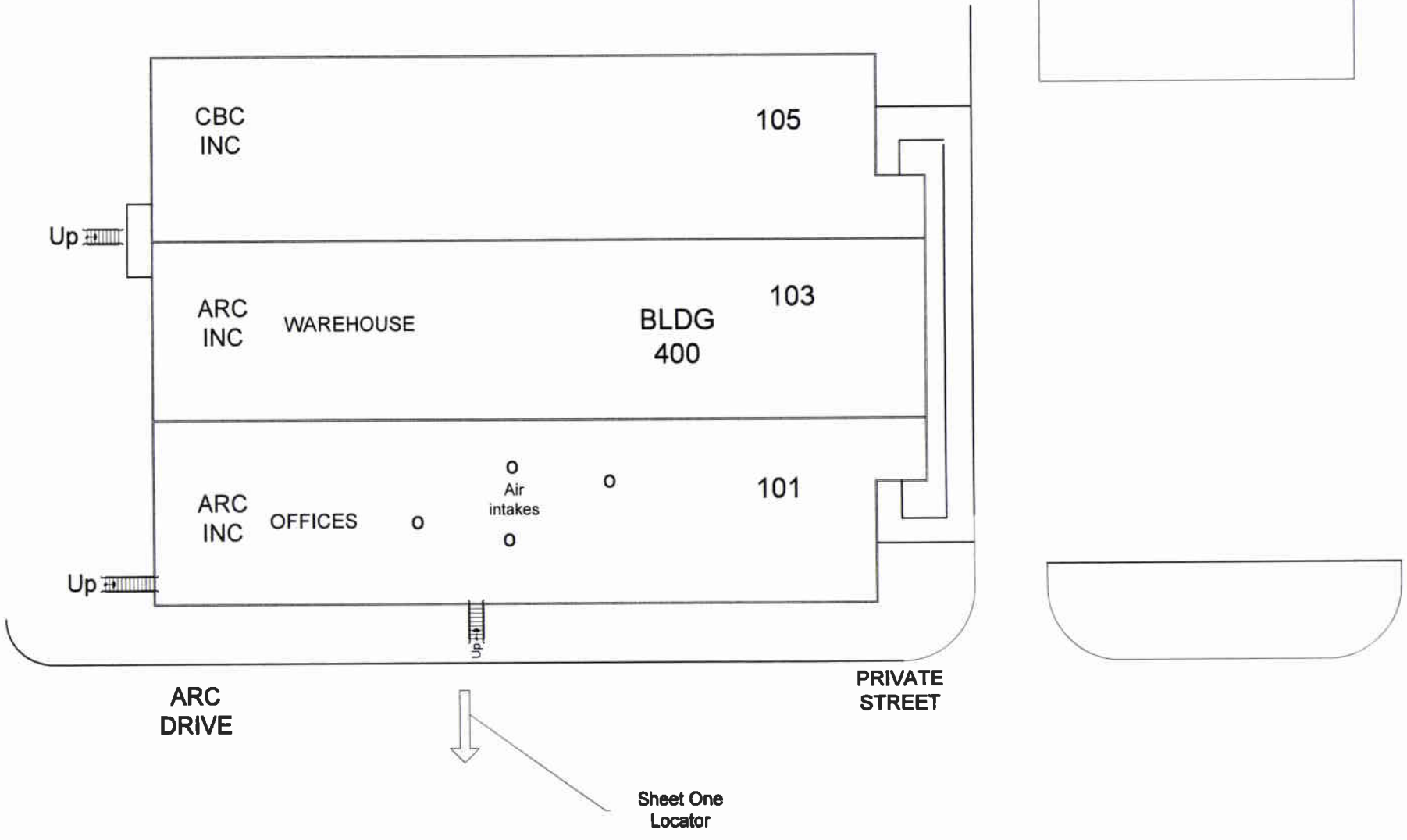
Approx. 1 in = 30 ft.

SITE PLAN

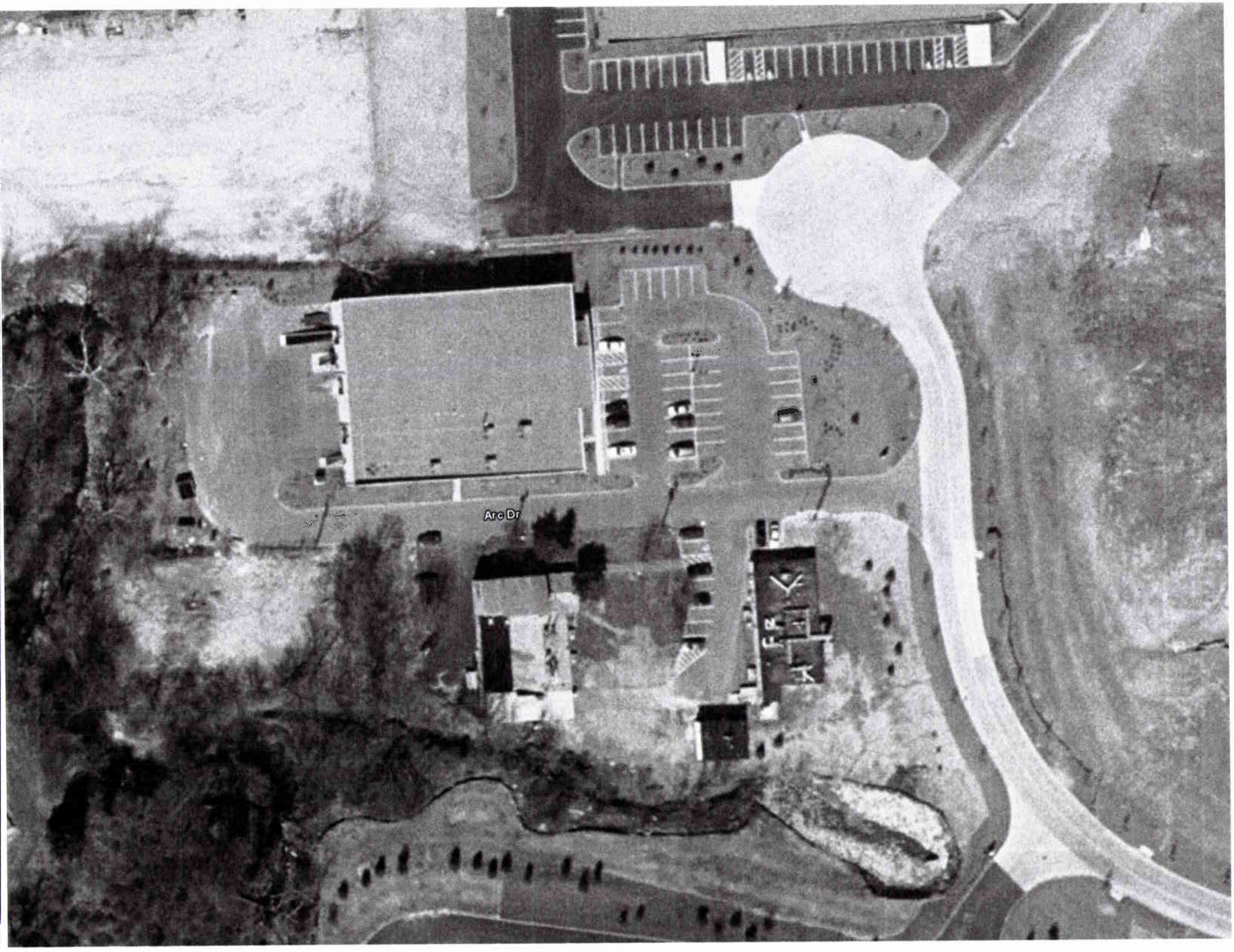
SHEET TWO

DO NOT SCALE

1 in. = approx 30 ft.




Arc Dr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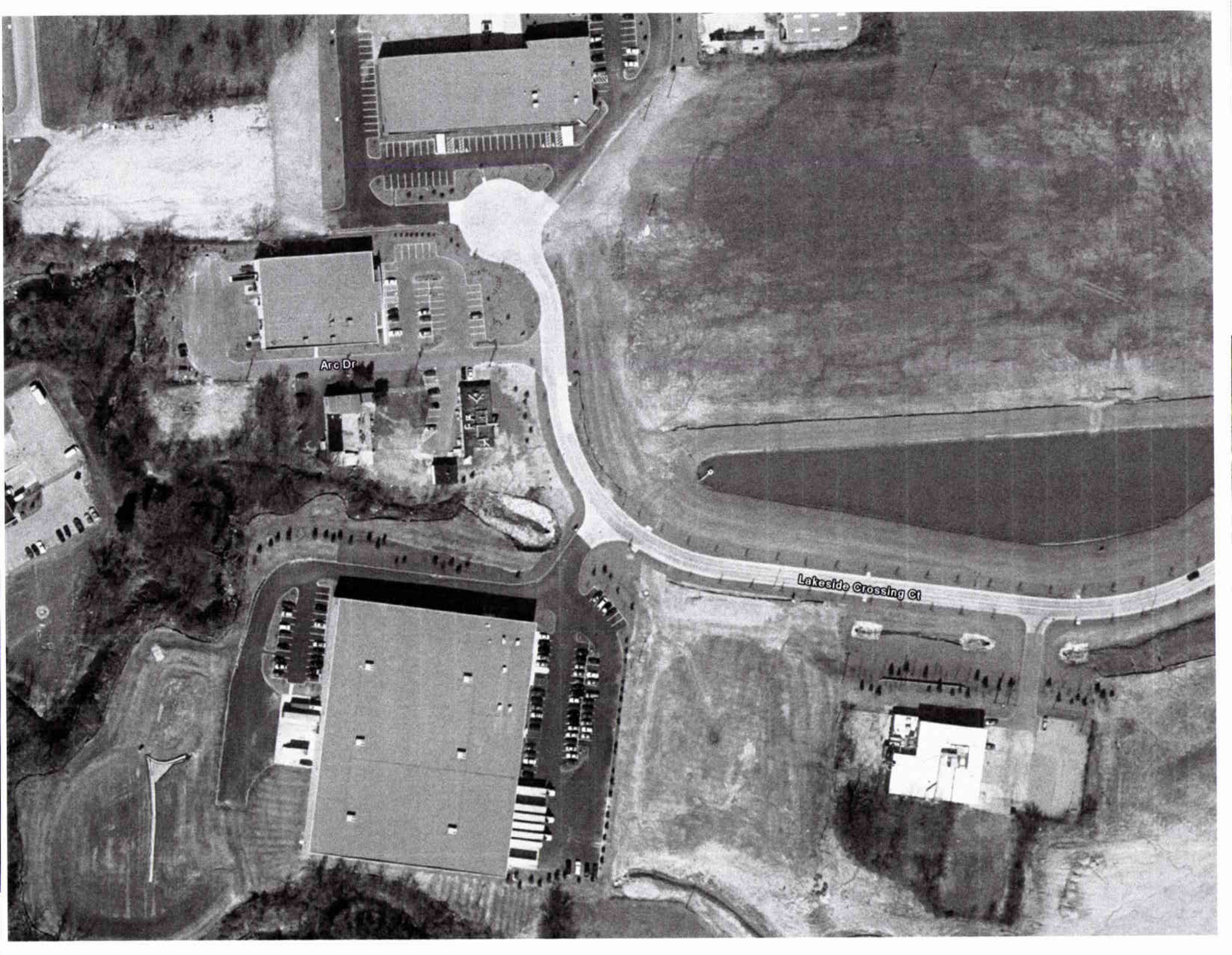
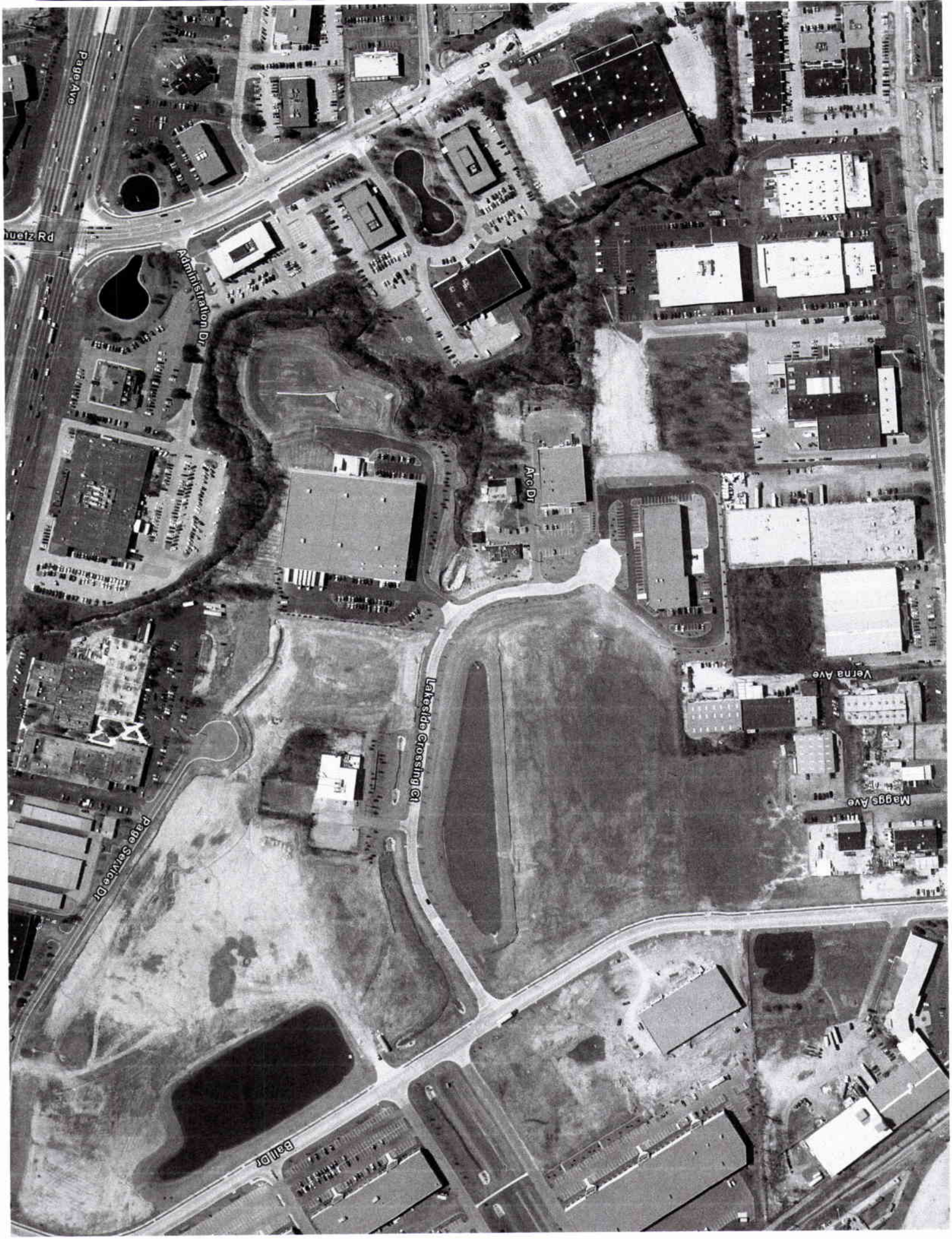

