REPORT ON THE NATIONAL SURVEY

OF LEAD-BASED PAINT IN HOUSING

Appendix I: Design and Methodology

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1. INTRODUCTION

The National Survey of Lead-Based Paint in Housing was conducted under the sponsorship of the Department of Housing and Urban Development to provide basic data for comprehensive and workable plans for the prompt and cost-effective abatement of lead-based paint hazards in private and public housing. The comprehensive and workable plans (CWPs) were required by the Lead-Based Paint Poisoning Prevention Act (LPPPA), as amended by Section 566 of the Housing and Community Development Act of 1987.[1] The CWP for private housing was issued to Congress in December, 1990.[2] The CWP for public housing is being prepared for future issuance.

This report is Appendix I of the *Report on the National Survey of Lead-Based Paint in Housing*. It presents a detailed description of the design and methodology of the survey, including research design, survey sample design, data collection protocols, quality assurance, and data preparation.

1.1 Background

This section presents the background for the National Survey. It briefly describes the data available prior to the National Survey on the estimated extent of lead-based paint hazards in the United States.

1.1.1 Prior Surveys and Their Limitations

There were four notable surveys of lead-based paint in housing that preceded the National Survey. Three municipal surveys were conducted in the mid-1970s, and one national survey of public housing was carried out in the 1980s.

The Washington, DC, survey, conducted in 1973 by the National Bureau of Standards (now the National Institute of Standards and Technology [NIST]) had a sample of 233 housing units (of which 115 were inspected) representing the city of Washington.[3] This survey also acted as HUD-sponsored field test for a Pittsburgh survey conducted a year later.

The Pittsburgh survey, conducted in 1974 and 1975 by the Allegheny County (PA) Health Department for the National Bureau of Standards under HUD sponsorship, is by far the largest study of its type ever conducted. The survey completed inspections in approximately 3,300 housing units out of a sample of 4,000 units that represented the entire Pittsburgh urban area.[4]

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[1] Amendment in Section 566 of the Housing and Community Development Act of 1987 (Public Law 100-242).

[2] U.S. Department of Housing and Urban Development, Office of Policy Development and Research (1990), *Comprehensive and Workable Plan for the Abatement of Lead-Based Paint in Privately Owned Housing: Report to Congress*.

[3] Hall, William; and Ayers, Tyrone (1974), *Survey Plans and Data Collection and Analysis Methodologies: Results of a Pre-Survey for the Magnitude and Extent of the Lead-Based Paint Hazard in Housing* (NBSIR 74-426), U.S. Department of Commerce, National Bureau of Standards.

[4] Shier, Douglas R.; and Hall, William G. (1977), *Analysis of Housing Data Collected in a Lead-Based Paint Survey in Pittsburgh, Pennsylvania*, Parts I and II (NBSIR 77-1250 and 77-1293), U.S. Department of Commerce, National Bureau of Standards.

The Phoenix survey, conducted in 1976 by the Arizona Department of Health Services, had a sample of 268 units and conducted inspections of 146. The sample represented a single Phoenix census tract that was chosen because of a high number of both pre-1940 units and children under five years old.[5]

The fourth survey was part of a national study of the modernization needs of public housing. It was conducted in 1984-1985. Two hundred and sixty-two public housing units (apartments) plus associated common areas (i.e., hallways, playgrounds) were inspected in 131 public housing projects in 34 cities. The 34 cities had community lead-poisoning prevention programs that provided for the inspections.[6] The results of the study were projected onto the national stock of public housing.[7]

The reported percentage of housing units in the samples found to contain lead-based paint are summarized for these four studies in Table 1-1.

Limitations of Previous Surveys

As a basis for calculating national estimates of the number of housing units with lead-based paint, analyzing other lead hazards in housing, and estimating the cost of abatement, these prior surveys are limited.

Sample Limitation. Because of the limited geographic coverage of most of the surveys, there is no way of knowing the extent to which the findings are representative of housing throughout the nation.

Wide Divergence in Estimates of Homes with Lead. As reported in Table 1-1, the prior surveys' estimates for the percentage of homes with lead varied immensely. For housing built prior to 1940, the range was 71 to 100 percent; for homes built between 1940 and 1959, the range was 64 to 92 percent; and for units built between 1960 and 1977, the range was 48 to 76 percent. The wide ranges of these percentages underscore the need for a systematic national survey to generate estimates sufficiently reliable for analysis and policy development.

Differences in Estimates of Unsound Paint Conditions. The ATSDR report estimated that there were 1,972,000 housing units with lead-based paint in an "unsound" condition. This figure provided an indicator of the number of units in which the risk of exposure to lead from paint was greatest. It was based on data from the 1983 American Housing Survey, which reported on peeling paint, cracked plaster, and holes in walls. Peeling paint was the indicator selected to represent unsound condition. To calculate the estimate, ATSDR multiplied the estimated number of units with lead-based paint in each of the three periods of construction by a single average percentage of units with peeling paint for all housing in the nation, regardless of year of construction. This method appears to have resulted in an underestimate. The prevalence of peeling paint, according to the 1983 American Housing Survey, was 8.7 percent in pre-1940 housing, 4.3 percent in housing built between 1940 and 1959, and 1.8 percent in housing built between 1960 and 1979. If these percentages had been used in the ATSDR model, the estimated number of housing units with lead-based paint and peeling paint would have been 2,574,000 instead of 1,972,000.

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[5] Arizona Department of Health Services, Division of Environmental Health, Bureau of Sanitation (1976), "Lead-Based Paint: Report of Findings to the State Legislature" (mimeo).

[6] A project is a public housing development consisting of one or more buildings in the same neighborhood.

[7] Wallace, James E. (1986), *The Cost of Lead-Based Paint Abatement in Public Housing*, U.S. Department of Housing and Urban Development.

TABLE 1-1
PREVALENCE OF LEAD-BASED PAINT IN HOUSING BY YEAR OF CONSTRUCTION BASED UPON PRIOR SURVEYS

Survey	Year of Construction					
	pre-1940		1940-1959		1960-1977	
	Percent of units w/LBP	**Units in Sample**	**Percent of units w/LBP**	**Units in Sample**	**Percent of units w/LBP**	**Units in Sample**
Pittsburgh						
All Housing	88%	2,525	74%	178	61%	27
Public Housing	71	76	79	117	60	63
Washington, DC	100	63	92	24	76	17
Phoenix	100	124	85	22	NA	NA
Public Housing (1)	81	99	64	96	48	52

(1) This survey, part of the Modernization Needs Study, used different year-of-construction intervals than the other surveys. The prevalence of 81 percent is for public housing built prior to 1950, and the prevalence of 64 percent is for the period 1950-1959.

Measurement Imprecision. The portable X-ray fluorescence analyzers used in all of the surveys were subsequently found by NIST to have been highly imprecise at the 1.0 mg/cm^2 (milligram per square centimeter) level.[8] Paint with a loading of lead greater than this level is defined as lead-based paint under the Federal standard.

Lack of Dust and Soil Lead Data. The prior surveys also lack some of the information needed to analyze lead hazards in housing and estimate the cost of abatement. They provide no information on the prevalence of lead in house dust and in exterior soil, yet these are two sources identified in the research literature as important pathways of lead, including lead-based paint. Therefore, the studies cannot be used to analyze the prevalence of lead in dust and soil, or the association between lead-based paint and lead in dust and soil. The prior surveys also provide limited information on the number and dimensions of the surfaces containing lead-based paint within housing units. Such information can be estimated, but such a procedure increases the error in calculating the costs of abatement. Cost estimates are legislatively required for public housing and are desirable in developing policies for private housing.

1.1.2 Lead in Surface Dust and Soil

A large number of studies published during the past two decades have indicated an association between lead dust and childhood blood lead. Three studies established the apparent importance of lead dust as a pathway for lead-based paint. In 1980, based on data from a study in Rochester, New York, Charney and colleagues concluded that, although several factors accounted for childhood lead poisoning, dust lead and hand lead (lead that clings to fingers and hands) were strongly correlated with blood lead, and that interior dust lead should be taken into account in attempting to reduce lead hazards in residential environments.[9]

In 1983, based on a HUD-funded study in Baltimore, Charney and colleagues analyzed whether dust control measures, in addition to treatment of potential lead-based paint hazards, would lower blood lead levels. The investigators concluded that their results showed "that a focused dust-control program can reduce blood lead levels more than standard lead removal in the home."[10]

Bellinger and colleagues (1986) enrolled 249 metropolitan Boston children with low-to-moderate blood lead levels at one month of age and collected data semiannually on blood lead levels, environmental lead (water, air, dust, paint, and breast milk/formula), sociodemographic factors, home environment and care-giving style, behavior (especially mouthing), and development. Environmental lead and mouthing behavior were significantly associated with blood lead, but home environment/care giving, child development, and sociodemographic characteristics were not. Although refinishing and month of sample selection were significant, dust lead was the most important environmental variable. The investigators concluded that "the most promising approach for achieving community-wide reductions in children's blood lead levels is reduction of the amount of lead in the proximate environment."[11]

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[8] McKnight, Mary E.; Byrd, Eric W.; Roberts, Willard E.; and Lagergren, Eric S. (December 1989), *Methods for Measuring Lead Concentrations in Paint Films* (NISTIR 89-4209), U.S. Department of Commerce, National Institute of Standards and Technology.

[9] Charney, E.; Sayre, J.; and Coulter, M. (February 1980), "Increased Lead Absorption in Inner City Children: Where Does the Lead Come From?", *Pediatrics*, 65(2).

[10] Charney, E.; Kessler, B; Farfel, M.; and Jackson, D. (1983), "Childhood Lead Poisoning: A Controlled Trial of the Effect of Dust-Control Measures on Blood Lead Levels," *New England Journal of Medicine* 309(18):1089-1093.

[11] Bellinger, D.; Leviton, A.; Rabinowitz, M.; Needleman, H.; and Waternaux, C. (1986), "Correlates of Low-Level Lead Exposure in Urban Children at 2 Years of Age," *Pediatrics* 77(6):826-833.

1.1.3 Pathways Between Paint Lead and Blood Lead

Bornschein and colleagues (1985)[12] at the University of Cincinnati studied the relationship between children's blood lead levels and measures of the extent of lead-based paint in dwelling units. They found that lead in paint does not directly impact blood lead levels, but it does impact them through the pathways:

- Lead-based paint hazard index ---> dust lead ---> blood lead, and

- Lead-based paint hazard index ---> dust lead ---> hand lead ---> blood lead.

In addition, it should be noted that exterior surface scraping of dust lead derives, in part, from paint lead. Bornschein, et al. reported a correlation of .30, with a significance at $p<.001$, between these two variables. The conclusion is that, except for children with an abnormal craving to eat substances not fit for food, or *pica*, dust is the major immediate source of lead for children, and that lead-based paint is a primary contributor to dust lead.

Analysis of Effects of Housing Condition. In an early paper from the Cincinnati study, Clark and colleagues found evidence that the condition of the paint affects the level of the hazard, because defective paint provides chips that are more accessible for direct ingestion and can readily contaminate dust circulating in a house.[13] Mean blood lead levels for residents of housing in poor condition were dramatically higher (approaching 35 µg/dl for children reaching 18 months of age) than those for housing in good repair. This study suggested the importance of "unsoundness" as a marker for lead poisoning hazard.

Isotope Ratio Analysis. Two studies have conducted isotopic analyses of lead in children's blood and environmental lead and made inferences about the sources of the blood lead.[14] Yaffe and colleagues examined 12 children with blood lead levels above 30 µg/dl.[15] The lead in their blood resembled the lead in paint from exterior walls and the soils in adjacent areas where they played. Yaffe's data suggest that the soil lead came from the paint lead and that the soil lead was the proximate cause of the blood lead.

1.2 Reports Based on the National Survey

Reports on the National Survey included two HUD reports to Congress, the *Comprehensive and Workable Plan (CWP) for Private Housing*[16] and the *Comprehensive and Workable Plan (CWP) for*

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[12] Bornschein, R.L; Hammond, P.D.; Dietrich, K.N.; Succop, P.A.; Krafft, K.M,; Clark, C.S.; Pearson, D,; and Que Hee, S.S. (1985), "The Cincinnati Prospective Study of Low-Level Lead Exposure and Its Effect on Child Development Protocol and Status Report," *Environmental Research* 38: 4-18.

[13] Clark, C.S.; Bornschein, R.L.; Succop, P.; Que Hee, S.S.; Hammond, P. D.; and Peace B. (1985), "Condition and Type of Housing as an Indicator of Potential Environmental Lead Exposure and Pediatric Blood Lead Levels," *Environmental Research* 38:46-53.

[14] These analyses exploited the fact that lead obtained from different sources differs in isotopic composition.

[15] Yaffe, Yechiam; Flessel, Peter C.; Wesolowski, Jerome J.; Del Rosario, Aurora; Guirguis, Guirguis N.; Matias, Violeta; Degarmo, Thomas E.; Coleman, Gordon C.; Gramlich, John W.; and Kelly, William R. (July/August 1983), "Identification of Lead Sources in California Children Using the Stable Isotope Ratio Technique," *Archives of Environmental Health* 38(4):237-245.

[16] U.S. Department of Housing and Urban Development, Office of Policy Development and Research, (1990), *Comprehensive and Workable Plan for the Abatement of Lead-Based Paint in Privately Owned Housing: Report to Congress*.

Public Housing (forthcoming), and Midwest Research Institute's report, *Analysis of Soil and Dust Samples for Lead (Pb) Final Report*.[17] These are briefly described below.

Comprehensive and Workable Plan for Private Housing

The Comprehensive and Workable Plan (CWP) for private housing contained extensive statistical data on lead-based paint in private housing. Among other findings, it reported that lead-based paint is widespread in private housing. A large majority of the homes built before 1980 have lead-based paint. Homes with children under age seven are just as likely to have lead-based paint as those without small children. However, relatively few homes have conditions that pose priority hazards. The CWP included data on the characteristics of the housing unit and the household occupying it. As found in prior studies, lead-based paint is found more often in prewar housing units than in those built since 1940. Unlike previous findings, though, no correlation was found between the prevalence of lead-based paint and the income of the household.

In agreement with prior research, the survey found an association between lead-based paint and the presence of high levels of lead in dust and soil. The chance of a home having high dust lead levels is about twice as large if the home has high levels of interior lead-based paint than if it does not. The CWP supports the pathway models that cite soil outside the building to be another direct source of childhood lead exposure and an indirect source of lead dust in the home. The chance of this occurring is at least four to five times greater if the house has exterior lead-based paint than if it does not.

The statistical findings of the National Survey are included in Appendix II of the present report.

In addition to statistical findings, the CWP presented the results of a literature search on the history of lead-based paint use, effects of lead exposure, and prior studies of lead-based paint in housing, including prevalence of childhood lead exposure, prevalence of lead-based paint in housing, and sources and pathways of lead. The CWP also analyzed the cost and other issues related to testing and abating lead-based paint, such as testing technology, industry capacity, and methods of abatement. As part of a program review, the CWP considered representative city and state programs, private abatement activity, and current HUD regulations.

The recommendations contained in the comprehensive plan proposed as a result of the CWP's findings included: updating the HUD lead-based paint regulations; the provision of public information by various means; further research on testing, abatement, and health effects of paint lead; and soil lead abatement. Other recommendations covered: developing local programs with a training component; providing information and exchange; and monitoring, evaluating, and reporting. The CWP also reviewed current HUD and Health and Human Services (HHS) programs which could provide financial resources for private housing lead-abatement programs.

The CWP for Public Housing is being developed and will be available at a later date.

Analysis of Soil and Dust Samples for Lead

The Environmental Protection Agency (EPA), through an Interagency Agreement with the Department of Housing and Urban Development (HUD), was given the task of providing analytical support to HUD for the National Survey of Lead-Based Paint in Housing.

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[17] Spurlin, Dr. S. et al., Midwest Research Institute Report: *Analysis of Soil and Dust Samples for Lead (Pb),* May 1991.

Midwest Research Institute (MRI), as the prime contractor to EPA's Office of Toxic Substances (EPA/OTS), Field Studies Branch, was given the task of providing appropriate analytical protocols and carrying out the analysis of the dust and soil samples collected by Westat as part of the National Survey. The Midwest Research Institute also was charged with monitoring the quality of the results from the subcontractor laboratories used to conduct the analyses. A subsequent task was added to the initial work assignment -- to evaluate several systems and select a sample collection system that could be used to sample lead in household dust. The evaluation and results of this procedure were incorporated into the field protocol in the national survey.

The Midwest Research Institute's report, *Analysis of Soil and Dust Samples for Lead (Pb)*, discusses the pretest survey, the dust and soil sampling procedures, the selection of laboratories, the sample handling system, and the sample analysis. It describes the quality assurance program, including quality control results and their assessment. Quality control charts from the analytical laboratories are included, as is a discussion of the quality control results for the National Survey.

2. THE RESEARCH DESIGN FOR THE NATIONAL SURVEY

2.1 Objectives and Data Requirements

The objectives of the National Survey were based on Section 302 of the Lead-Based Paint Poison Prevention Act of 1971, as amended. The research requirements set forth in that Act were to provide:

- An estimate of the amount, characteristics, and regional distribution of housing in the United States that contains lead-based paint hazards at differing levels of contamination.
- A comprehensive and workable plan for the cost-effective inspection and abatement of public housing..., including an estimate of the total cost of abatement.
- A comprehensive and workable plan, including any recommendations for changes in legislation, for the prompt and cost-effective inspection and abatement of privately-owned single family and multi-family housing, including housing assisted under Section 8 of the U.S. Housing Act of 1937.

To attain these objectives, the National Survey of Lead-Based Paint in Housing was designed to obtain data for estimating:

- The number of dwelling units in the United States with interior and exterior lead-based paint, by year built, type of housing, level of lead loading, and census region.
- The number of multi-family (private and public) residences with lead-based paint in common areas, by year built, level of lead loading, and census region.
- The extent of surface area of lead-based paint in order to estimate national abatement costs in public and privately owned housing.
- The prevalence of paint in unsound condition.
- The prevalence of lead in dust in dwelling units and in soil around the perimeter of residential structures.
- The characteristics of housing with varying levels of lead hazard and examine possible priorities for abatement.

The information was needed to support a number of research questions. These included the analyses of: the relationship among sources and pathways of lead in the residential environment; the characteristics of housing with varying hazard levels; and the costs, effectiveness and benefits of alternative strategies of reducing lead-based paint hazards. Information also was needed to identify the dimensions of each of these issues.

2.2 Research Design

This section presents a brief overview of the research design for the National Survey. The final research design was the culmination of a systematic process involving several rounds of planning, testing, and revision, with participation from a number of agencies, experts, and contractors.

As part of this design process, HUD and EPA developed a Memo of Understanding to enable HUD to draw upon EPA's experience and perspective in environmental health hazards. HUD and EPA brought together the Interagency Task Force on the National Survey to enable this sharing. The Task Force participants included scientists, statisticians, lawyers, and other professionals actively involved in lead issues. Agencies and organizations represented in the Task Force included HUD, EPA, Centers for Disease Control, Department of Health and Human Services, Agency for Toxic Substances and Disease Control, National Institute of Environmental Health Sciences, National Institute of Occupational Safety and Health, Consumer Product Safety Commission, National Institute of Standards and Technology, and Occupational Safety and Health Administration.

After a Task Force review, HUD was asked to respond to questions and concerns raised dealing with technical, statistical, policy, and funding matters. In each case, HUD and the survey team investigated and developed a response to each comment or question. As a result, in many cases, accommodations and changes were made that improved the research design.

The final design components as they were ultimately implemented are summarized in Sections 2.2.2 through 2.2.5.

2.2.1 Overview of the Research Design

The sample design was multi-tiered. It was structured to support the development of national estimates based on inspections of 400 households. The use of cluster sampling techniques in combination with efficient in-home procedures minimized the per-household costs and allowed for the inspection of a sufficient number of households to form reliable national estimates. The data collection protocols and survey methodology combined field interview activities, dwelling unit inspection, physical sample collection, and in-field materials testing.

The major components of the research design were:

- Sample design and selection.
- Data collection protocols.
- Survey methodology and operations.
- Methods to measure lead loadings and concentrations in paint, dust, and soil samples.
- Quality assurance plan.

As previously noted, the objectives of the Survey were to obtain data to produce statistically reliable national estimates of a number of dimensions of lead-paint hazards. Thus, the research design had to accommodate methods for collecting data from a statistically valid national sample that would support analytical findings on the following: the number of private and public dwelling units with lead-based paint; totals of surface area of lead-based paint; prevalence of lead in dust and soil in or around dwelling units; paint condition; levels of lead hazard; characteristics of the household residents and structural characteristics of dwelling units with lead-based paint; and costs of abating the lead in these units.

The survey sample design began with the stratification of housing units into privately owned and publicly owned units. The design for private housing used a stratified random sample of 300 dwelling units developed through multistage area probability sampling. The design for public housing combined area probability sampling with sampling from lists of public housing projects to produce a sample of 100 public housing units. These sample sizes were affordable and provided the statistical precision needed for the national estimates required by Congress. The sampling plan stipulated the eligibility criteria for housing to be included in the survey sample, such as cut-off for age of construction (pre-1980) and type and usage of dwelling unit. For a complete list of criteria, refer to Section 3.3.

The methods designed to construct the sample frames and draw the sample involved a variety of methodologies at different stages of selection, including generation of initial sampling data from 1980 Census Bureau information, field listing and screening of housing units, telephone screening of sampled private units and public projects, and dividing the final sample into categories, or strata comprising private single and multi-family units and public units. Each methodology was stratified into one of three dwelling-age categories. The incorporation of age strata, or the categorization of housing stock by decades(s) of construction (see Section 3.4) into the design was based on differences in historical patterns in the use of lead-based paint. Age strata also were needed to analyze the associations between age of structure, paint condition, and the condition of the substrate, which is the construction material underlying the paint. Also analyzed were the lead loadings in dust, and lead concentration in soil. Refer to Section 5.7 for details on dust loadings and soil lead concentration.

The sample frame was constructed by selecting a sample of 30 counties designated as the Primary Sampling Unit that was used for both the private and public housing samples. For the private housing sample, five census blocks were selected in each county. A census block is a block or group of adjacent blocks in an urban area, or a Census enumeration district or group of adjacent enumeration districts in a rural area. Using detailed maps and listing forms, field interviewers traveled to the census blocks and developed lists of all housing units within each census block. A sample of the listed dwelling units was selected for further in-person screening interviews to determine the units' eligibility for the survey (in terms of their type and age) and to collect residents' names and phone numbers.

Telephone interviewers subsequently contacted residents of sampled eligible private units to administer a questionnaire about the household members, the dwelling unit and the structure. Interviewers also elicited inventories of rooms and scheduled on-site visits by field data collection teams.

For public housing units, however, the sample frame was constructed from HUD's national list of public housing units. Telephone contact was made with public housing administrators to update the lists, sample dwelling units, and collect structural data about the units.

The data collected in the field consisted of observational recording and structural measurements of randomly selected rooms and architectural components of the unit. Further observations and measurements covered the exterior of the structure, and common areas in multi-family structures. The design called for the collection of environmental samples related to these areas, and a data collection system that would permit the tracking and tying together of all data collected for each unit. The environmental samples were designed to measure the lead loading of sampled painted surfaces inside and outside the unit. Samples also were needed to measure the lead loading of interior dust and concentration of exterior soil at locations in and around the unit. Hence, the design spelled out the number and type of architectural components and locations around the unit that should be selected for measurement, observation, and sample collection.