Arc Dr
Lakeside Crossing Ct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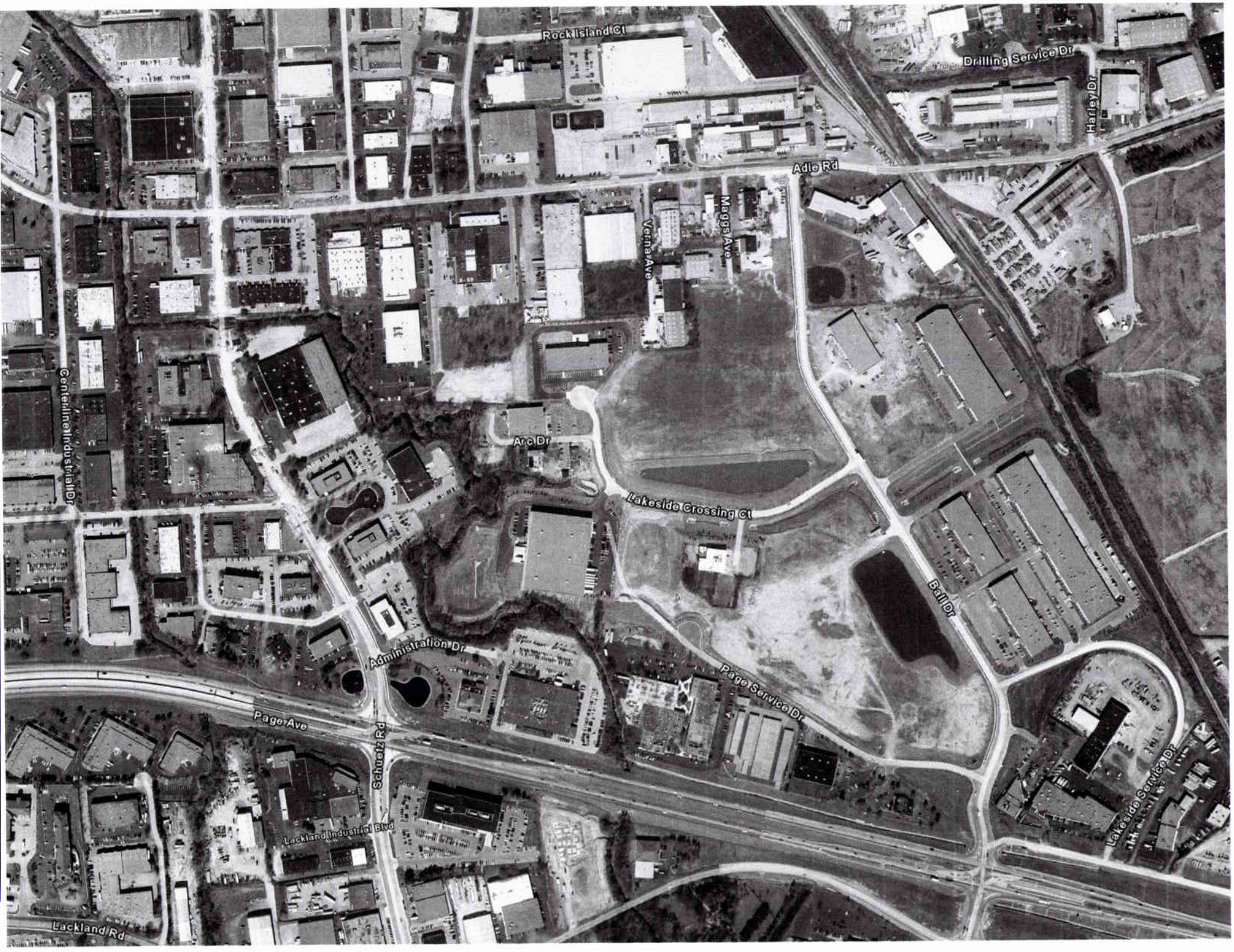
Administration Dr
Arc Dr
Lakeside Crossing Ct
Verna Ave
Maggs Ave
Page Service Dr
Ball Dr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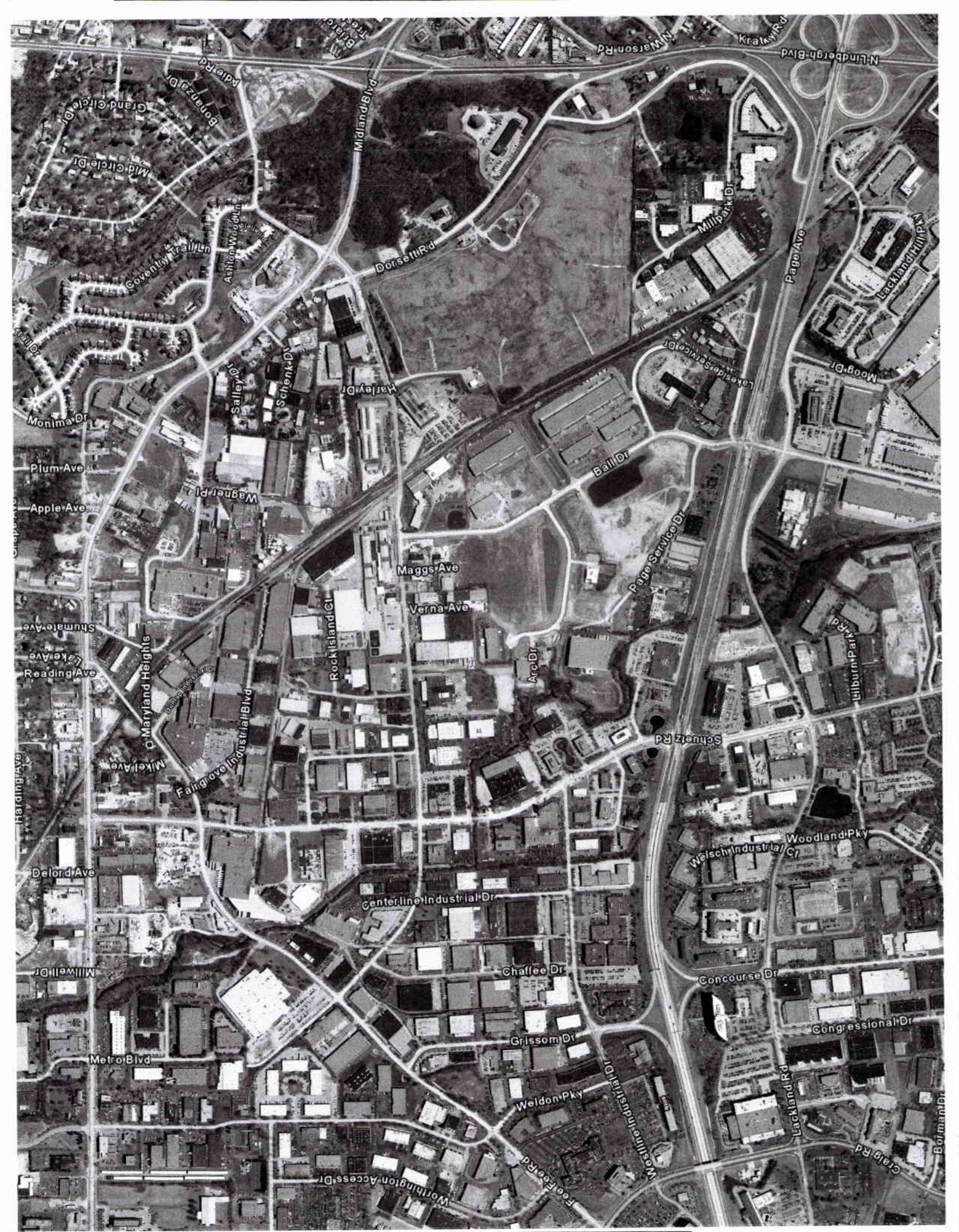
Drilling Service Dr
Harley Dr
Adie Rd
Maggs Ave
Verna Ave
Centerline Industrial Dr
Arc Dr
Lakeside Crossing Ct
Ball Dr
Administration Dr
Page Service Dr
Page Ave
Schuetz Rd
Lackland Industrial Blvd
Lakeside Service Dr
Lackland Rd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Kratky Rd
N Lindbergh Blvd
Adie Rd
Bonanza Dr
Grand Circle Dr
Mid Circle Dr
Midland Blvd
Millpark Dr
Page Ave
Lackland Hill Pky
Coventry Trail Ln
Ashton Woods Ln
Dorsett Rd
Lakeside Service Dr
Moog Dr
Trail Dr
Salley Dr
Schenk Dr
Harley Dr
Monima Dr
Plum Ave
Apple Ave
Wagner Pl
Ball Dr
Page Service Dr
Maggs Ave
Verna Ave
Rockisland Ct
Arc Dr
Shumate Ave
Lake Ave
Reading Ave
Maryland Heights Expy
Fairgrove Industrial Blvd
Mikel Ave
Harding Ave
Delord Ave
Schuetz Rd
Lilburn Park Rd
Welsch Industrial Ct
Woodland Pky
Centerline Industrial Dr
Millwell Dr
Chaffee Dr
Concourse Dr
Congressional Dr
Grissom Dr
Metro Blvd
Weldon Pky
Westline Industrial Dr
Lackland Rd
Craig Rd
Borman Dr
Worthington Access Dr
Feeder Rd

APPENDIX B

This appendix contains a summary of licensing and regulatory actions and correspondence regarding the history of the ARC facility with respect to form and quantity of radionuclides authorized for use and possession. It also details the chronology and subject of license amendments as well as incidents involving the spread of radioactive materials.