The design also established the data collection methodologies for obtaining the data: telephone interviews and in-person interviews for household information and some structural data; observation and/or measurement for the rest of the structural and architectural data; *in-situ*, non-destructive readings of lead loadings on sampled paint surfaces using X-ray fluorescence devices; collecting dust samples using surface vacuuming/canister filter techniques; and taking soil core samples from selected ground areas outside the unit.

The survey design created the specifications for other necessary elements such as personnel qualifications and training protocols, protocols for collecting the environmental samples, and the chain-of-custody protocols for the samples and associated data. The design addressed other areas of quality assurance, such as field operations and laboratory analysis.

This research design reflects an explicit boundary of the survey. All audiences of the National Survey results should be aware it was never the survey's objective that the testing of sampled paint surfaces within homes be sufficient to prove or disprove whether a lead hazard existed in a specific home, or had the potential for hazard. The data collection was designed to provide the supporting basis for national estimates, not to determine definitively whether a particular house had lead-based paint present.

The statistical sample was specifically designed to permit the development of valid national prevalence estimates, even with limited data on any particular dwelling. Given the ratio of sampled surfaces to the total number of painted surfaces in a home, it is readily conceivable that lead-based paint could be present in a given home but not detected as part of a statistically based sampling procedure. Conversely, the testing protocol could have produced a very high lead reading where there was, in fact, no current hazard. That is, lead-based paint was present, but was totally enclosed.

To create extensive lead tests designed to say with certainty whether a lead hazard existed in each unit was beyond the scope of the survey and would have substantially increased cost and effort levels. Past experience has shown that the more burden placed on a survey's respondents, the more refusals that can result. There is generally a direct relationship between the length and intrusiveness of a data collection effort and the rate at which sample respondents decline to participate either beforehand or as a breakoff during the actual collection. Consequently, the increased time and effort spent in each unit can actually reduce the quality of the overall survey data, rather increase quality as might be expected from increased effort.

In the remainder of this report, each of the key components and individual elements of this design is presented in its appropriate section.

2.2.2 Sample Design and Selection

The sample design was the result of compromise between funding availability and the research objectives. The target of 400 dwelling units was affordable and provided the statistical accuracy needed to develop national estimates upon which government policy could be based. The sample selection followed a multi-stage design with the following stages:

Private Housing. A six-stage design was developed for private housing that consisted of four steps to select the housing units and two stages for selecting environmental sampling locations inside and outside the units:

- Selecting 30 counties, stratified by Census Region and climate zone.
- Selecting five census blocks per sampled county as the source for a screening sample of dwelling units.
- Selecting a sample of listed dwelling units in each block for in-person screening.
- Selecting a stratified random sample of approximately ten dwelling units from the screened dwelling units of each sampled county (an average of two units per census block).
- Selecting interior rooms and exterior walls from which to collect data and samples.

- Selecting the specific locations and types of construction materials in rooms, on walls, and outside the unit for sample collection.

This design produced a sample of 300 privately owned units. The 300 units were apportioned among six strata, described in full in Section 3.3. These strata were based on grouping by three construction age categories and single/multi-family dwelling-types. Following selection of a dwelling unit, two additional sampling stages covered *within-unit* (unit level) sampling for collecting observational and measurement data, and environmental samples, for selected architectural components/locations of the unit and surrounding area. These stages of sampling are described below in Sections 3.7 and 3.8. The interior and exterior architectural components such as doors, molding, cabinets, radiators, etc. were grouped into strata according to postulated similarity of function and similarity of painting history.

Public Housing. The public housing sample was drawn from these same 30 counties, but subsequent selection procedures varied somewhat. Lists of eligible (i.e., family units built prior to 1980) public housing projects were developed. The list frame provided a source for a stratified random sample of 100 public housing units in the sampled counties. The 100 units were apportioned among three public dwelling-unit age strata, described in full in Section 3.4. There was no attempt to limit PHA housing projects to the census blocks selected for the private housing sample. However, the within-unit sampling procedures were the same.

2.2.3 Data Collection Protocols

The survey design included a within-dwelling unit sampling plan so that when findings from all dwelling units were amassed in a single database, the resulting estimates of the percentage of homes with lead-based paint at different levels would be reliable. After the dwelling units were selected in the sample, a telephone interview was conducted to collect basic household data and to develop a full inventory of household rooms. For private housing, the interview was done with the resident. For public housing, the architectural information was collected from the PHA administrative contact. The household data was collected at a later time, during the on-site housing unit inspection.

A set of customized field data collection forms were then pre-printed for each household, reflecting the random selection, from the completed inventory, of one wet room and one dry room for the unit. A wet room has plumbing while a dry room does not. The forms also contained a scheme for the inspection team to choose particular architectural components from among all the possible components in the selected rooms, exterior wall, and common areas. This scheme was based on the previous assignment of a random priority to each possible component for each sampling location in each dwelling unit. The dwelling-unit inspection protocol called for the field team to verify the information on the form and do an inventory of architectural features by component and substrate material. The in-home inspection team only had to identify which surfaces were present and painted, and the form would tell them which of these to test.

The dwelling unit inspection protocol also called for the inspection team to take measurements of the architectural components, to be used for deriving the national estimates of total surface area of lead-based paint. To develop the criteria for priority lead hazards, the team also recorded observational data on the condition of the paint and the substrate material.

The design established similar protocols for the exterior of all sampled units and for adjacent hallways and common rooms of multi-family dwellings.

The same within-unit sampling plan was employed for both private and public housing.

Finally, the data collection protocols laid out systematic specifications for the number, locations, and sample collection/field measurement of environmental samples of paint, dust, and soil associated with each dwelling unit.

2.2.4 Paint, Dust and Soil Samples

The research design specified the collection of three types of environmental samples for each dwelling unit: paint measurements, interior dust samples, and exterior soil samples. The locations where various types of samples would be collected included:

- One wet room and one dry room, both randomly selected (paint measurements and dust samples).
- One other nonrandom, standard location within the units (dust sample).
- Any location within the unit for a *purposive* (see below for definition) paint test; one exterior wall of the building (paint measurements).
- The adjacent common hallway and main entry way for multi-family dwellings (paint measurements and dust samples).
- A randomly selected common room for multi-family dwellings (paint and dust samples).
- Soil around the building.
- Playground equipment (paint measurements) and playground soil.

The final location satisfies the survey's focus on the effects of lead on children. For more detail on identifying and choosing the environmental samples, refer to Section 3.7.

Paint Samples. The design called for collecting the data on paint-lead loadings using an in-situ, non-destructive protocol. It specifically eliminated the alternative, which entailed collecting paint scrapings from several locations in the unit and submitting them for laboratory analysis using Atomic Absorption Spectroscopy. The chosen protocol was to take readings of paint surfaces using MAP/XRF technology.

MAP/XRFs were selected for the paint-lead data collection, since they were deemed capable of taking readings of lead loadings on the premises, in a nondestructive manner, and with sufficient precision and reliability for the analytical objectives of the survey. The selection of the MAP/XRF was based on NIST studies that indicated that the "spectrum reading" MAP/XRF results were more accurate and precise than the previously-used "direct" reading MAP/XRF technology. Extensive pre-field, in-field, and post-field experiments were enacted to collect additional MAP/XRF readings to help in the evaluation of the MAP/XRF readings.

The protocol for measuring paint-lead loading with the MAP/XRF specified a single reading of 60-second duration using a 40 millicurie cobalt source. For each component to be tested, the protocol provided for the technician to use individual discretion in choosing a convenient and safe spot that was accessible, there was no person on the other side of the wall, and where there was no electrical wiring or pipes with leaded joints in the wall).

The protocol for selecting the locations to be tested used a combination of random, standard and *purposive* selection of locations and of architectural components within locations. For purposes of this report, purposive selection involves the intentional selection of area most likely to have lead paint. The protocol called for the field team to identify painted surfaces and their substrate material, in order to place them in the architectural component strata determined by the sample design.

Identification and Measurement of Painted Areas. The paint sampling protocol also required the field team to identify, classify and measure the area of major painted components, such as walls and ceilings. The identification/classification protocols established standard rules for dealing with classifying and recording measurements for single components with more than one substrate (e.g., both wood and plastic baseboards). For sampled components with multiple discrete occurrences (e.g., 3 windows), the protocols called for the field team to classify and measure all of them, then choose which one to test at their discretion, all other factors being the same. In order to limit the amount of time spent in the dwelling unit, the protocol settled on a procedure to measure only the length of certain types of components (such as baseboards) and count other types (such as doors and windows), then apply standard parameters for widths or areas during the analysis stage.

Dust Samples. The dust collection protocol established fixed locations in the unit as a whole, in individual sampled rooms, and in multi-family housing common areas for the collection of dust samples. All dust samples were collected using portable vacuums. For floors, the collection technique was vacuuming of dust from a four-square-foot floor area, using a template to define the vacuumed area. For window sills/stools or window wells[18] , the protocol defined a sample as the accumulation resulting from continuous vacuuming until "enough" dust was collected (or until all window sills/stool or all window wells in a sampled room had been vacuumed). A cumulative area measurement of all vacuumed areas was then recorded for the sample.

Soil Samples. The soil collection protocol established three standard locations around the building exterior, and three more from any common play areas.

The collection technique involved using a corer to take samples from the soil. The protocol defined a sample as a blended composite of three cores taken at twenty-inch intervals from each sample location. The protocol also addressed the depth of the core and the amount of each core to use for the sample.

The soil collection protocol also set up rules for types of areas to avoid (such as depressions collecting runoff from other areas) and how to handle typical urban situations where there may be a scarcity of locations suitable for soil sampling.

The decisions for the locations for dust and soil samples were designed to correspond with the pathway models being tested.

For all three types of environmental samples, the protocols prescribed the standardized techniques for using the sampling equipment during the actual collection (for both accuracy and purity of sample), as well as proper handling between samples and between visits. They delineated the guidelines for handling and cleaning the collection devices during and between each sampling activity. For these samples, protocols also put in place measures to prevent cross-contamination from outside the sampled unit, from the field technicians, or from one sample to the next. The protocols addressed the handling, storage, protection, and shipment of the collected samples. Copies of the dust and soil sampling protocols are found in Appendix A of this document. The protocols are documented in the Field Manual.

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[18] The window sill is the building component forming the bottom of a window opening. The window stool is the flat, horizontal molding fitted over the sill, on the window interior, between jambs. The window well is the horizontal area of the sill that comes in contact with the bottom rail of the operating sash when closed.

3. SAMPLE DESIGN AND SELECTION

This section presents a detailed description of the sample design of the National Survey. The survey design was based on a multi-stage, stratified random sample. Private and public housing were sampled, using somewhat different methodologies. This section covers both.

3.1 Target Population

Private Housing Population

Except for the categories listed below, the study population consisted of all housing in the United States constructed before 1980. Newer houses were presumed to be lead-free because, in 1978, the Consumer Product Safety Commission banned the sale of lead-based paint to consumers and the use of such paint in residences.

Certain other categories of housing were also excluded from the study:

- Housing used exclusively by the elderly or handicapped, e.g., housing in which the minimum age of residents is 50 and no children are allowed to reside.[19]
- Housing for the elderly insured under Section 231 of the National Housing Act.[19]
- Group quarters such as nursing homes or dormitories.
- Vacation homes.
- Homes in Alaska and Hawaii.
- Military housing.
- Unoccupied housing.

Thus, along with housing constructed after 1979, these categories were all defined as out-of-scope and thereby ineligible for the survey. All other private housing formed the population eligible for the survey. Approximately 77 million units were in the target population.

Public Housing Population

The survey was limited to public housing owned and assisted by public housing authorities. There are other forms of housing subsidies, notably Section 8, which were not considered eligible. Only public housing projects were included. Single-family dwellings, such as scattered-site public housing, were excluded. The sample frame included only housing eligible for assistance under the Comprehensive Improvement Assistance Program (CIAP).

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[19]Housing for the elderly is exempt from the provisions of Section 302 of the Lead-Based Paint Poisoning Prevention Act.

Additional exclusion criteria are as follows:

- Projects that were no longer active in the public housing program.

- Projects that completed construction in 1980 or later.

- Projects or units designated as elderly housing.

- Projects where the proportion of elderly units is 90% or more.

All of these categories were defined as out-of-scope and therefore, ineligible for the survey. All other public housing formed the population eligible for the survey.

The following criteria were used to define elderly housing for the purpose of the sample frame:

- Units in a project or building formally designated for elderly use under HUD procedures for the public housing program. (The designation may have occurred at the inception of the project or at a later date.)

- Units for which elderly have preference in tenant selection as approved by HUD.

- Units with less than one bedroom.

3.2 Sample Design : Selection of Counties

A sample of 30 counties was selected from the approximately 3,000 counties in the United States. The counties were stratified by climate and census region and selected with probability proportional to size. The size measure was the 1980 population.

In order to optimize the Congressionally required estimates, a design stratified on dwelling unit age and type was constructed. Privately owned dwelling units were grouped into:

- Two types of housing:

  - Privately owned single-family houses, defined as having one to four dwelling units.

  - Privately owned multi-family houses, defined as having five or more dwelling units.

- Three age categories designated by construction date:

  - Built between 1960 and 1979.

  - Built between 1940 and 1959.

  - Built before 1940.

Table 3-1 displays the national distribution of occupied privately owned housing by construction year and housing type. The private dwelling units were allocated across the strata using statistical optimality criteria. The basic sample design is laid out in Table 3-2.[20]

- Public housing was grouped into three age categories of construction date:
  - Built between 1960 and 1979.
  - Built between 1950 and 1959.
  - Built before 1950.

A sampling frame is the source from which sample units are selected. Two data sources were used to compile the county-level information for the initial sampling frame:

- For private housing -- Bureau of the Census tape "1980 STF3C - National Data", containing information for each county or county-equivalent in the contiguous United States.
- For public housing -- A HUD file, where each record described a public housing project.

The number of private single family and multi-family dwelling units in each county was obtained from the Census tape. Furthermore, the distribution of private dwelling units by year-interval of construction (pre-1940, 1940-1959, and 1960-1979) was estimated for each county. These intervals defined the age-strata for private housing; they permitted roughly equal distributions of the housing population, given that the source data were not broken down below the decade level, and the desirability of separating pre- and post-World War II housing stock. Under the assumption of independence of housing type and age, their joint distribution was estimated for each county and for all counties combined. The desired sample size of 300 private dwelling units was distributed among the six strata (two housing types multiplied by three age intervals) proportional to the national experience, with a slight oversampling of multi-family units.

Public housing information on the HUD file was summarized in the following manner. The number of non-elderly dwelling units by year-interval of construction completion (pre-1950, 1950-1959, and 1960-1979) was tabulated for each county and for all counties. These intervals are the three strata for public housing. Note that the two older age strata for public housing used 1950 as the dividing boundary, while the same strata for private housing used 1940. This was done because almost no public housing was constructed prior to 1940. For the cumulative data, the approximately four percent of the dwelling units with missing date of construction were distributed proportionally over the three intervals. The sample size of 100 public housing units (plus 10 more for attrition) was then distributed over the three intervals proportional to the national experience. Using these data, the sampling rate was constructed for the three public housing domains.

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[20] It was estimated that this design would result in estimates of percentages having confidence intervals no wider than ± 7 percent for private single-family housing and no wider than ± 12 percent for private multi-family housing.

TABLE 3-1
NATIONAL DISTRIBUTION OF DWELLING UNITS BUILT BEFORE 1980

Number of Pre-1980 Dwelling Units (000)				
	Construction Year			
Type	1960-1979	1940-1959	pre-1940	Total
Privately Owned-Occupied				
Single Family	29,137	18,782	18,499	66,418
Multifamily	6,548	1,690	2,521	10,759
Sub-Total	35,685	20,472	21,020	77,177
	1960-1979	**1950-1959**	**pre-1950**	**Total**
All Public, Family Units	182	278	346	807
Total	35,867	20,750	21,366	77,984

Source: 1987 American Housing Survey.

TABLE 3-2
SAMPLE DESIGN PLANNED FOR NATIONAL SURVEY OF LEAD-BASED PAINT IN HOUSING

Survey Design				
	Construction Year			
Type	1960-1979	1940-1959	pre-1940	Total
Privately Owned-Occupied				
Single Family	104	63	59	226
Multifamily	34	21	19	74
Sub-Total	138	84	78	300
	1960-1979	**1950-1959**	**pre-1950**	**Total**
All Public, Family Units	49	21	30	100
Total	187	105	108	400

A dichotomous climate severity variable was created for each state based on the classification system of the American Housing Survey (Hadden and Leger, 1988)[21] anticipating that maintenance of a structure including painting would differ by climate severity. Those states with a mild climate rating by Census geographic region are:

Northeast:
New Jersey, Pennsylvania, Rhode Island

North Central:
Illinois, Indiana, Kansas, Missouri, Nebraska, Ohio

South:
Alabama, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina, Texas

West:
Arizona, California, Nevada, New Mexico, Oregon

The remaining states had a severe climate rating.

When the two county-level files (one containing information on private housing and the other on public housing) were merged, an indicator of public housing availability was created to differentiate those counties with a Public Housing Authority from those without one. A composite size measure that reflected numbers of units in each of the nine strata of interest (three dwelling ages multiplied by three dwelling types) was also constructed at this point. The resulting file was then sorted by several characteristics: public housing indicator, Census region, climate rating, State, and size measure. Thirty counties were then selected via a probability minimum replacement (PMR) selection scheme (Chromy 1979, Williams and Chromy 1980).[22]

3.3 Multi-stage Sample: Differences Between Private and Public Sampling Procedures

To carry out the sample design, a multi-stage area probability sample was drawn according to the stages outlined below. The first four stages pertain to the selection of dwelling units and the last two pertain to selecting locations and architectural components within each unit. Certain aspects of the initial frame development and operational sampling procedures were different for the private and public strata of the sample. Where differences occurred, the comparable stages for private and public sampling are presented in parallel columns. Figure 3-1 is a summary display of the multi-stage outline. The details of each stage follow.

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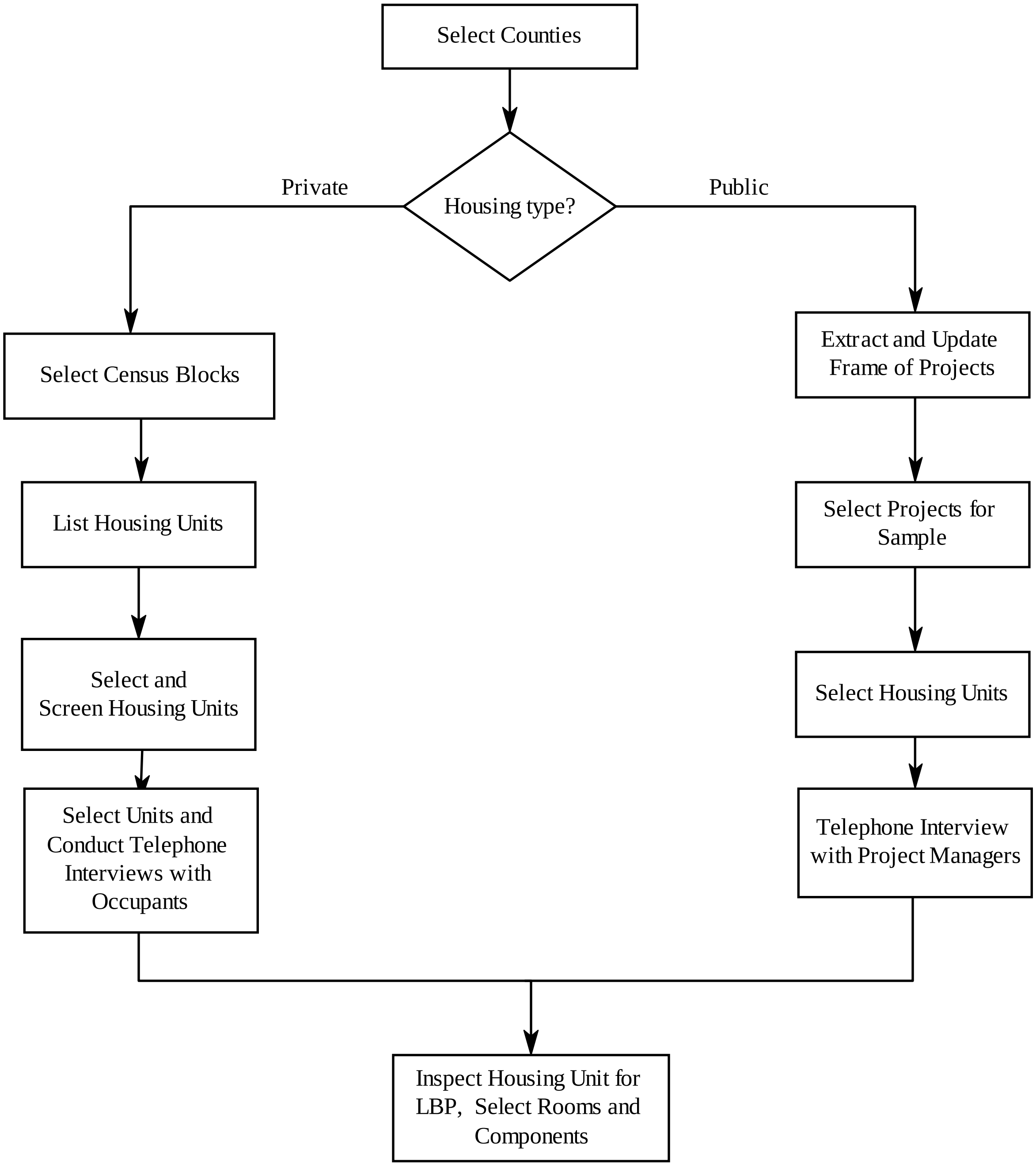
[21] Hadden, L. and M. Leger (1988). Codebook for the Annual Housing Survey Database. Project Report by Abt Associates under HUD Contract No. HC-5740.

[22] Chromy, J.R. (1979). "Sequential Sample Selection Methods," Proceedings of the American Statistical Association. Williams, R. and J. R. Chromy (1980). "SAS Sample Selection Macros," Presented at 1980 SAS Users Group Annual Conference, San Antonio.

FIGURE 3-1 MULTISTAGE SAMPLE DESIGN



- Stage 1. A stratified sample of 30 counties was selected with probability proportional to size as described in Section 3.2.

PRIVATE HOUSING SAMPLE

- Stage 2. Within each sampled county, five census blocks were selected. Lists were developed of every housing unit within each census block.

- Stage 3. A sample of the listed dwelling units was selected for in-person screening visits to determine the type and age of the units, to establish eligibility for the Survey. An average of 20 units were screened per census block.

- Stage 4. From the approximately 11 eligible units in each sample census block, two (plus backups) were randomly selected inclusion, resulting in a total target sample of 300 households.

- Telephone interviews were conducted with residents of the sampled units to collect preliminary information needed to plans and carry out the within-unit subsampling in stage 5

PUBLIC HOUSING SAMPLE

- Stages 2/3. Within each sampled county, lists of Public Housing Authority (PHA) housing projects, and numbers and types of units in projects, were developed from lists supplied by HUD.

- Stage 4. From the final corrected list frame, a stratified random sample of 110 projects was drawn, and one unit was drawn within each project. 110 units were chosen to yield the desired sample size of 100, after expected attrition for out-of-scope, refusals, etc.

- Telephone interviews were conducted with project administrators of the sampled units to collect preliminary information for subsampling within units.

- Stage 5. Two rooms were selected at random for testing in each sampled dwelling unit. One was a random selection from among the dry rooms and the other from among the wet rooms.