Amendment 39

Corrects addresses of the Laboratory Buildings.
Eliminates RSC authority to change the facility.
Lists S.K.Gupta, Kamal Das and J Selvasekeran as authorized users for all nuclides on license.
Lists R.C.Speth as authorized user for items 6f, 6g and 6K thru 6N
Various changes to Paragraph 22, Material included by Reference.

Amendment 38

Editorial Changes
Deletes possession of Depleted Uranium.
Various changes to Paragraph 22, Material included by Reference.

Amendment 37

Adds various Letters to para 22 , Material included by reference.

Amendment 36

Increase possession limit for C-14 to 400 Curies
Increase Possession limit for H-3 to 12,000 Curies
Various changes to Paragraph 22, Material included by Reference.

Amendment 35

Added 2 kilograms of depleted Uranium to paragraph 6.
Various changes to Paragraph 22, Material included by Reference.

Amendment 34

Increase I-125 possession limit to 1.5 Curies.
Various changes to Paragraph 22, Material included by Reference.

Amendment 33

Various changes to Paragraph 22, Material included by Reference.

Amendment 32

Renewal of License

Amendment 31
RSO Change

Amendment 30
Changes Facility Address from Bowling Green Drive to ARC Drive.

Amendment 29 License Limits
(current)

Isotope	License Limit (Ci)	Form	Half-life	Emission Yield, Energy (kev)
C-14	300	Any	5600 y	1.0 B- 0.156max 0.045avg.
Ca-45	1	Any	165 d	1.0 B- 0.252max 0.075avg.
Cl-36	0.1	Any	3E5 y	.98 B- 0.714max
Cr-51	0.1	Any	28 d	EC No B Vxray 0.320 9%
H-3	7000	Any	12.2 y	1.0 B- 0.0186max 0.0057avg.
I-125	0.5	Any	60 d	EC No B
I-131	0.1	Any	8 d	1.0 B- 0.606max 0.19avg.
P-32	1	Any	14.5 d	1.0 B- 1.710max 0.690avg.
P-33	1	Any	25 d	1.0 B- 0.260max
S-35	1	Any	88 d	1.0 B- 0.167max 0.049a avg.
Byproduct Mat'l	All Above	Waste	---	----
Fe-59	0.1	Prepackaged Units		
Sr-85	0.1	Prepackaged Units		
Co-60	0.1	Prepackaged Units		
Fe-55	0.1	Prepackaged Units		

Amendment 28
Removes old Building 400 from License.

Amendment 27: January 30, 2002

Isotope	License Limit	Form
C-14	300	Any
Ca-45	1	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	0.5	Any
I-131	0.1	Any
P-32	1	Any
P-33	1	Any
S-35	1	Any
Byproduct Mat'l	All Above	Waste
Fe-59	0.1	Prepackaged Units
Sr-90	0.1	Prepackaged Units
Co-60	0.1	Prepackaged Units
Fe-55	0.1	Prepackaged Units

Grants request to remove HEPA filters from ventilation units.

ARC Letter to NRC November 15, 2001
Transmits COMPY code inputs for calculations.

ARC Amendment Request October 5, 2001
Request to increase possession limits to 600 Ci ^{14}C and 12,000 Ci ^{3}H.

ARC Letter to NRC September 17, 2001
Transmits results of COMPLY code runs for effluents.

Amendment 26: May 14, 2001
Acknowledges and incorporates ARC March 5, 2001 letter, excluding HEPA filters.

NRC NOV March 16, 2001
Identifies removable contamination of 1E6 to 6E6 dpm/100 cm^2 for ^{3}H and ^{14}C in restricted areas.

ARC Letter to NRC March 5, 2001
Request to remove HEPA filters.
Transmits COMPLY calculation results.

Amendment 25: February 22, 2001
Approves increase in contamination levels in restricted areas.

ARC Letter to NRC November 20, 2001
Request to increase contamination action levels in restricted areas.
Request to remove HEPA filter from ventilation units.

NRC NOV: March 14, 2000
Regards NRC Inspection November 29, 30 1999 concerning levels of contamination in building 100. Removable contamination throughout Building 100 and 300 ranging from 7E4 to over 1E6 dpm/100 cm^2.

Amendment 24: December 3, 1999
RSO change authorized

ARC Letter to NRC August 27, 1999
Response to NOV dated July 30, 1999 from inspection conducted May 24 through June 10, 1999.
Inspector identified 4,873,000 dpm/100 cm^2 ^3H and 341,000 dpm/100 cm^2 ^{14}C removable on floor near Bldg 100 compactor. He also identified 4500 dpm/100 cm^2 ^3H and 700 dpm/100 cm^2 ^{14}C removable on floor Building 300 unrestricted area. Note: wet wipes were used.

Amendment 23: April 21, 1999

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Byproduct Mat'l	All Above	Waste
Fe-59	0.1	Prepackaged Units
Sr-90	0.1	Prepackaged Units
Co-60	0.1	Prepackaged Units
Fe-55	0.1	Prepackaged Units

Refers to ARC letter dated March 31, 1999 excluding Decommissioning Plan for Building 400.

Amendment 22: February 24, 1999
RSO Change Approved.

Amendment 21: July 29, 1998
RSO Change Approved.

Amendment 20: April 16, 1998
RSO Change Approved.

Amendment 19: June 19, 1997

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Byproduct Mat'l	All Above	Waste
Fe-59	0.1	Prepackaged Units
Sr-90	0.1	Prepackaged Units

RSO Change

Amendment 18: June 19, 1997

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Byproduct Mat'l	All Above	Waste
Fe-59	0.1	Prepackaged Units
Sr-90	0.1	Prepackaged Units

RSO Change.

ARC Letter to NRC May 12, 1997

Response to NOV. Notes that an individual installed and operated a second, unauthorized waste compactor. Compactor was not attached to ventilation system.

NRC NOV: April 17, 1997

Removable ^{14}C on loading dock of 1E6 dpm/100 cm^2.
Training issue with respect to compactor located in Bldg. 100.

Amendment 17: March 5, 1997

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Byproduct Mat'l	All Above	Waste
Fe-59	0.1	Prepackaged Units
Sr-90	0.1	Prepackaged Units

Deletes Third Party Audits of former Condition 17/18.

NRC Letter to ARC December 27, 1996
RAI regarding high temperature bake out of glassware.

ARC Letter to NRC November 21, 1996
Provides additional information requested in NRC RAI of November 13, 1996

Amendment 16: November 13, 1996
RSO Change

NRC Letter to ARC October 15, 1996
RAI regard August 10, 1996 ARC letter.

NRC Letter to ARC September 12, 1996
Provides a preliminary copy of ORISE Bldg. 400 survey (report not finalized due to withdrawal of decommissioning plan and presence of contamination)

ARC Letter to NRC July 10, 1996
Withdrawals decommissioning notification for Bldg. 400; would like it left on the license.
Requests a copy of ORISE Confirmatory survey.

NRC Letter to ARC May 7, 1996

One time license extension.

ARC Letter to NRC March 30, 1996
Decommissioning Plan for Building 400. ^{3}H / ^{14}C 5,000 dpm/100 cm^2 Average, 15,000 dpm/100 cm^2 max, and 1,000 dpm.100 cm^2 removable.

ARC Letter to NRC March 5, 1996
Response to NOV. Bldg 400 put on survey program.

NRC NOV: February 6, 1996
High contamination levels in restricted areas. Old Building 400 not on routine survey program. Contaminated items found in dumpster.

Amendment 15: January 26, 1996

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Byproduct Mat'l	All Above	Waste
Fe-59	0.1	Prepackaged Units
Sr-90	0.1	Prepackaged Units

ARC Letter to NRC November 10, 1995
Response to NRC RAI of October 13, 1995. Withdraws request to add 11613 and 11623 Bowling Green to the license.

NRC Letter to ARC October 13, 1995
RAI regarding change to RPP in March 6, 1995 letter
Denial of April 25, 1995 amendment request to add 11613 and 11623 Bowling Green to the license for interim storage.
RAI regarding April 10, 1995 request to distribute another company's product.

NRC NOV July 28, 1995
C-14 spill inspection and concern about leaching radioactivity form floor tile.

June 8, 1995 ARC Letter

Regarding Spill/Personnel Contamination

Chemist dropped test tube containing 75 mCi C-14 in nitrobenzene/ether.

Amendment 14: May 23, 1995

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Byproduct Mat'l	All Above	Waste

Contains reference to waste compactor being limited to 2 Ci per compaction operation.
Licensee to monitor exhaust air from the waste compactor at the point of release to unrestricted areas.
License also refers to May 11, 1994 letter regarding reduction in liquid effluent discharges.

NRC Letter: May 4, 1995

Recommendation to replace all floor tile in Bldg 100 due to chronic contamination in Building 100.

Revised Amendment Request April 25, 1995

Request to increase ^{3}H limit.
Request to add Fe-59 and Sr-90 to license.

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5.0	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	7,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Fe-59	0.1	Any
Sr-90	0.1	Any

Also adds 11613 Bowling Green and 11623 Bowling Green to the license.
(Note: Bldg 300 is 11624 Bowling Green Dr. and Bldg 100/200 are 11612 Bowling Green)

Amendment Request March 28, 1995
Request to increase Tritium Limit to 7,000 Ci.

Amendment Request March 6, 1995
Change RSO, reorganize radiation safety organization.

Amendment 13: September 1, 1994

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5.0	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	5,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any
Above Byproduct Material	Solid Waste	Per 7/26/94 letter

Added extended interim waste storage per July 26, 1994 letter.

ARC Letter to NRC August 26, 1994
Revised drawing for Bldg 200 extended interim waste storage.

Amendment Request August 12, 1994
Request to use washer-dryer for laundry.

Amendment Request July 26, 1994
Request to allow extended interim storage of LLRW in Bldg 200.

Amendment 12: July 18, 1994

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5.0	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	5,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any

Authorizes use of oven cleaning system per May 11, 1994 request.

Requests expedited consideration of glassware washing (baking) system. Consists of conventional self-cleaning oven/range set on "self-clean".

MSD Letter to ARC June 14, 1994
Letter grants interim authority to continue discharges through July 1994.

MSD Letter to ARC June 7, 1994
Denies ARC's request March 29, 1994 request to continue to discharge 1 Ci C-14 and 5 Ci ^{3}H annually.

NRC NOV May 20, 1994
NOV refers in part to spread of contamination in unrestricted areas.

ARC Letter to NRC May 11, 1994
Discusses glassware cleaning process relative to Metropolitan Sewer District restricting releases to 1 Ci/y from all licensees.

Amendment 11: April 21, 1994

Isotope	License Limit	Form
C-14	300	Any
Ca-45	5.0	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	5,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any

Authorizes waste storage up to 3 years.
Does not authorize possession or use of Na-22 since this not byproduct material (accelerator produced). RAM to be used at 11612, 11624, 11633 Bowling Green Dr.

NRC NOV January 20, 1994
Contamination identified on Bldg. 100 loading dock of 23K dpm/100 cm^2.
Also identifies chronic contamination in Building 100.

ARC Letter to US NRC January 19, 1994
Requests increase in ^{3}H to 300 Ci.
Also transmits Decommissioning Funding Plan dated 1/1/94.