  One exterior wall of the dwelling unit was similarly selected, inventoried for architectural components, and assessed; several components from within these groups were selected at random for paint testing.

- Stage 6. All components (architectural features) in the wet and dry rooms and on the exterior wall were inventoried, grouped into one of four component categories, and assessed for paint history. A random sample of one or two surfaces from each of the four groups was selected for paint lead testing.

Dust sampling was done in three rooms/locations within the unit, and in two common-entry locations where applicable. Soil sampling was done in three locations outside the building. Paint and dust sampling were done using the same sampling rules in one randomly selected common area of multifamily dwellings. Purposive paint and soil samples were taken from any common playground area.

This multi-stage design was chosen over other approaches because it efficiently and economically satisfied major operational requirements of the study. The objectives and design of the study required in-person visits to the sampled dwelling units. The clustering of homes allowed those visits to be conducted much more economically. Also, a survey sample requires a *sampling frame*, i.e., a list of all dwelling units eligible for the survey. For private housing, no such list exists nationally, or even in many localities. In light of time and cost constraints, the required number of lists was minimized by using the multi-stage area probability sample for the private housing. A geographic grouping of the sampled homes was deemed to be operationally efficient and statistically acceptable. Also, tying the development of the public housing list frame to the same counties as used for the private housing extended the efficiency of the clustering of the whole survey operation. The following sections provide the details and rationale for the design.

It should be noted that the cost of efficiencies of clustering come with a price. Because homes in the same neighborhood tend to be more alike than homes in different neighborhoods, the precision of estimates calculated from a clustered sample is less than the precision from a single random sample. As a rule, clustering is used when the expected cost savings outweighs the expected precision loss. It was anticipated that this clustered design of 400 homes would result in sampling errors of two to six percentage points for estimates of percentages.

3.4 Within - County Private Housing Sample Selection

Census Block Sampling

With each of the 30 sampled counties, five census blocks were selected using systematic random selection. To ensure that the full spectrum of income levels would be represented in the sample, a measure of wealth was computed for each census block. The measure of wealth was created from a weighted average of the value of owner-occupied housing and the rent of renter-occupied housing. The blocks were sorted by this wealth measure and every *n*th block was selected, where *n* was chosen to be one-fifth of the number of blocks in the county. Thus, one census block was selected from the poorest fifth of the census blocks in the county, one census block was selected from the second poorest fifth, and so on, up to the richest fifth.

Developing the Private Sample Frame

Field interviewers were sent to each of the 150 census blocks in the 30 counties to list every dwelling unit in the census block. This process created a frame for the sampling of dwelling units. The interviewers listed 27,833 dwelling units, an average of 186 per census block ranging from 0 to 2,467 housing units.

Selecting the Screening Sample

Samples of dwelling units were selected from the lists using systematic random sampling procedures. Every *n*th dwelling unit in the list was selected where *n* was chosen to result in a fixed sample size for the census block. At this stage, approximately 3,000 units, or ten times the desired final sample size of 300 was selected, to allow for attrition due to out-of-scope units, refusals to participate, and other losses.

Screening of Dwelling Units Sampled from Segment Lists

The sampled dwelling units were visited by a field interviewer, who conducted a brief screening interview with an adult occupant. The objective of the screening interview was to determine if the dwelling unit was eligible for the survey and, if so, to which of the six age/type strata it belonged. Screening was attempted on 2,978 dwelling units, an average of 20 per census block. Fifty-four percent of these dwelling units were determined to be eligible for the survey.

Sampling of Eligible Units

A sample of dwelling units was randomly selected from the eligible homes according to the survey design in a manner that maintained the sample design structure (in terms of housing type and construction date) and ensured that all eligible census blocks were represented in the sample. To allow for attrition (refusals, unable to contact, etc.), the initial sample size was inflated by about 50 percent, to 447 units. For 403 of these units, a reserve or backup unit was selected from the same county and design stratum. The backup was telephoned only if the primary unit failed to yield an appointment for an inspection visit, or canceled after making the appointment.

Telephone Interviews with Sampled Screened Units

Household interviews were conducted by telephone with the sampled homes (and backups when necessary) to collect detailed information about the dwelling unit and the rooms in the dwelling unit to be used for within-unit sampling. Additional data concerning the occupants (i.e., occupation, hobbies, age, income) were collected. Appointments were made to visit the dwelling unit. Ultimately, 607 units were contacted by telephone. Appointments were made with 55 percent of the dwelling units for a total of 332 appointments.

Private Housing Unit Sample Substitution Plan

In-field substitution of dwelling units was not allowed in the private housing design. In cases where a respondent was unable or refused to keep an appointment, the field interviewer reported this immediately to the field manager. The backup sample for the dwelling unit in question was then contacted by the telephone staff to conduct the Household Interview and schedule an appointment for the inspection team while they were still in the county.

Final Sample Size

Inspection visits were completed in 284 private dwelling units, 86 percent of the 332 appointments. Table 3-3 displays the distribution of the completed inspections across the six design strata. Figure 3-2 displays the development of the private housing sample and includes a yield by sample stages. Table 3-4 displays the development of the sample from screening through completed inspection as a percent of units at the prior stage.

TABLE 3-3
DISTRIBUTION OF COMPLETED INSPECTIONS
BY CONSTRUCTION YEAR AND DWELLING UNIT TYPE

Completed Inspection Visits				
	Construction Year			
Type	**1960-1979**	**1940-1959**	**pre-1940**	**Total**
Privately Owned- Occupied				
Single Family	94	72	61	227
Multifamily	26	15	16	57
Sub-Total	120	87	77	284
	1960-1979	**1950-1959**	**pre-1950**	**Total**
All Public, Family Units	30	24	43	97
Total	150	111	120	381

FIGURE 3-2
DEVELOPMENT OF THE PRIVATE HOUSING SAMPLE:
YIELD BY SAMPLE STAGES

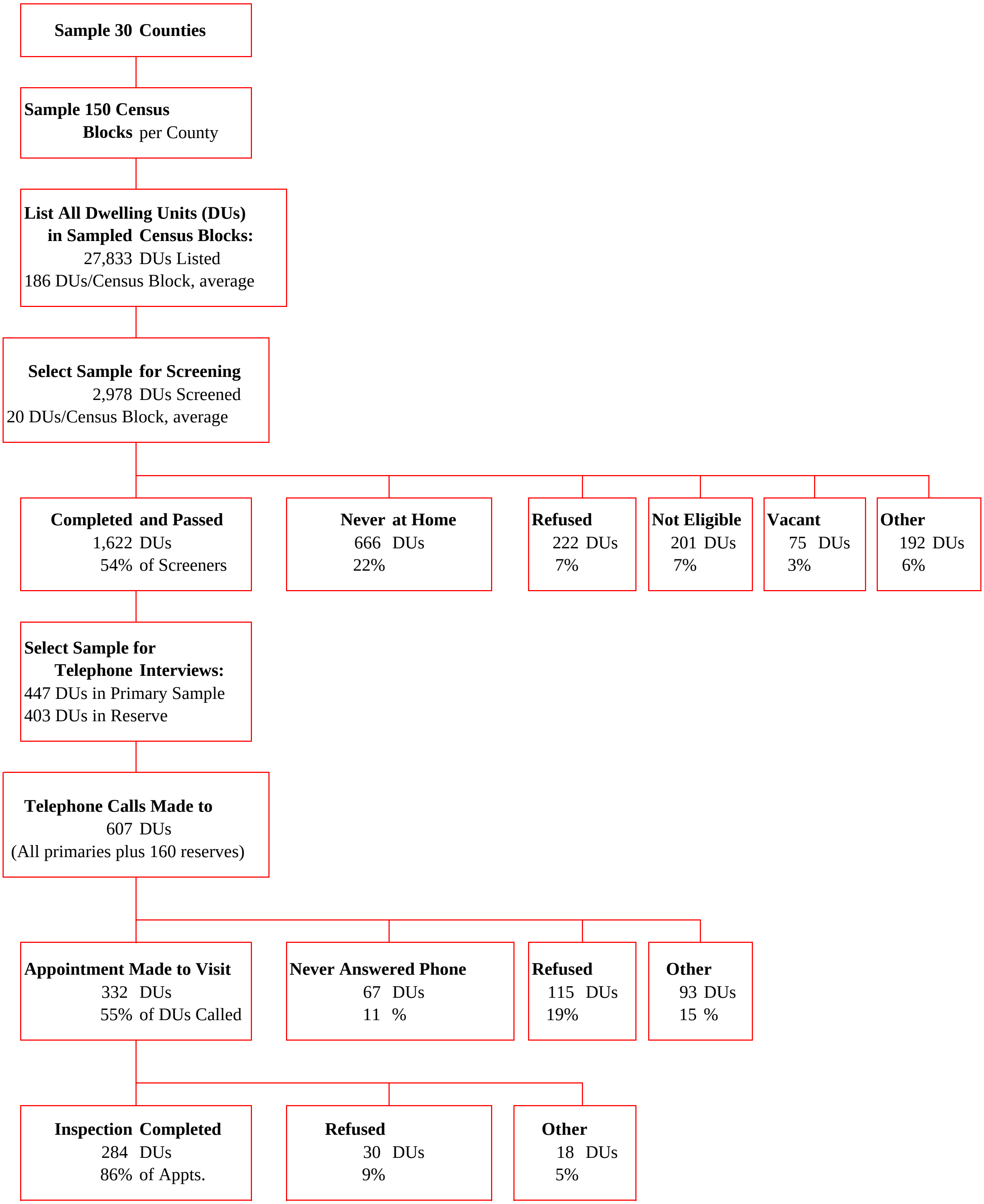


TABLE 3-4
DEVELOPMENT OF PRIVATE HOUSING SAMPLE FROM SCREENING THROUGH COMPLETED INSPECTION AS A PERCENT OF THE PRIOR STAGE

a. Passed Screener - Pct of Population

Type	Construction Year 1960-1979	1940-1959	pre-1940	All
Single Family	1.5%	2.6%	2.4%	2.0%
Multifamily	2.0%	3.3%	3.3%	2.5%
All	1.6%	2.6%	2.5%	2.1%

b. Primary Phone Sample - Pct of Passed Screener

Type	Construction Year 1960-1979	1940-1959	pre-1940	All
Single Family	36%	20%	21%	25%
Multifamily	35%	56%	34%	39%
All	36%	23%	23%	28%

c. Total Phone Sample - Pct of Passed Screener

Type	Construction Year 1960-1979	1940-1959	pre-1940	All
Single Family	46%	31%	28%	35%
Multifamily	44%	71%	49%	51%
All	46%	35%	31%	37%

d. Appointments - Pct of Total Phone Sample

Type	Construction Year 1960-1979	1940-1959	pre-1940	All
Single Family	56%	54%	59%	56%
Multifamily	59%	41%	45%	50%
All	57%	51%	55%	55%

e. Completed Inspections - Pct of Appointments

Type	Construction Year 1960-1979	1940-1959	pre-1940	All
Single Family	84%	90%	86%	86%
Multifamily	74%	94%	89%	83%
Total	82%	91%	87%	86%

3.5 Within - County Public Housing Sample Selection

The selection process for public housing units followed a different path than that for private housing. The public housing plan was designed to utilize existing records (HUD's computerized listing of PHA properties) and resources (HUD regional and PHA staff). It is generally more efficient to create a sample frame from existing records and lists than to develop a frame by collecting new data, as in the case of the private housing sample. The availability, accuracy and comprehensiveness of existing list sources are factors in deciding whether to use existing lists as the starting point for the sample frame.

Public Housing Frame Development

The frame for the public housing sample was developed from a data file, provided by HUD, that contained information on each public housing project in the nation. The file contained 10,140 records of projects with a total of 933,573 family units. Of these, 7,483 projects, with 796,656 family units, were reported to have been built before 1980.