ARC Letter to NRC December 7, 1993

Request for additional time to respond to November 30, 1993 NRC RAI. Also, withdrawals request for increased ^{3}H and ^{14}C limits.

NRC Letter to ARC November 30, 1993
RAI regarding ^{3}H trap, increased license limits, personnel change.

Amendment Request September 24, 1993
Add Na-22 0.1 Ci to license.

ARC Letter to NRC September 9, 1993
Identifies iodination to be conducted in a hood/glovebox w/ charcoal filters.
Identifies tritiation to be conducted in a hood.

Amendment 10: August 23, 1993

Isotope	License Limit	Form
C-14	100	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	5,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any

Location of use is 11612, 11624, 11633 Bowling Green Dr.

Amendment Request February 26, 1993

Isotope	License Limit	Form
C-14	1000	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	14,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any

Also refers to extended decay in storage program of 3y duration to allow for DIS of S-35.
Refers to storage in Buildings 200 and 400.
Also, delete license condition 17 and 18.

Amendment 9: November 12, 1992

Isotope	License Limit	Form
C-14	100	Any
Ca-45	5	Any
Cl-36	0.1	Any
Cr-51	0.1	Any
H-3	5,000	Any
I-125	1.0	Any
I-131	0.1	Any
P-32	10	Any
P-33	10	Any
S-35	20	Any

Adds P-33 to the license
Modification to license condition 17

ARC Amendment Request to NRC October 29, 1992
Requests revision to license application to add P-33 to license.

ARC Letters to NRC October 14, 1992
Sealed sources are not used (excluding quench sources)
Discussion of RSO's available hours

ARC Letter to NRC October 1, 1992
Withdrawals Broadscope A license request. Amendment request includes 11612, 11624, 11633 Bowling Green Drive as locations of use.

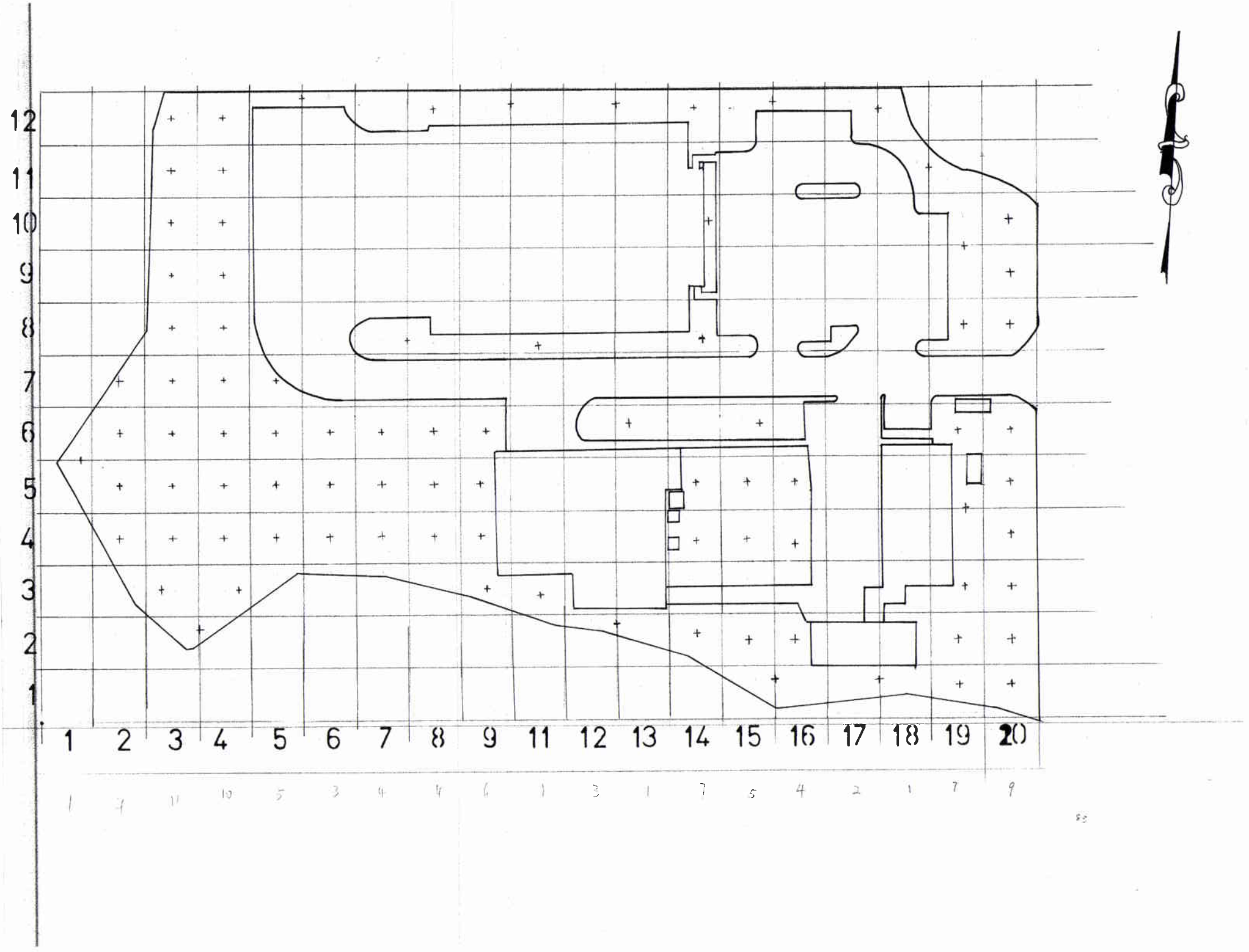
ARC to NRC: June 6, 1992
Radioactive Material License Renewal Application: requests Type A Broadscope authority.

Amendment 5: September 13, 1990
2 year license renewal.

August 1983 Radioactive Material License amended to reflect operations at the new facilities located on Bowling Green Drive.

1980 Original ARC facility licensed in downtown St. Louis.

APPENDIX C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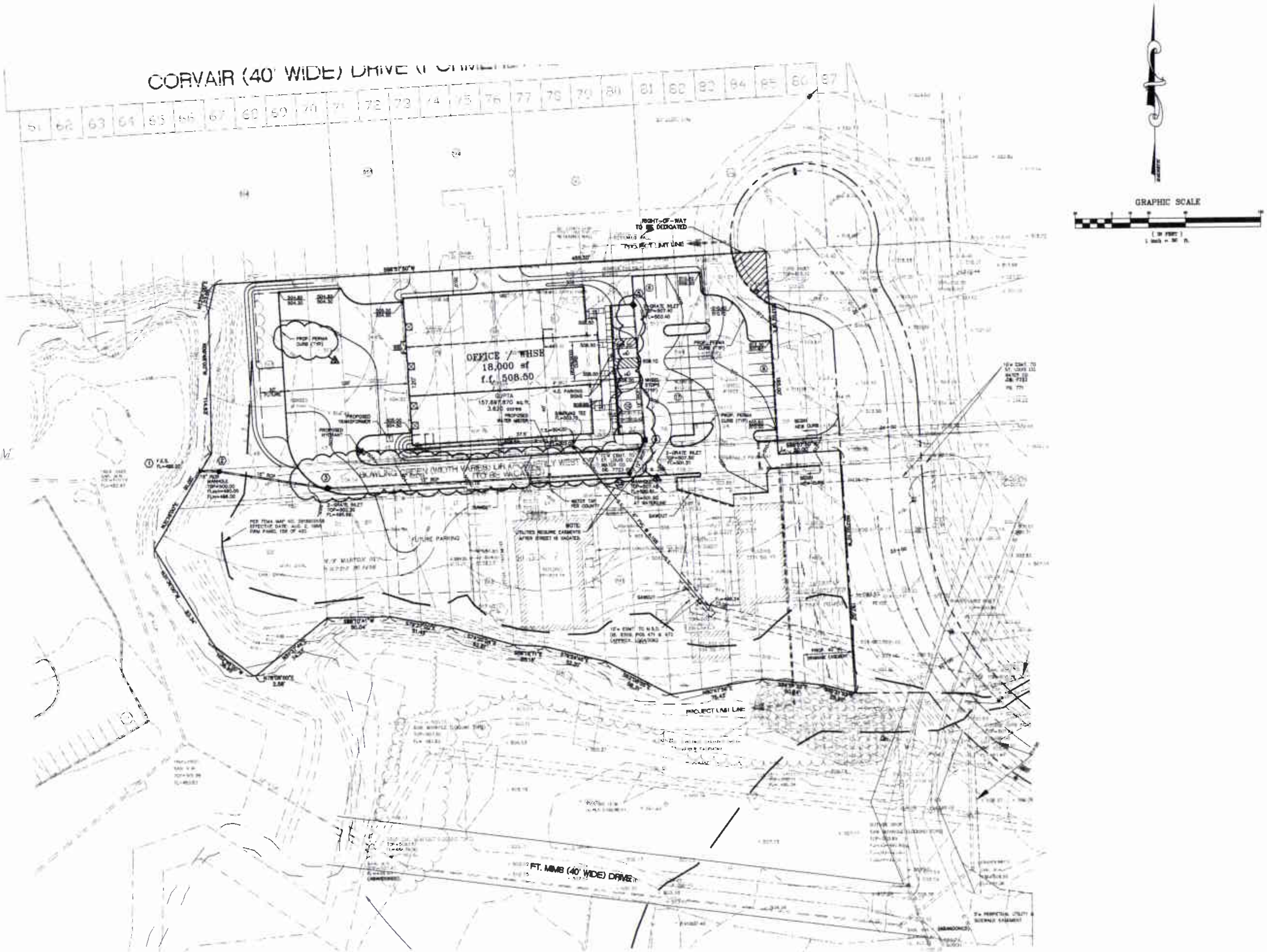


Duke Realty Corporation
St. Louis, MO 63141
Phone: (314) 212-8000
Fax: (314) 212-8297

Civil Engineer:
STOCK & ASSOCIATES CONSULTING ENGINEERS, INC.

SCOPE DOCUMENT

Revisions:
REVISED PER DUKE 3/14/02
ISSUANCE 4/29/02
REVISED PER M.S.D. 8/4/02
FINAL MSD REVISION 8/21/02
REVISED PER OWNER 8/27/02
REVISED PER DUKE 9/13/02

ARC, INC.

CITY OF MARYLAND HEIGHTS
MISSOURI 63146

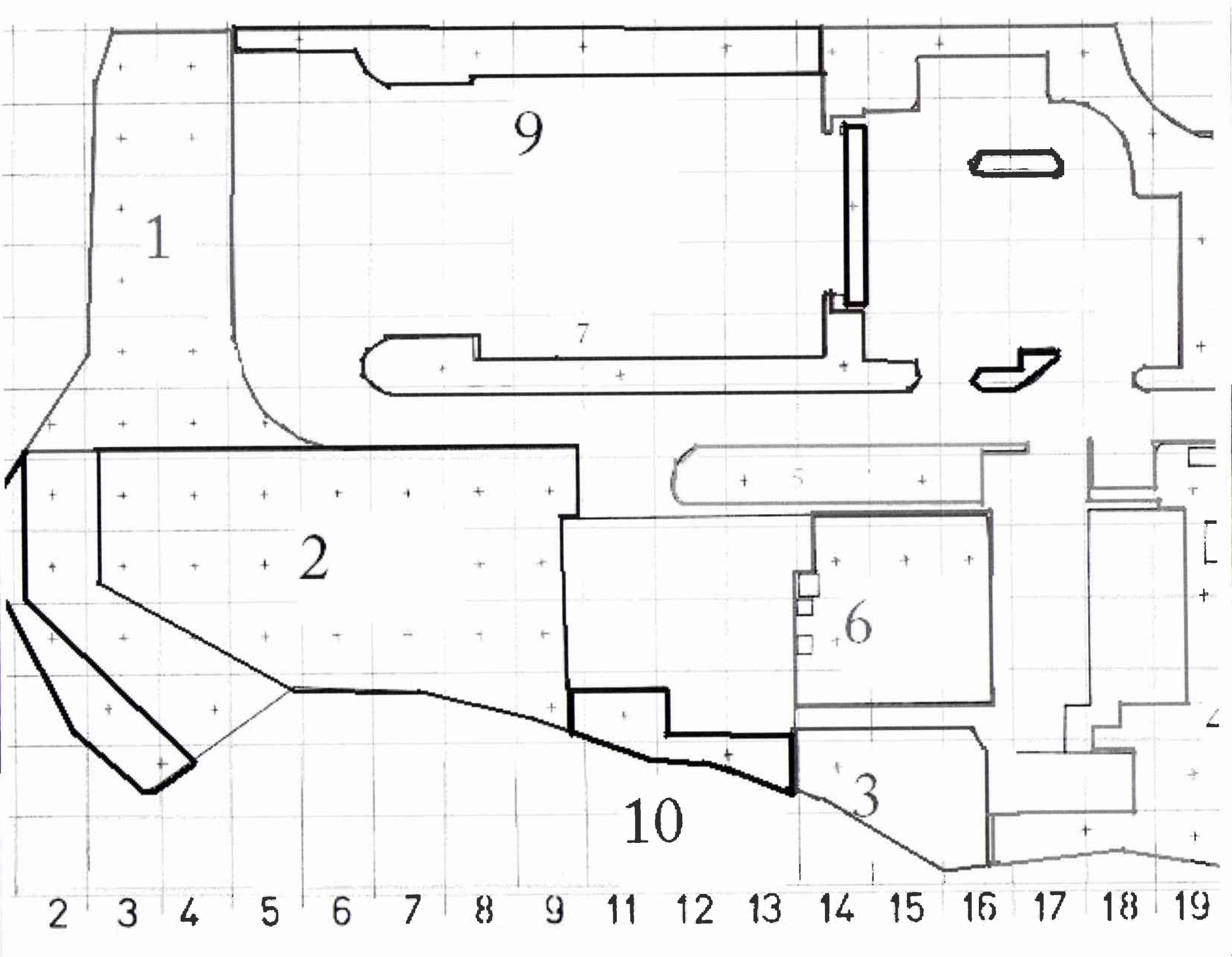
SITE & GRADING PLAN

M.S.D.-P No. 24749
M.S.D. BASE MAP No: 15-N

Drawing Number:
C-3
3 of 7 Sheets

Duke Job Number:
—

A/E Job Number:
202-2727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APPENDIX D

VSP Update For ARC
Date: 2009-08-01
By: Ning Zhang

1. Procedure:

   Open VSP → Open Project

   The projects for sectors are stored in: C:\ARC\Decommissionning Plan\Updated on 20090801

   For each opened project:

   (menu) Sample Goals → Estimate the Mean → Data Not Required to be normally Distributed → Stratified Sampling

2. Parameter setting for each sector:

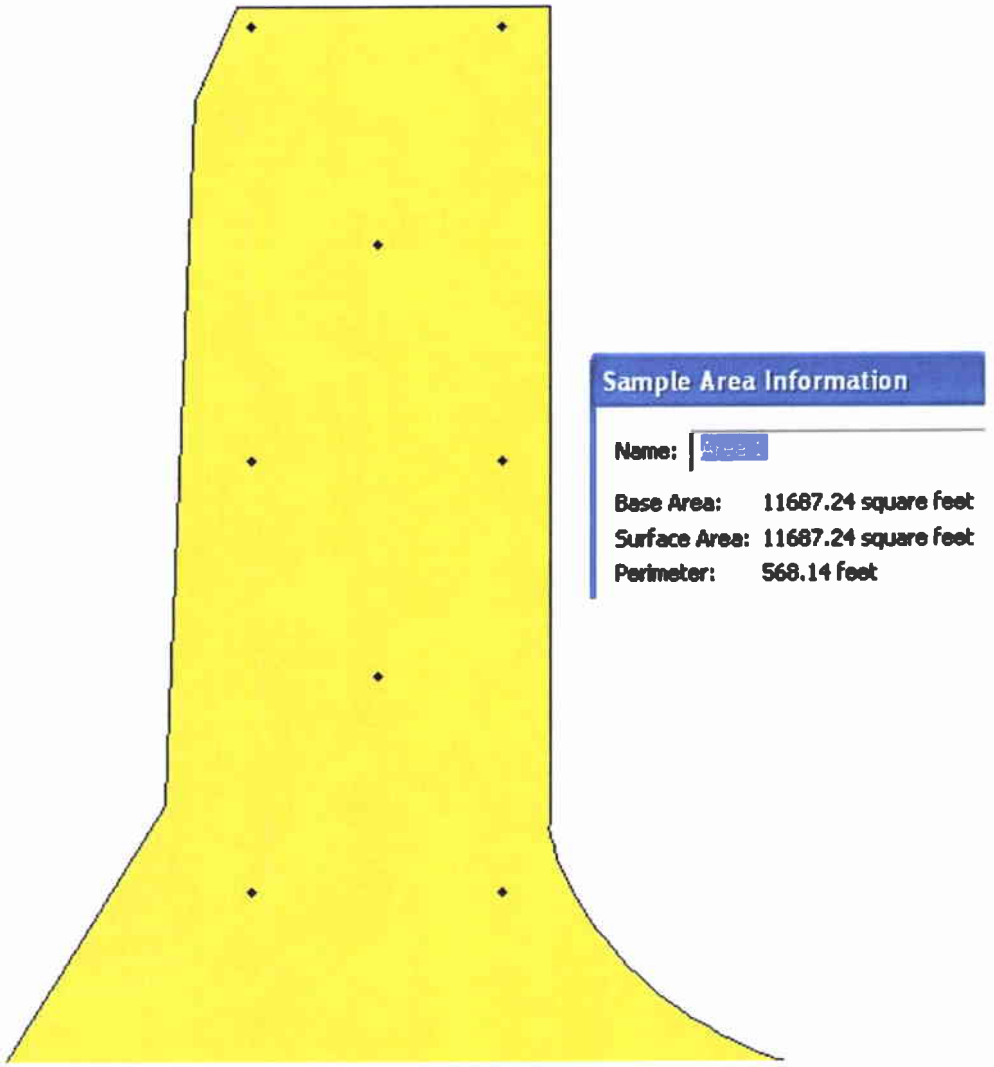
   Method: Predetermined number
   Specify total number of samples: (Please see attachment 2)
   Choose Method of Allocation of Sample strata: optimal
   Specify cost per sample: $120
   Specify Sampling Design in stratum 1: Systematic Grid

3. Results: Please see attachment 1

4. List of files: Please see attachment 3

Attachment 1
Plots of VSP for each Sector

Section 01

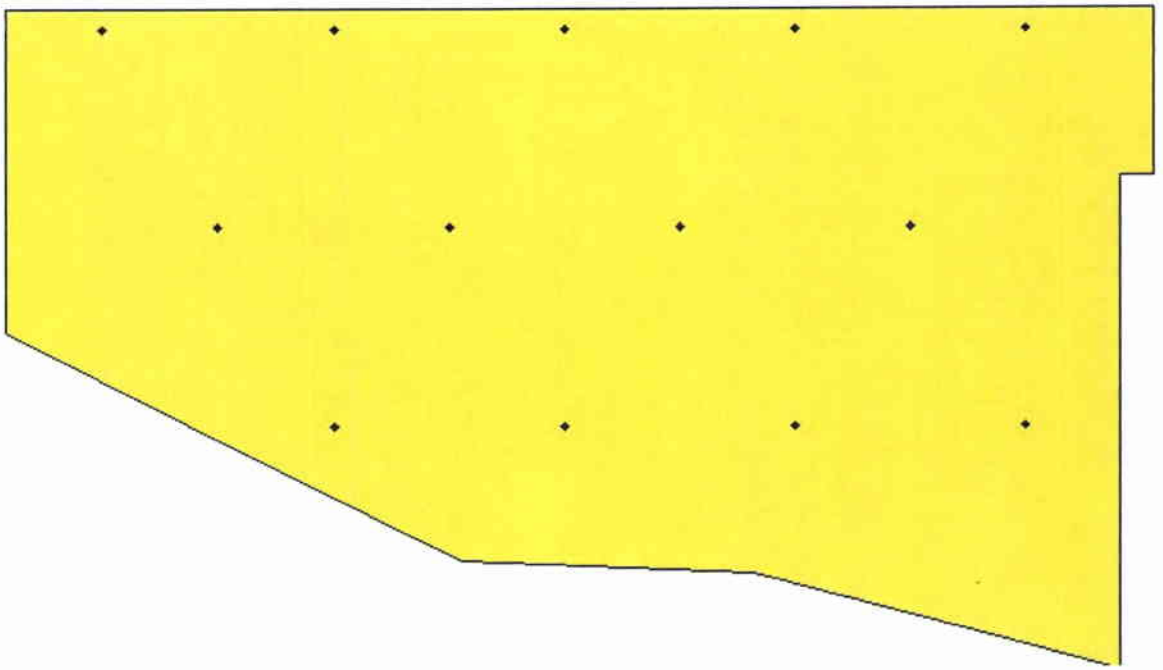


Section 02

Sample Area Information

Name: Survey Unit 02

Base Area: 18074.73 square feet
Surface Area: 18074.73 square feet
Perimeter: 583.28 feet