All records on the file that described public housing projects in any of the 30 sampled counties were extracted. The extract included presumably out-of-scope projects, such as projects reported to have been built after 1979, or to have no family units. There were 793 records of projects, with 186,210 family units, on the extract.

To ensure that the frame data was as current and accurate as possible, all PHAs in the 30 counties were contacted to verify and update the following data for each project in the extract: existence, name, location, construction date, and number of family units. The verification effort also sought to identify any in-scope projects in the PHAs' inventory that were not on the extract from HUD's records. If so, these projects were added to the frame. Projects were in-scope if they were built before 1980 and had one or more family units.

After adding newly identified projects and eliminating out-of-scope or non-existent projects and units, the final sampling frame had 636 records of projects containing 205,565 family units. Three of the 30 counties had no in-scope public housing units. An additional eight counties each had less than 500 in-scope units. The three largest counties accounted for 111,363 in-scope units.

Sampling of Projects and Dwelling Units from Lists

After the PHA housing inventory list was verified and corrected, it was divided into the three age strata. Each stratum was sorted by county. The public housing sample was designed to be equally probable within age strata. That is, all units in the same age stratum had the same probability of selection, although units in different age strata had different selection probabilities. In order to sample public housing family units with equal probability within age strata, projects were sampled with probability proportional to their sizes. The measure of size was the number of family units in the project. Units within projects were then sampled with equal probability. One dwelling unit within each sampled project was randomly selected for inclusion in the study. Because of past practices in public housing projects, painting history is likely to be very similar for all units at the same public housing project location. Thus, the sampling plan specified that no more than one unit from a specific project could be selected as a primary sample.

To allow for attrition, 110 projects were selected, with the goal of achieving the target sample size of 100. During the course of the field work, it was discovered that eight projects that had previously been reported as in-scope, and had been selected into the sample, were in fact out-of-scope. The reasons included: the project didn't exist, a project was listed twice under different names, and there were no pre-

1980 family units in the project. These eight projects were in four different counties and contained 2,519 units.

Telephone Interviews with PHAs to Sample Units from Selected Projects

Thus, after selection of the 110 projects, the next sampling stage randomly selected one unit from each project, as follows. A telephone representative contacted each PHA with a sampled project and determined how units within the project were numbered or listed. The interviewer used whatever listing was available or convenient for establishing a clear sequence of all units in the project as a serial list numbered 1 through N, where N was the total number of units in the project. (For instance, if the units were numbered 1-A through 1-F, 2-A through 2-F, etc., 1-A might become unit number 1, 1-B unit number 2, ... 1-F unit number 6, 2-A unit number 7, etc.) The telephone representative guided the PHA representative in assigning the serial numbers and counting through the list to the randomly selected dwelling unit. (For the previous example, if random number 9 were assigned for the sampled unit in that project, counting to the 9th unit would identify 2-C as the sampled unit.) This dwelling unit became the sampled unit for that project.

Public Housing Unit Sample Substitution Plan

Frequently no one from the survey team or the PHA spoke directly with the unit resident prior to the visit. Substitutions for sampled units were occasionally necessary due to the unsuitability of the unit (e.g., the unit was under renovation, the building was inaccessible due to construction). An on-site substitution plan was established which allowed a visit to a substitute unit which was in the same building and had a similar floor plan and paint history. The field staff followed five sampling substitution rules:

- If the sampled public housing unit was not available, select the unit immediately above the sampled unit.
- If there was no such unit or it was unavailable for any reason, select the unit immediately below the sampled unit.
- If there was no such unit or it was unavailable for any reason, select the unit to the right of the sampled unit.
- If there was no such unit or it was unavailable for any reason, select the unit to the left of the sampled unit.
- If all these options were exhausted, the PHA should designate a unit that could be entered for inspection.

Final Sample Size

In addition to the eight projects discovered to be out-of-scope, there was one refusal and four cases of canceled or incomplete inspection visits. The final public housing sample thus consisted of 97 completed inspection visits completed out of 110 initially sampled units.

3.6 Sampling Within the Dwelling Unit

The within-unit sampling plan was an integral part of the multi-stage design. As mentioned in Section 2.2.1, the research design specifically adopted a sampling approach that was meant to yield national estimates, not to perform extensive lead testing of specific units. This design resulted in part from resource limitations and from the need to minimize respondent burden during the unit inspection. These considerations led to the within-unit sampling plan described in this section. This plan employed a stratified approach of random, fixed, and purposive selection of rooms, locations, architectural features in and around the unit which would be the target of environmental samples and measurements. This design met the goals of controlling the number of observations per unit, producing data for national estimates, and permitting a link to current understanding of the typical applications of lead-based paint in the home and pathway models for the dispersion of lead between the home and the environment.

The sample design called for the same within-unit sampling procedures to be used for both private and public housing. The within-unit procedures cover all sampling that took place at the unit level. The final design of random, fixed, and purposive selections for locations, architectural components, and types of environmental samples/measurements can be described in terms of the following stages and categories.

Rooms/Locations

In the first stage of within-unit sampling, rooms or other locations were selected as follows.

Room or Location	Environmental Sample
Interior of unit: 1 wet room and 1 dry room	(paint and dust)
Interior of unit: main entry way	(dust)
Exterior of building: 1 wall	(paint)
1 common area room*	(paint and dust)
Outside unit/inside building:	
Common hallway adjacent to unit*	(paint and dust)
Common hallway inside main entrance to building*	(paint and dust)
Outside building:	
Surrounding ground	(soil)
Play area*	(paint and soil)

* If present (multi-family only)

From among all rooms in a household, one wet room and one dry room were selected at random based on information obtained in the telephone household interview. Previous studies indicated that rooms with plumbing fixtures (e.g., bathrooms, kitchens) had a higher likelihood of having lead-based paint. In terms of the number of rooms and the square footage of paint therein, though, wet rooms were outnumbered by dry rooms. The stratification by wet and dry helped ensure adequate coverage of both types of rooms.

Architectural Components

At the next stage of within-unit sampling, all possible painted surfaces were categorized into four strata of architectural components. This stage applied to sampled rooms (wet, dry, and common) and to the sampled exterior wall, and was used exclusively for collecting paint-related data. It employed the following pre-determined list of:

Room Component Strata:

- Walls, ceiling, and floor.
- Components made of metal substrates (e.g., metal molding, window frames, door frames, radiators).
- Components made of nonmetal substrates (e.g., wood door and window systems, wood molding).
- Other (e.g., built-in shelves, cabinets, fireplace, etc.).

Exterior Wall Component Strata:

- Wall.
- Components made of metal substrates (e.g., metal trim, window frames, door frames, railings, columns).
- Components made of nonmetal substrates (e.g., wood trim, window frames, door frames, railings, columns).
- Other (e.g., porch, stairs, etc.).

For the components in strata 2 and 3, the critical distinction was the substrate. For rooms, *all components in the room* were part of the sample frame. For the exterior wall, *only the components attached to that one wall* were part of the sample frame.

One painted component was selected from each of the four strata, with a fifth randomly selected from among all four strata. (After random selection of one exterior wall, the wall itself was a unique stratum, with a certain selection as a sampled component.)

These strata were constructed to help ensure a representation of the occurrence of lead-based paint on these different, common building materials. Each of the substrate materials was anticipated to have a potentially different frequency of usage for lead-based paint, and different characteristics of usage. The four strata were designed to group components likely to have similar painting histories. This approach met the design goal of ensuring equal representation of the four strata. The stratification of painted surfaces into these four component groups helped ensure adequate coverage for each type of substrate material, with minimal MAP/XRF tests.

Environmental Sample Selection

The combination of the room/location sampling and the architectural component sampling determined the final selection and distribution of environmental samples collected and physical measurements taken. The distribution of the samples is presented in Table 3-5.

TABLE 3-5
DISTRIBUTION OF ENVIRONMENTAL SAMPLES

	Paint	Dust	Soil
Unit Interior			
Wet Room	5	3	
Dry Room	5	3	
Entry Way	1		
Purposive, Anywhere in Unit	1-2		
Building Common Areas*			
Common Hallway	1	1	
Common Main Entrance	1	1	
Common Room/Area	5	3	
Building Exterior			
Wall	5		
Purposive, Anywhere on Wall	1-2		
Outside Surrounding Area			
Entry Way			1
Drip Line			1
Remote Location			1
Play Equipment*	1-8		
Play Area			3

* If present; for multi-family only

The following outline presents brief descriptions of the types of selection criteria for these samples:

1. Random sampling

   - 10 paint samples: 2 rooms sampled. For each room

     - Subsampling of 1 architectural component from each of the 4 groups of interior components per room, plus a 5th selection: 1 component randomly selected from 1 of the four groups.

     - Measurements and counts of all painted components in each room.

   - 5 paint samples: 1 exterior wall sampled. For the wall:

     - Wall selected as 1 component; subsampling of 1 architectural component from each of the other 3 groups of exterior components, plus a 5th selection: 1 component randomly selected from 1 of the four groups.

     - Measurements and counts of all painted components on the wall.

   - 5 paint samples: 1 common room sampled, if present (multi-family housing only). For the room:

     - Subsampling of 1 architectural component from each of the 4 groups of interior components, plus a 5th selection: 1 component randomly selected from 1 of the four groups.

     - Measurements and counts of all painted components in each room.

2. Standard location sampling

   - 2 paint samples: wall outside unit in common hallway and wall inside common front door of building (multi-family housing only).

   - 1 paint sample for each type of outside play equipment, if present (multi-family housing only). Up to 8 samples taken.

   - 1 dust sample inside unit entry way.

   - 2 dust samples: outside unit in common hallway and inside common front door of building (multi-family housing only).

   - 1 soil sample outside front entry way of building and 1 soil sample at remote location.

   - 3 soil samples in play area, if present (multi-family housing only).

3. Fixed locations within randomly selected areas

   - 6 dust samples: 3 dust samples (floor, window sills, and window wells) within each of the 2 randomly sampled rooms.

   - 3 dust samples (floor, window sills, window wells) within sampled common room, if present (multi-family housing only).

   - 1 soil sample from *drip line*, or collection point for run-off from a painted exterior wall of randomly sampled exterior wall.

4. Purposive (field technician to search for surfaces most likely to have lead based paint)

   - Up to 2 paint samples of any components anywhere in unit.

   - Up to 2 paint samples of any components anywhere on exterior of building.

Sampling Procedures

In order to minimize delays and complexities in the field operations, the actual sampling of the wet and dry room and the sampling of five components (within the four component strata) was conducted prior to the site visit based on the room inventory obtained during the telephone Household Interview. The random sampling of the exterior wall and of its components and the assignment of the random priority to potential common rooms their components also was prepared ahead of time.

The wet/dry room selection was a simple random pick based on numbers drawn from a random numbers table. The sampling of components within strata was more complex. The forms used to collect data in the field listed all possible architectural components within a stratum. For each housing unit the following sampling approach was used. Based on a random sampling algorithm, each component within each component stratum was assigned a random rank order ranging from 1 through n (n = the number of component types in the stratum). The field data collection forms for each unit were then individually produced with this randomly selected rank ordering of components within strata. The field staff used each unit's custom form to determine the component that had been ranked as "1" in its stratum. If that (e.g., ceiling) was painted and accessible, it was tested. If the component was not present, was unpainted, or was inaccessible, the form specified what other component should be substituted (the component numbered "2"). Every component was assigned a number specifying its rank in the substitution order.

The same approach was used for component sampling on the exterior wall and for common room sampling in multi-family housing.

Because random techniques were used to sample painted surfaces, there was concern that some lead-based paint in the home might go undetected. In order to minimize the probability of missing lead-based paint in a home, technicians were instructed to look for and test painted surfaces in the dwelling unit deemed likely to contain lead. The technicians' selections were based on their knowledge of past painting practices and experience with testing paint for lead. If the first test failed to find lead, a second selected surface was tested. Due to practical constraints, the technicians sometimes were limited to searching for lead-based paint in areas of the dwelling unit entered during the course of the inspection and did not wander throughout the dwelling unit looking for lead-based paint. A similar set of one or two purposive samples was taken for the exterior wall.