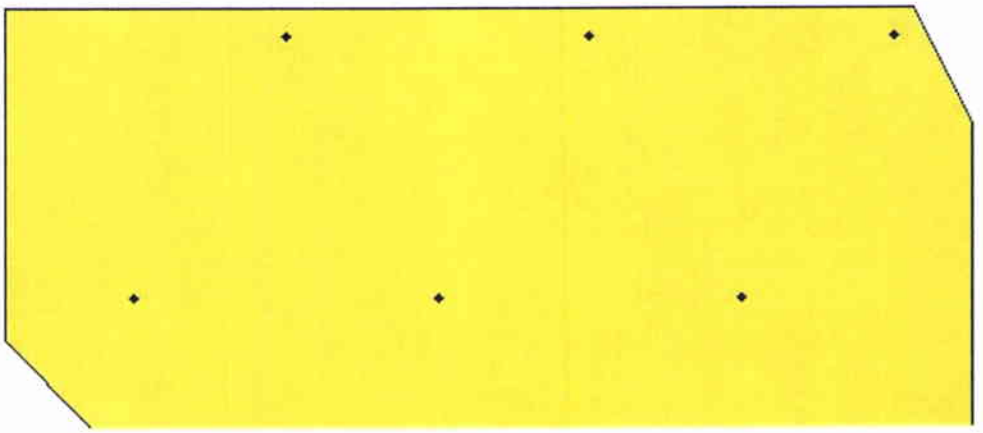


Section 03

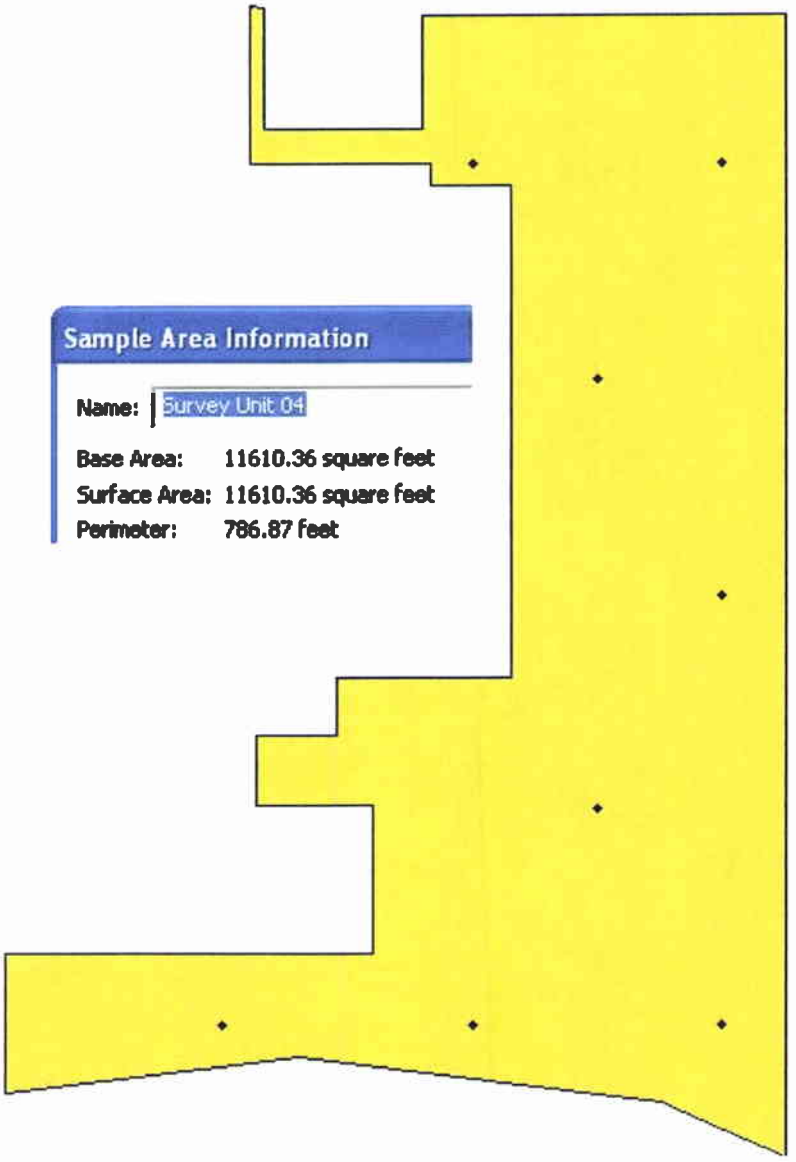
Sample Area Information

Name: Survey Unit 03

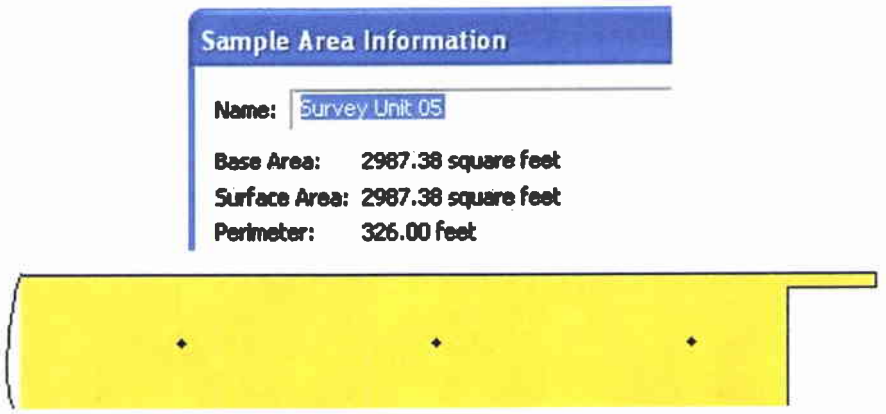
Base Area: 2665.60 square feet
Surface Area: 2665.60 square feet
Perimeter: 219.04 feet



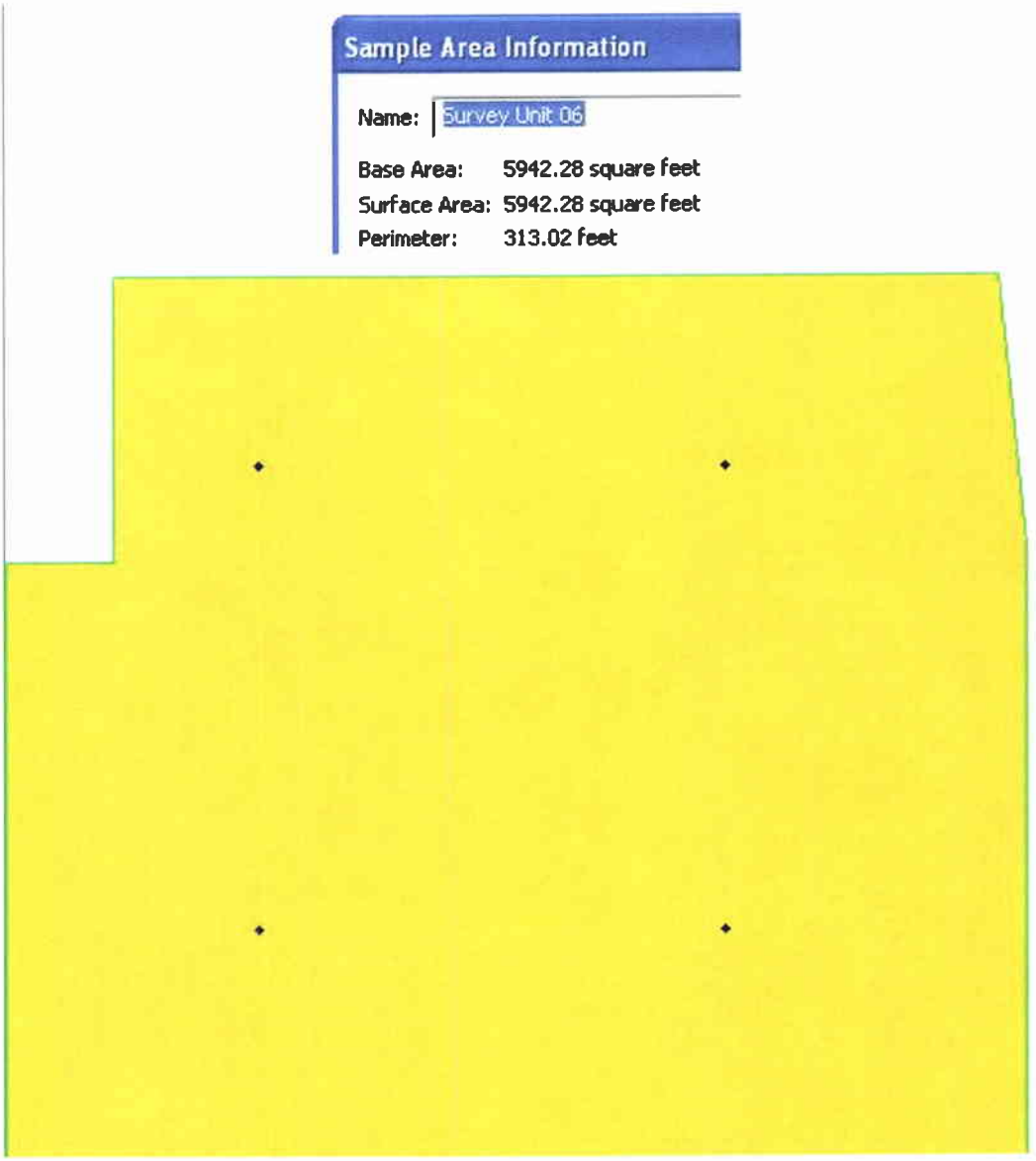
Section 04


Sample Area Information
Name: Survey Unit 04
Base Area: 11610.36 square feet
Surface Area: 11610.36 square feet
Perimeter: 786.87 feet

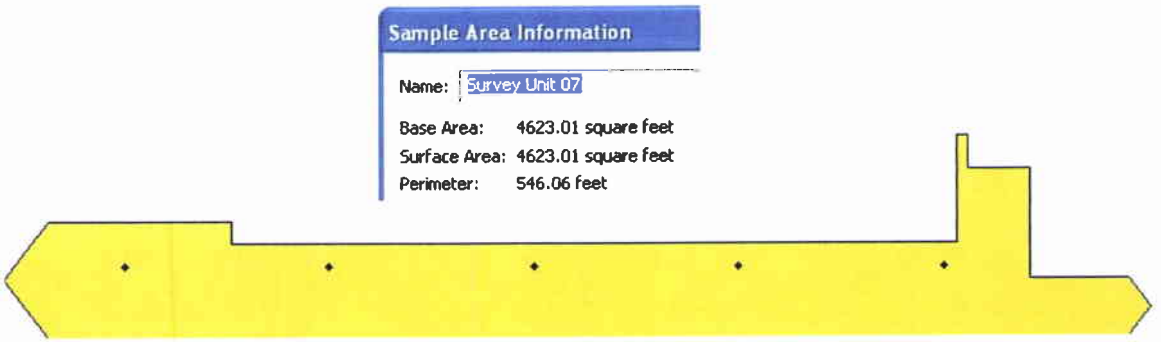
Section 05


Sample Area Information
Name: Survey Unit 05
Base Area: 2987.38 square feet
Surface Area: 2987.38 square feet
Perimeter: 326.00 feet

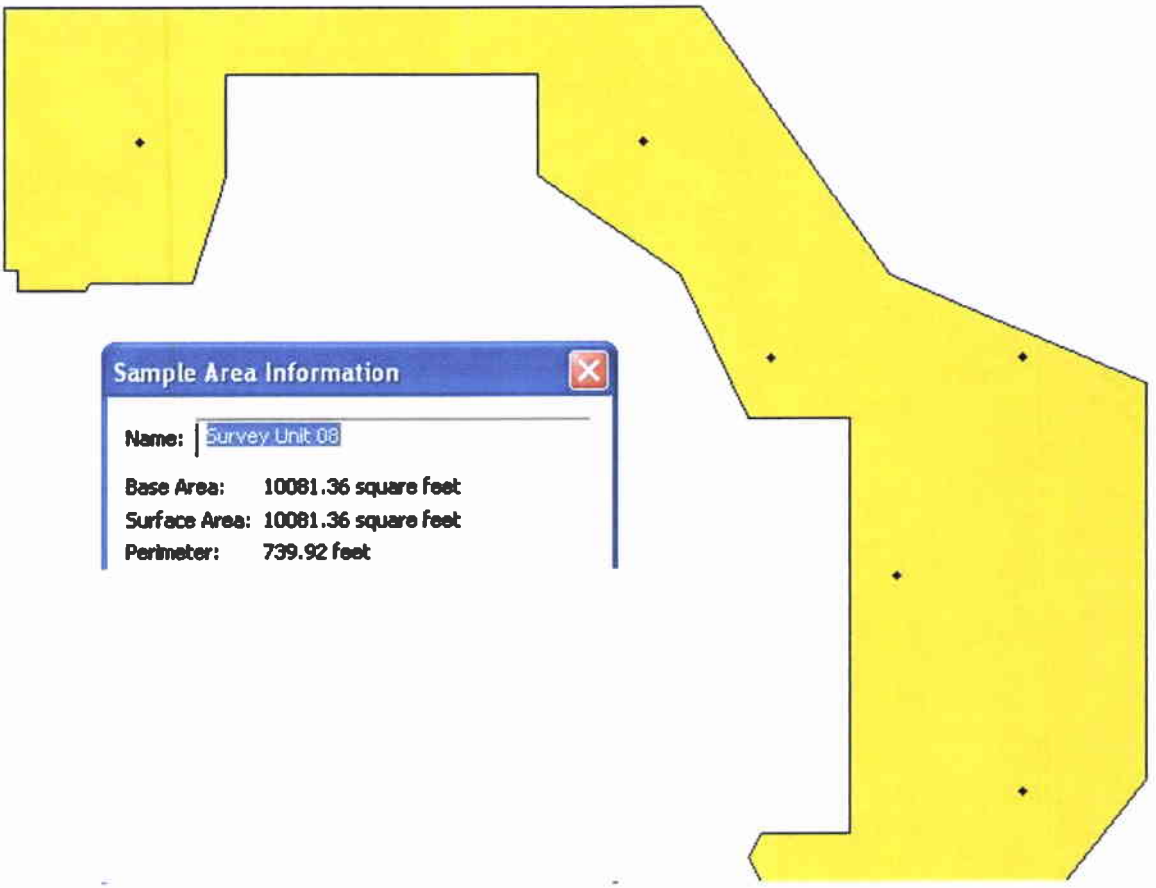
Section 06


Sample Area Information
Name: Survey Unit 06
Base Area: 5942.28 square feet
Surface Area: 5942.28 square feet
Perimeter: 313.02 feet