3.7 Dust and Soil Sampling

Dust and soil sampling were conducted at pre-established locations that paralleled key points in several lead dust pathway models. These locations, the rationales for dust and soil sampling, and the number of samples were as follows:

Dust samples:

- Floor of wet room (1) and dry room (1).

  The floor is a collection sink for dust; children come into direct contact with it when crawling or playing.

- Window sills/stools of wet room (1) and dry room (1).

- Window wells of wet room (1) and dry room (1).

  The windows are boundaries between the interior of the unit and exterior sources of environmental lead; the wells are collection sinks for dust; the abrasion of opening/closing windows causes paint dust to collect on horizontal window components.

- Inside most frequently used entry to dwelling unit (1).

- Outside unit in common hallway (1) and inside common front door of building (1) for multi-family housing only.

  Entry ways and common heavy traffic areas are more likely to collect deposits of soil tracked in from outside the building.

- Common room floor (1), window sills/stools (1), and window well (1) for multi-family housing only.

Soil samples:

- Near front entry way to structure (1).

  The entry way is a proximate source of exterior soil lead that could be tracked into the interior.

- At drip line of sampled exterior wall for building roof (1).

- Remote location halfway between dwelling unit and property line (1).

  The remote location provided data on the background contribution of environmental sources of lead not associated with the unit or building itself.

- Play area if present (3) for multi-family housing only.

  Play areas are likely sources of exposure for children.

4. DATA COLLECTION PROTOCOLS

4.1 Data Requirements

The information collected was needed to support a number of research questions, as discussed in Section 2. Information covered the percent of housing with lead-based paint hazards and analyses of: the characteristics of housing with varying hazard levels; costs, the effectiveness and benefits of alternative strategies of reducing lead-based paint hazards; and the relationship among sources and pathways of lead in the residential environment. Information also covered identification of the dimensions of each of these issues.

In order to obtain data that would support these analyses and the more detailed questions described in Section 2.1, the project team developed the following list of required data items for each household in the survey. The following list covers the data collected by the main survey (after constructing the sample frame):

1. Information about all household members, including demographic data (age, sex, race), income, and occupation and personal activities linked to lead exposure;
2. Financial information about the dwelling unit (market value or monthly rent, ownership status);
3. Structural information about the unit (age, HVAC systems, number and types of rooms);
4. Identification and measurements of interior and exterior painted surfaces, by architectural component;
5. Identifications of substrate materials of painted surfaces;
6. Identification of condition of paint and substrates;
7. Identification of exterior structural condition;
8. Measurements of lead loadings in paint;
9. Measurements of lead loadings in interior surface dust;
10. Measurements of lead concentration in exterior soil; and
11. Determination of other potential proximate sources of lead from multi-family housing common rooms, passageways, and play areas.

In order to collect this data at the level of detail required by the sampling and analysis plans, three primary data collection methods were created: a household questionnaire, a dwelling unit inspection, and a battery of paint, dust, and soil samples.

4.2 Household Questionnaire

Data items 1, 2, and 3 were collected by a telephone interview with an adult resident of the sampled dwelling unit. The data collection instrument entitled the "Household Questionnaire" accomplished the following:

- Collected information on the construction age of the unit by decade;
- Identified public housing units (scattered site projects) that entered the private housing sample;
- Collected information on household demographics, jobs and hobbies related to lead (e.g., oil refinery work or furniture stripping) and income in broad ranges; and
- Performed a comprehensive room inventory that described each room and determined if the room had plumbing and if any renovations had recently been performed.

This method was used for the private housing sample. (A copy of the questionnaire is included in Appendix B of this document). A variation on this method was used for the public housing sample. The structural and room inventory data were collected in a telephone interview and conducted with a representative of the cognizant Public Housing Authority. However, the information about the household residents was collected in the field using an in-person interview that took place at the time of the housing unit inspection.

4.3 Housing Unit Inspection Protocol

The remaining data items (4 through 11) required in-person visits to the sampled housing units. The field protocol was divided into two major types of data collection that were performed during a single visit to each sampled dwelling unit. The first was a Housing Unit Inspection, which consisted of the observation, inventory, measurement, and recording of data about sampled rooms, architectural components, construction materials, and condition of painted surfaces inside the unit, on the exterior of the building, and in common areas of multi-family housing. The second type was the collection of environmental samples.

To minimize the length of the visit, and to assign tasks to field personnel with appropriate skills, inspection visits were conducted by two-person field teams. Each team consisted of one field interviewer to administer questionnaires, fill out observational data forms, and administer sampling and operations records. A second field technician conducted the collection of physical samples and readings.

The Housing Unit Inspection required the interviewer to conduct the following data collection tasks:

- Obtain the resident's consent to the inspection, using an informed consent and waiver form (Appendix B),
- Administer a brief questionnaire to confirm several of the questions from the telephone interview;
- Complete a battery of interior and exterior observation and inventory forms which fulfilled several data collection functions:

- Explicitly identify or guide the interviewer in identifying sampled rooms and architectural components;

- Create an inventory of painted components;

- Record measurements and counts of inventoried components;

- Identify each component's substrate material;

- Record the condition of the paint and the substrate; and

- Serve as the data collection form for the MAP/XRF readings of sampled painted components, taken according to the Paint Sampling Protocol.

• Assist the field technician by identifying sample locations and maintaining the logs and administrative records pertaining to paint, dust, and soil sampling.

4.4 Paint, Dust, and Soil Sampling Protocols

The paint sampling protocol employed on-site readings of lead loading using a MAP/XRF device. Dust and soil protocols involved collection of physical samples and their transmittal to a laboratory for analysis of lead content.

Paint Sampling

Components were selected for testing, as described in Section 3.6.

The lead-based paint testing was accomplished by using the MAP-3 portable spectrum analyzer device manufactured by Scitec, Inc. that estimated the lead content of the paint.[23] The MAP/XRF was equipped with a 40-millicurie Co^{57} source, a scanner, a display console, and carrying case. The protocol called for the technician to place the MAP/XRF's scanner against the sampled component, hold it stationary and flat against the surface throughout a 60-second reading, then record the reading from the MAP/XRF's console.

The paint sampling protocol also specified procedures for assuring accuracy of readings, or permitting post facto adjustments for instrument variability. These included the one-minute stationary reading of each paint sample; the use of a full intensity radiation source; the recording of standard readings before and after the field period as well as at the beginning and end of each day, guidelines on the regular replacement of the battery power source; and shipping and storage guidelines to protect the instrument.

Selection of MAP/XRF Equipment

There were two primary rationales for choosing the MAP/XRF to test for lead in paint. The spectrum analyzer MAP/XRFs were used in preference over the direct reading XRF because the National Institute of Standards and Technology (NIST) determined that they were more accurate and more precise

[23]Consideration was given to scraping samples of paint for laboratory analysis. Laboratory analysis is more precise and accurate than *in situ* XRF. However, it requires damaging painted surfaces in peoples' homes. It was felt that the gain in measurement precision and accuracy would be more than offset by effects of a very large refusal rate.

than the direct-reading XRFs used in earlier surveys.[24,25] The spectrum analyzer XRF was used in preference to taking paint scraping samples because the survey was conducted in occupied dwellings where it was not feasible to take scrapings for laboratory analysis.

Dust Sampling

The dust sampling protocol involved the collection of an array of samples, described in Sections 3.6 and 3.7, at locations inside and outside the unit.

The dust collection protocol employed a portable vacuum pump fitted with a length of Tygon tubing, a 37-mm mixed cellulose ester membrane filter cassette (0.8 µm pore size) connected to the other end of the tubing, and an angle-cut Teflon collection nozzle inserted over the filter cassette. For samples of floor dust, the protocol specified laying down a template that outlined an area of one square foot. The technician vacuumed the area in overlapping passes, first left to right over the entire area and then top and bottom. Care was taken to hold the nozzle level to the surface and to move the nozzle at a steady rate. Next, the template was moved over one foot and the process repeated until four square feet were HEPA vacuumed. This protocol required about four minutes.

For areas which could not accommodate the template, such as window wells, the entire area was HEPA vacuumed and dimensions of the area were recorded.

Throughout these procedures the technician was careful to hold the nozzle upright and not allow dust to fall out of the cassette. The vacuum pump was continuously running throughout the vacuuming of the entire sample area to help ensure that dust did not escape from the cassette. The technician changed the cassette and nozzle after each sample. Nozzles were washed at the end of the day and reused the next day.

When finished with one sample, the technician detached the dust filter cassette from the tubing and inserted plugs in each end of the cassette. Tape was wrapped around the long axis of the cassette covering both plugs. The technician placed the cassette and a preprinted sample ID label in a small plastic bag, sealed the bag, and gave it to the interviewer to insert that bag into a second bag. The interviewer would then affix a second preprinted adhesive ID label to the outer bag. (See Appendix A of this document for the full detail on the protocol prepared by MRI.)

Soil Sampling

The soil sampling protocol called for the field technicians to employ a soil corer with plunger to collect soil and expel the sample into a plastic bag. The corer was inserted into the ground and removed. The sample plug was expelled from the corer into a plastic bag. For each sampled location, the technician drew three soil plugs from the ground, the first as close as possible to the targeted sample site, and the other two 20 inches to either side of the first. The protocol defined the soil sample for each statistically sampled location as the blended composite of the three soil plugs. Hence, all three were expelled from the corer into the same plastic bag. When this was done, a preprinted identification label was placed in the plastic bag, which was then sealed and placed in a second bag affixed with an adhesive ID label. After each composite sample was drawn, the technician cleaned the corer before collecting the next sample. (See Appendix A for the full detail on the protocol prepared by MRI.)

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[24] McKnight, Mary E.; Byrd, W. Eric; Roberts, Willard E. (May 1990), *Measuring Lead Concentrations in Paint Using a Portable Spectrum Analyzer X-Ray Fluorescence Device* (NISTIR W90-650), U.S. Department of Commerce, National Institute of Standards and Technology.

[25] McKnight, Mary E.; Byrd, W. Eric; Roberts, Willard E. and Lagergren, Eric S. (December 1989), *Methods for Measuring Lead Concentration in Paint Films* (NISTIR 89-4209), U.S. Department of Commerce, National Institute of Standards and Technology.

For dust and soil samples, the protocols prescribed detailed procedures and techniques for cleaning of equipment, anti-contamination measures, and physical handling before, during, and after sampling. These were designed to assure collection of full, accurate samples, free of contamination.

To insure against sample loss and assure valid linking of analytical results with statistical sampling data, the protocols for paint, dust, and soil also prescribed the procedures for sample logging, labeling, double-checking, and transmission of chain-of-custody forms to all parties.

5. FIELD OPERATIONS

This chapter presents the field procedures employed in the National Survey. Included are descriptions of field operations for: listing and screening activities used for private housing frame development; housing unit inspection; using the MAP/XRF and other field technicians' duties, field interviewing and using of survey instruments; and conducting the laboratory analysis. This section incorporates brief discussions of two activities integral to field operations that were conducted by telephone from the field operations headquarters. The first is the verification and final sampling of the public housing list sample. They are presented because they closely parallel the private housing frame development, which depended heavily on field activity. This activity also was combined with the scheduling and coordination activities of the in-field public housing inspections. The second is the telephone interviewer of sampled private units, which was tightly bound to the field effort. Interviewers scheduled the visits of the field team for household inspections. Interviewers also carried out the room inventory. The inventory was initially designed as a field activity, but was ultimately carried out as a field preparation activity to make the in-field household inspection more efficient. Copies of all data collection forms and related field materials are included in Appendix B of this document.