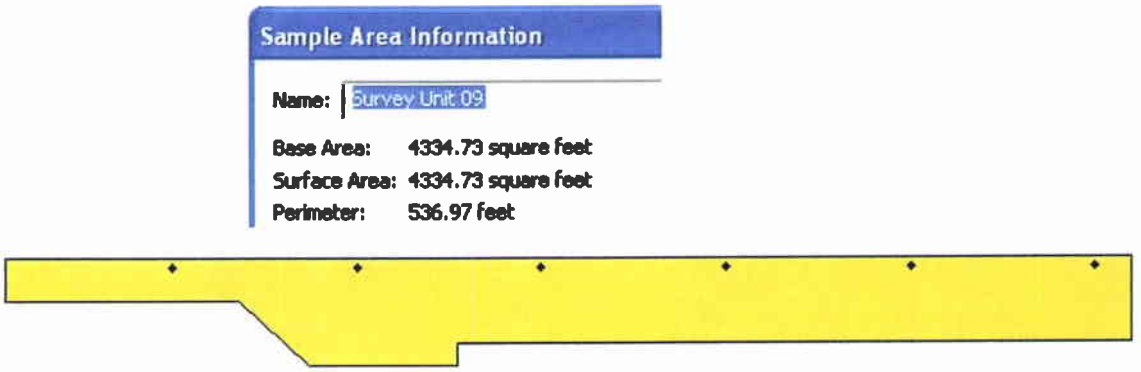
Section 07


Sample Area Information
Name: Survey Unit 07
Base Area: 4623.01 square feet
Surface Area: 4623.01 square feet
Perimeter: 546.06 feet

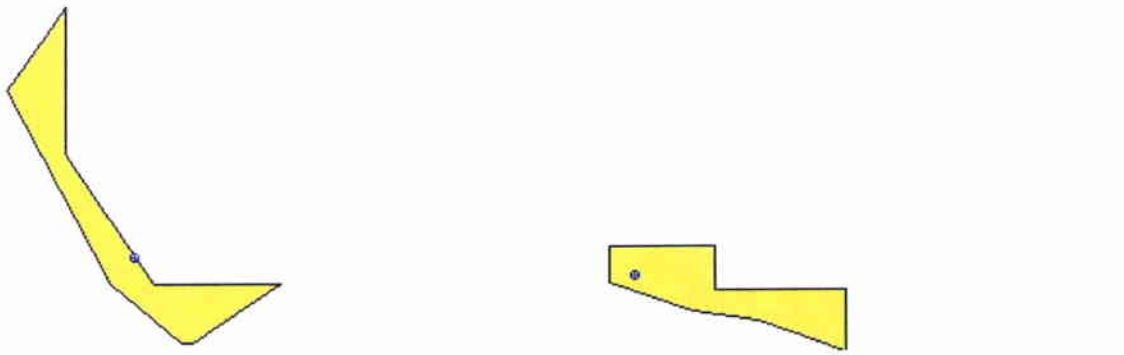
Section 08


Sample Area Information
Name: Survey Unit 08
Base Area: 10081.36 square feet
Surface Area: 10081.36 square feet
Perimeter: 739.92 feet

Section 09


Sample Area Information
Name: Survey Unit 09
Base Area: 4334.73 square feet
Surface Area: 4334.73 square feet
Perimeter: 536.97 feet

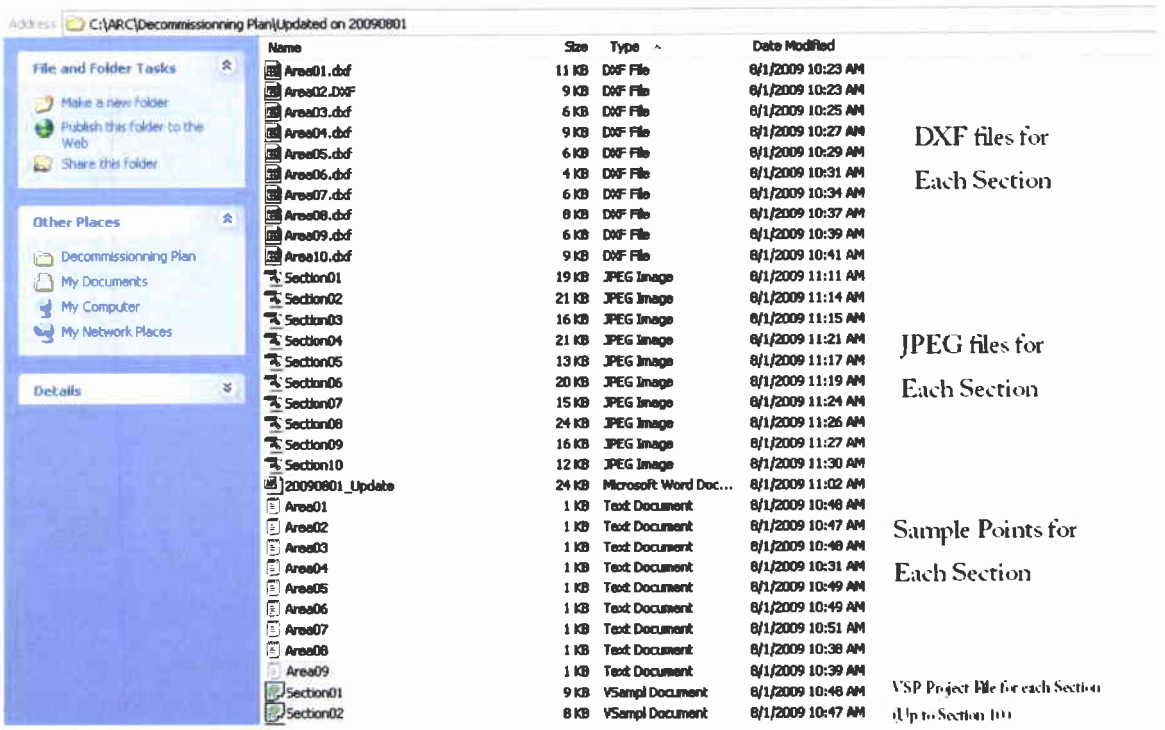
Section 10



Appendix 2
Number of Samples per Section

Section Number	Predetermined Sample Number	Actual Sample Number by VSP
1	7	8
2	12	13
3	5	6
4	7	8
5	2	3
6	4	4
7	3	5
8	6	6
9	3	6
10	5	5
Total	**54**	**64**

Appendix 3
List of Files



APPENDIX E

Section 8.1 – Surface Soil Sampling

Purpose

To describe the method for collecting samples of surface soil for routine radiochemical/radiophysical analysis.

Responsibilities

- The Site Coordinator is responsible for assuring that this procedure is implemented.
- Survey team personnel are responsible for following this procedure

List of Equipment

- ✓ Digging implement: garden trowel, shovel, spoons, post-hole digger, etc.
- ✓ Special sampling apparatus (cup cutter, Shelby tube, etc.) as required.
- ✓ Plastic bags, approximately 10 cm diameter x 30 cm long.
- ✓ Masking tape.
- ✓ Record forms and/or logbook.
- ✓ Labels and security seals.
- ✓ Indelible pen.
- ✓ Equipment cleaning supplies, as appropriate (see Section 4.5).

Sample Collection

NOTE: Because standard surface soil contamination criteria for radionuclides are usually applicable to the average concentration in the upper 15 cm of soil, the usual sampling protocol described here is based on obtaining a sample of this upper 15 cm. Special situations, such as to evaluate trends or airborne deposition, determining near surface contamination profiles, and measuring non-radiological contaminants, necessitate special sampling procedures. These special situations are evaluated and incorporated into site-specific survey plans as the need arises.

Direct surface and 1 meter gamma radiation measurements may be performed at each location before initiating sampling. This will identify the presence of gross radionuclide contamination which will require special handling and equipment cleanup procedures. Contact the Site Coordinator if the exposure rate measurement exceeds the capability of the instrumentation available on site before proceeding with sample collection. If contamination is suspected a beta-gamma "open" and "closed" measurement may also be desired before sampling begins.

1) Loosen the soil at the selected sampling location to a depth of 15 cm, using a trowel or other digging implement.

2) Remove large rocks, vegetation, and foreign objects (These items may also be collected as separate samples, if appropriate).

3) Place approximately 1 kg of this soil into a container sufficient to ensure moisture leakage and/or cross-contamination does not occur. If it is not possible to reach a depth of 15 cm using a hand tool (i.e. trowel or shovel) 1 kg of soil should be collected from the accessible depth. The actual depth should be recorded on the sample container and the data form.

4) Seal the sample container.

5) Label and secure the sample container in accordance with Section 8.15 and the chain-of-custody procedures in Section 8.16. Record pertinent information on the Chain-of-Custody Form (Figure B-16, or equivalent).

6) Record sample identification, location, and other pertinent data on appropriate record forms (Figures B-13, B-14, B-15, or equivalent), maps, drawings, and/or site logbook.

7) If the location has been identified as having elevated activity a measurement should be obtained after the sample is collected to determine the possibility of contamination at a depth greater than 15 cm. If a subsurface sample is deemed necessary, refer to Section 8.2.

8) Clean sampling tools, as necessary, before proceeding to the next sampling location, in accordance with instructions in Section 4.5.

Field Compositing of Samples

NOTE: The application of composite sampling is determined on a site-specific basis as designated in the survey plan or otherwise directed by the Site Coordinator (the latter requires documentation if it is a deviation from the survey plan). Data quality objectives for the project, analytical cost considerations, and

special case site conditions are used to identify situations where sample compositing may be employed. Generally, five samples may be included in a composite with a maximum number of ten. The area represented by a composite sample will vary and should not exceed 100 m^2 unless specified otherwise in the survey plan or directed by the Site Coordinator (the latter requires documentation for the decision). Refer to the note in the Sample Collection section on page 2 of this procedure for applicable information related to sampling depths and measurements.

1) Collect equal aliquots of soil over 15 cm depth intervals from each location that will be included in the composite and place in bowl, on plastic sheeting or other type of containment.

2) Thoroughly mix sample and break up aggregates.

3) Divide soil into equal quadrants.

4) Place an equal aliquot (approximately 50 to 100 grams) from each quadrant into the sample container.

5) Repeat steps 3 and 4 a total of 3 times. Total sample amount collected should approximate 1 kg.

6) Proceed with steps 4 through 8 of the Sample Collection section on page 2 of this procedure.

SP3

SAMPLE PREPARATION

1.0 PURPOSE

The purpose of this procedure is to provide a procedure for sample preparation for various radiochemical analyses.

2.0 RESPONSIBILITIES

2.1 Field Survey Personnel

- Create Lab Work Request (LWR) using the IEAV Database
- Include instructions when special sample processing conditions exist, e.g., the sample may have a volatile isotope (H-3, C-14, Tc-99, etc.) present

2.2 Laboratory Manager and Laboratory Personnel

- Create LWR using the IEAV database when samples are not associated with the Field Survey Project
- Include instructions when special sample processing conditions exist, e.g., the sample may have a volatile isotope (H-3, C-14, Tc-99, etc.) present
- Review each LWR to ensure special sample processing conditions are taken into consideration
- Process samples according to the procedure

3.0 SAMPLE PREPARATION

3.1 Soil and Sediment for Gamma Spectroscopy

3.1.1 If a sample requires analysis for volatile nuclides (e.g. H-3, Tc-99, or iodine) go to 3.1.9.

3.1.2 Dry the entire the sample in an appropriate container at 120°C (±10°C) for 8-16 hours, or until the sample is completely dry. When drying several samples, the samples should be loaded into the drying oven from top to bottom. If the percent moisture of the sample is requested, the wet weight of the sample is recorded on the wet to dry form before the sample is placed in the drying oven. **See step 3.1.2 of SP3 JHA.**

3.1.3 Turn off the drying ovens and allow the samples to cool. After the samples have cooled, remove them from the drying oven starting from the bottom

and ending at the top. If the percent moisture of the sample is requested, the dry weight of the sample is recorded on the wet to dry form before proceeding to the next step. **See step 3.1.3 of SP3 JHA.**

3.1.4 If the samples from a given task do not require complete homogenization, use a steel mallet to break up each sample. Go to step 3.1.8. Clean the mallet thoroughly after each use. **See step 3.1.4 of SP3 JHA.**

3.1.5 For samples requiring homogenization, place each sample in a labeled can with 3 to 5 steel balls, if necessary, seal the can, and secure the can on the shaker. **See steps 3.1.5 - 3.1.7 of SP3 JHA.**

3.1.6 Shake each sample for 1 hour. **See steps 3.1.5 - 3.1.7 of SP3 JHA.**

3.1.7 With a can opener, open the end of the can without the lid and remove the steel balls. Clean the steel balls after each sample by shaking in a can containing clean sand. Check the sample to ensure that there are no large, solid portions remaining. If the sample needs further blending, transfer the sample to a new container and repeat steps 3.1.5 and 3.1.6. **See steps 3.1.5 - 3.1.7 of SP3 JHA.**

3.1.8 If the sample contains rocks, pass it through a 0.25" sieve to remove the larger rocks. Clean the sieve and the bottom pan between samples by vacuuming it with a HEPA filter vacuum and using a foaming surfactant cleaner. **See step 3.1.8 of SP3 JHA.**

3.1.9 Pour the sample into a tared, labeled counting container. Use a counting container that will hold it with a minimum of void space. Tape the lid of the container to prevent spillage. **See step 3.1.9 of SP3 JHA.**

3.1.10 Weigh and record the net weight of the sample on the sample label.

3.1.11 Clean the exterior of the container and all processing equipment.

3.2 Soil and Sediment for Wet Chemical Analyses

3.2.1 For a sample requiring the analysis of volatile isotopes, the sample is homogenized by hand, if possible. A representative aliquot is taken and the wet chemical analysis is performed.

3.2.2 For a sample not requiring the analysis of volatile isotopes, dry the entire sample in an appropriate container at 120°C (±10°C) for 8-16 hours, or until the sample is completely dry. When drying several samples, the samples should be loaded into the drying oven from top to bottom. **See step 3.1.2 of SP3 JHA.**

3.2.3 Turn off the drying ovens and allow the samples to cool. After the samples have cooled, remove them from the drying oven starting from the bottom and ending at the top. **See step 3.1.3 of SP3 JHA.**

3.2.4 Place each sample in a labeled can, add 3 to 5 steel balls, seal the can, and secure the can on the shaker. **See steps 3.1.5 - 3.1.7 of SP3 JHA.**

3.2.5 Shake each sample for 1 hour. **See steps 3.1.5 - 3.1.7 of SP3 JHA.**

3.2.6 With a can opener, open the end of the can without the lid and remove the steel balls. Clean the steel balls after each sample by shaking in a can containing clean sand. **See steps 3.1.5 - 3.1.7 of SP3 JHA.**

3.2.7 If there is visible organic material in the sample, place it in an ashing container and record the weight. The dry weight of the sample is recorded on the dry to ash form. The sample is placed in a muffle furnace at 500°C for at least 4 hours.

3.2.8 Place the ashing container in the muffle furnace. Check the "Set Point" on the furnace to make sure the temperature is correct. If the "Set Point" does not read 500°C, change the "Set Point" to 500°C. **See step 3.2.3 of SP3 JHA.**

3.2.9 After the samples have completed ashing, turn off the furnace. Allow a minimum of 2 hours for the furnace to cool before opening the door. **See step 3.2.4 of SP3 JHA.**

CAUTION: NEVER ATTEMPT TO REMOVE A SAMPLE WHILE THE FURNACE IS ON AND/OR HOT. THERE IS A POTENTIAL FOR ELECTRICAL SHOCK.

3.2.10 After cooling, the sample is then re-weighed and the ashed weight is recorded on the dry to ash form. The dry to ash ratio is then calculated.

3.2.11 The ashed sample is used for analysis with reference to dry weight for calculation of final results.

3.3 Vegetation for All Radiochemical Analyses

3.3.1 Wash the vegetation to remove particles, which may contain radionuclide contamination, from the outer surface.

3.3.2 Determine the wet weight of the sample.

3.3.3 Perform analysis of any volatile radionuclides, if required.

3.3.4 If analysis is not to be performed for volatile radionuclides, dry the

vegetation at 120°C (±10°C) for 8 to 16 hours. Weigh the dry sample and calculate the wet to dry weight ratio using the wet to dry form at the end of the procedure. See Steps 3.1.8 and 3.1.9 for sample loading. **See step 3.1.2 and step 3.1.8 of SP3 JHA.**

3.3.5 Ash each sample at 500°C for at least 4 hours (samples may be ashed overnight). Refer to Steps 3.2.7 through 3.2.10 for the ashing procedure, precautions, and JHAs. Weigh the ash material and determine the dry and wet to ash weight ratios using the wet to dry form at the end of the procedure. Analysis should be performed on the vegetation ash and the final results calculated against the original wet weight.

3.4 Water for All Radiochemical Analyses Except for Plutonium, and/or Americium-Curium

NOTE: ALL WATER SAMPLES HAVE A MAXIMUM HOLDING TIME OF SIX MONTHS.

3.4.1 Unless suspended and dissolved solid results are required by the client or there are radioisotopes present that could possibly be volatilized by acidification, acidify all water samples to a pH of 1-2 using nitric or hydrochloric acid.

3.4.2 Samples, acidified or non-acidified, requiring filtration are filtered through a 0.45 micron pore size. The filters with the suspended portion of each sample are placed in a labeled Petri dish.

3.4.3 Suspended and dissolved solid fractions are analyzed by the requested analytical procedure for the isotope(s) of interest.

3.4.4 All water samples will be returned to the licensee and/or client or discarded once the six month holding time is exceeded.

3.5 Water for Plutonium and/or Americium-Curium Analysis

NOTE: ALL WATER SAMPLES HAVE A MAXIMUM HOLDING TIME OF SIX MONTHS.

3.5.1 Samples are filtered through a 0.45 micron pore size. The filters with the suspended portion of each sample are placed in a labeled Petri dish.

3.5.2 The sample filtrate is returned to the original sampling containers. Nitric acid or hydrochloric acid is then used to adjust the pH to approximately 0.6 (approximately 10 mL concentrated HNO_3 per liter of sample). After the addition of the nitric or hydrochloric, add 2 to 5 drops of hydrofluoric acid to the sample to help dissolve any potential plutonium contamination in the

sample.

3.5.3 The acidified liquid and the filter portion of each sample are analyzed by for the isotope(s) of interest.

3.5.4 All water samples will be returned to the licensee and/or client or discarded once the six month holding time is exceeded.

3.6 Smears

3.6.1 Remove the smear from its packet using forceps, touching as little of the smear as possible. The smear may contain loose contamination; effort should be taken to minimize loss or movement of material on the smear. Do not handle smears with bare hands.

3.6.2 If tritium or carbon-14 analysis is required, the smear should come to the laboratory in a scintillation vial containing 5 to 10 mL of de-ionized water. Add 10 mL of scintillation cocktail, Ultima Gold or equivalent. Shake well to mix the water and the cocktail. Submit to counting room for liquid scintillation counting.

3.6.3 Each smear requiring gross alpha and beta counting should be secured to the planchet with double-sided tape, placed in a carrier with the same number as the smear, and counted on the low background alpha/beta counter.

3.6.4 After counting, return the smear, or smear and planchet, to its packet for further analysis or archival.

3.7 Miscellaneous Samples

Miscellaneous samples will be processed to meet client requirements. Processing will be documented in the task folder indicating what actions were taken to put the sample(s) in a form that could be analyzed. Actions may include, but not be limited to, blending, grinding, acid dissolution, etc.

SP3, Revision 5
SOIL PREP ASSIGNMENT SHEET

TASK #: _____ ACTIVITY LEVEL: _____

ASSIGNED TO: _____ DATE: _____

LWR #: _____

SAMPLES & INSTRUCTIONS: _____

OVEN USE LOG

Oven #	Beginning Sample #	End Sample #	Date/Start Time		Date/End Time		Temp in Celsius	Initial when entered in Oven Log

SP3, Revision 5

WET TO DRY CALC

TASK#:			DATE:			INPUT BY:		
Sample Number	CRUCIBLE NUMBER	CRUCIBLE WEIGHT	CRUC + WET SAMPLE WEIGHT	CRUC + DRY SAMPLE WEIGHT	Grams WET / Gram DRY	Percent Moisture	Percent Solids	Grams water per gram wet soil
		Analyst review:				Date:		
		Reviewed by:				Date:		
		Given to:				Date:		

DRY-TO-ASH WEIGHT DATA SHEET

TASK# _____ **Date:** _____ **Input by:** _____

Check balance before weighing the samples. All weights are in grams.

Sample Number	CRUCIBLE NUMBER	CRUCIBLE WGHT (A)	CRUC + DRY SAMPLE WGHT (B)	CRUC + ASH SAMPLE WGHT (C)	DRY/ASH RATIO

Equation for calculating the dry to ash ratio:

$$\frac{B-A}{C-A}$$ = No. grams of dry sample per gram of ash sample

Analyst: _____ Date: _____

Reviewed by: _____ Date: _____

Appendix F

References

References

Abelquist, E. Decommissioning Health Physics, A Handbook for MARSSIM Users, Institute of Physics, 2001.

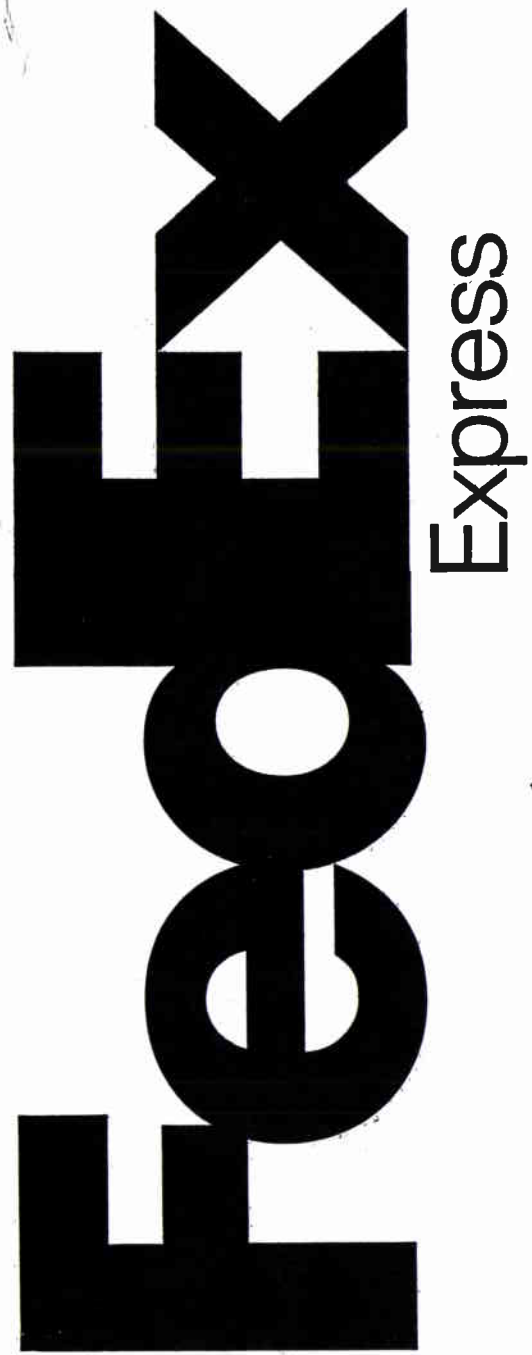
NUREG 1505, USNRC, A Nonparametric Statistical Methodology for the Desi9gn and Analysis of Final Status Decommissioning Surveys , Rev !, 1998

NUREG 1507, USNRC, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions (prepublished draft), 1998.

NUREG 1575 Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM), Rev 1, 2000

NUREG 1576 Multi-Agency Radiological Laboratory Analytical Protocols Manual, 2004

NUREG 1757 USNRC, Consolidated Decommissioning Guidance (3 Volumes)



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