5.1 Objectives

The objective of the national survey field operations was to implement the data collection phase according to the overall research design and the specific data collection protocols designed for the Survey. Operationally, the objective required the training of field staff in the data collection procedures and protocols, placing them into the field to collect the data. It also required managing the field operations and controlling the processes of collecting, transmitting, and managing the data. For environmental samples, field operations personnel had to execute strict quality control and chain-of-custody procedures in collecting and transmitting the samples. This ensured that further laboratory analyses could be performed on dust, soil and paint and provide meaningful results for incorporation into the overall analysis. The ultimate objective of the field operations was, therefore, the collection and processing of accurate and statistically valid data and physical samples from the dwelling units in the 30 sampled counties, which could support the national estimates required by the research objective.

5.2 Field Period

The field period for the national survey extended from November, 1989, to March, 1990. Listers, screeners, field interviewers, and field technicians were trained in November. Listing activity began that same month and field screening of dwelling units began in December. The final screenings briefly overlapped the start of the inspection visits in January, 1990. Field activities were completed in March, 1990.

5.3 Private Housing Frame Development

5.3.1 Listing

After random selection of five census blocks from each of the sampled counties, maps of the selected census blocks were prepared. Two copies of each census block map were forwarded to the Field Director, who reviewed the maps and resolved any problems. A Listing Folder was prepared for each census block and sent to the designated field interviewer. The Listing Folder included two copies of the census block map with the perimeter outlined in yellow, and a supply of blank dwelling unit main listing sheets (two-ply non-carbon duplicates).

For listing, the field interviewers prepared a route list of streets to cover the census block, and then traveled every street to record every dwelling unit When listing was completed, the interviewer returned one copy of each map and one copy of the completed listing sheets to the Field Director, who reviewed the listing materials and resolved any irregularities.

All listing was conducted using standard survey research listing methodology, augmented by project-specific protocols.

5.3.2 Screening

A systematic random sample of listed dwelling units was selected for each census block from the completed listing sheets. The target sample sizes ranged from 24 to 40 housing units per census block, depending on the number of dwelling units in the block. These were the estimated numbers of screening interviews required to obtain two completed inspections per census block, based on assumptions regarding the eligibility and response rates.

The sampled units were assigned identification numbers (IDs), which were entered into a computerized dwelling unit tracking system. Street address, city, state and ZIP code were also entered. Screener Packets were prepared for each county that included the materials which a field interviewer needed to screen all the dwelling units in the county. The Screener Packet included:

- 250 blank Screener Questionnaires;
- Label affixed to back of Screener Questionnaires containing unit ID and address;
- 250 HUD Letters of Introduction;
- Photocopy of Listing Sheets with sampled households indicated; and
- Complete list of units sampled from the county.

The survey contractor issued approximately 7,500 screener instruments in 30 Screener Packets, corresponding to the 30 counties.

The screening task involved going to the designated homes and initiating contact with a resident over the age of 18. The interviewer briefly introduced the study and obtained agreement to ask a few questions about the home, e.g., age of home, single or multiple dwelling unit, own or rent. If no one over 18 was home, the interviewer queried as to the best time to return. If no one was home, the interviewer left a note saying he/she had been there and would return at a later time. A HUD letter introducing the survey was also left.

At the conclusion of efforts to visit to each unit, the interviewer entered a final *result code* on each Screening Questionnaire (e.g., result code P9 = completed screener, P10 = not eligible). After screening efforts had been performed for each unit, the interviewer returned all completed screener instruments to the Field Director, along with complete contact records for all units.

After a review, all information from the screener was entered into the dwelling unit tracking system and the screeners were filed. After the screening was completed, the tracking system database was used to identify all in-scope units, which formed the frame for the final selection of the dwelling units to be inspected. Nationally, screening interviews were attempted with 2,978 dwelling units; 1,622 dwelling units were eligible for inspection.

5.4 Public Housing Frame Development

The development of the sample frame for public housing followed the steps outlined below, for each of the 30 counties:

- Generated a computer listing of PHA inventory.
- Contacted the HUD field staff designated to assist the survey and obtained name/number of a PHA staff member to verify and correct the inventory.
- Contacted PHA and determined a strategy for verifying inventory.
- Conducted inventory verification and correction.
- Submitted the corrections for updating the computer file.
- Drew a sample of projects and selected a dwelling unit within project. and
- Contacted PHA to (1) determine the address of sample selections, (2) conduct the room inventory portion of Household Interview, and (3) set appointments for inspection.

Initial PHA Housing Tape. HUD's Public Housing Enumeration tape contains a national public housing authority inventory. The data includes the name, address, administering agency, program, size, age and other information for each public housing complex in the nation. A list of 793 public housing projects in the 30 sampled counties was extracted from the master list. The data was not guaranteed to be current, fully accurate, or complete.

Verification of PHA Housing Inventory. The next step was to verify and update the list of housing projects. The survey staff contacted HUD field representatives assigned to assist the survey. The HUD field representative provided the names and telephone numbers of knowledgeable PHA staff members at all PHAs in the 30 counties comprising sampled counties. When there were multiple PHAs present in a county, the representative provided contact names for all PHAs.

Telephone representatives called the PHA staff contact persons, introduced the study, and determined the best method for verifying the inventory of housing in that PHA. The data items verified were:

- Projects still in inventory.
- Number of family units.
- Number of elderly units.
- Date of construction completion of project, and

- Any additional projects in the inventory? If yes, the above information was requested and recorded for the additional projects.

Telephone interviewers paid special attention to distinguish the year construction was completed from the year the building became part of the PHA inventory. Sometimes buildings are acquired by a PHA long after construction. The construction completion date, not the acquisition date, determined the potential painting history of the building.

All changes (additions, deletions, corrections) in the PHA inventory were noted on an Inventory Verification Form. The list of projects, as updated with the changes, formed the sample frame for the public housing sample.

5.5 Field Data Collection

5.5.1 Telephone Interviews

For both the private and public housing sample, telephone contact was made with responsible individuals at the sampled units to collect household information and schedule appointments for on-site inspection. Although the approaches for the two samples were similar, there were some methodological differences.

Private Housing Interviews

The information collected in the screening interviews and entered into the tracking system was designed to facilitate re-contacting by telephone the residents of the units in the sample. This telephone contact was used to conduct the Household Interview (using the Private Housing Questionnaire described in Section 4.2), schedule an appointment for the on-site inspection and offer a $50 incentive to participate in the survey.

The packets were transferred to survey contractor's telephone center, where telephone interviewers administered the Private Housing Questionnaire and then proceeded to operational tasks, including scheduling an appointment for the inspection. Telephone interviewers used calling protocols that entailed using project-specific scripts and standard interviewing procedures for telephone manners, callback procedures, and call result reporting and coding. At the conclusion of calling, the interviewers forwarded questionnaires and appointment schedules to the Field Director in preparation for the site visits.

Critical data items from the telephone survey, such as the call result code and appointment information for the home visit, were entered into the tracking system.

Public Housing Interviews

The telephone interviewer re-contacted each PHA in order to identify the sampled dwelling units, conduct the Household Interview and schedule visits. As described in Section 3.5, the telephone interviewer carried out the unit sampling at this point. He/she discussed with the PHA representative how the units were numbered. Using each project's list of units, the telephone interviewer instructed the PHA staff contact to count through the list to the *n*th dwelling unit. This unit was selected for inclusion in the sample.

At this point, the exact address of the sampled unit was determined. The telephone interviewer went on to conduct the Household Interview with the PHA staff contact. The Private Housing

Questionnaire was modified for the public housing interview, since the interview was conducted with the PHA staff, not the unit residents. (If the PHA contact person was not familiar with the dwelling unit, the telephone interviewer asked for referral to a person who was familiar.) These questions verified certain data items already obtained from the computerized public housing inventory (e.g., year of construction completion). In addition, the telephone interviewer conducted the room inventory. As with the private housing sample, this inventory was used to perform the within-unit sampling in advance of the on-site inspection. Questions concerning household residents were not asked at this time; these questions were administered to the residents themselves, during the dwelling unit visit. A PHA representative took care of contacting the dwelling unit residents and obtaining their cooperation for the study.

5.5.2 Housing Unit Inspections

The inspection protocol was the same for both private and public housing. Inspection teams conducted inspections in 284 privately owned and 97 public housing units, for a total sample size of 381 dwelling units. The inspection visits were performed by a two-person team: a field interviewer who interviewed the occupant, and collected and recorded the within-unit architectural sampling and observational information within each dwelling unit; and a technician who performed the MAP/XRF testing and collected the dust and soil samples. A description of procedures observed for in-house inspections follows.

Preparation of Field Teams. Technicians and interviewers were brought to the survey contractor's headquarters for a four-day training session. The training covered all aspects of the home visit plus detailed training on the use of the MAP/XRF and the procedures for collecting dust and soil samples. An additional half-day training session was conducted for dust sampling.

Field Materials. Each technician was equipped with equipment and supplies that had been tested for lead contamination. The technician's equipment/supplies inventory included:

Clipboard
Picture ID badge
Pens
Scitec MAP/XRF scanner, console, and carrying case
Unpowdered gloves
Paper slippers
HEPA Vacuum pump and attachments (5-foot length of Tygon tubing, 25-foot length of tubing, nozzles)
Dust sample cassettes
Template for vacuuming
Masking tape (to affix template if necessary)
Soil sample corer
Alcohol-free wet wipes
Bottle brush
Flashlight
Putty knife
Brick hammer
Trowel
Extension cord (25-foot)
Electric plug adapter
Ladder (3-foot)
Personal *dosimeter* (portable device used to measure cumulative exposure to radiation)

Interviewer's equipment/supplies included the following materials:

Clipboard
Pens
Calculator
Picture ID badge
Identification tags for all equipment
Large and small plastic bags
Notepaper with project logo
Self-stick removable notes
Tape measure (30-foot)
Overnight delivery shipping materials
HUD letters of introduction
Dwelling-unit Inspection Packets

Preparation for Visit. In preparation for the in-house visit, an Inspection Packet was assembled at the field management office located at the survey contractor's headquarters. The packet contained all the forms and information needed by the interviewer/technician team to conduct the inspection. Among other items, the packets included a copy of the Household Questionnaire conducted by telephone, customized forms for recording MAP/XRF results, and logs to record dust and soil sampling. Copies of the forms can be found in Appendix B of this document. Packet customization included putting the household identification number on each form, designating what components should be tested in each sampled room of the unit, and inserting adhesive identification labels for application to each dust and soil sample container.

A fully prepared packet included:

- Copy of Telephone Household Interview (Form 5);
- Informed Consent Release and Waiver Letter (Form 6);
- Dwelling Unit Form customized for specific dwelling unit (Form 13);
- Interior Observation Form customized for sampled dry room (Form 15);
- Interior Observation Form customized for sampled wet room (Form 15);
- Exterior Observation Form customized for sampled wall (Form 17);
- Soil/Dust Sample Log (Form 19);
- Common Area Inventory (Form 25)*;
- Common Area Observation Form (Form 27)*;
- Common Area Collection Form (Form 29)*;
- Control Log (Form 35);
- Request for Results Form (Form 64), with business reply envelope; and

- $50 incentive check made out to resident and blank receipt acknowledgment form.

  * Multi-family housing only

The packets were shipped to the interviewer via overnight delivery service. Typically, the set of packets for a county was waiting for the interviewer at the hotel upon his or her arrival in the county.

Housing Unit Inspections. The day before each inspection, the interviewer called the resident to confirm the appointment recorded on the copy of the telephone Household Interview. If necessary, the interviewer rescheduled while in the field. A PHA representative confirmed the public housing appointments, and usually escorted the inspection team to the public housing units and waited for them to complete the inspection and sampling. When the inspection team arrived at an address, the interviewer noted which wall of the structure faced the street named in the address of the unit. That was designated as wall 1. Going clockwise, the remaining three walls were numbered 2, 3, and 4. The same rule was applied to interior walls. This numbering was used in conjunction with the Observation Forms for within-unit sampling of walls. This was the only aspect of statistical sampling that the inspection team needed to conduct in the field.

After entering the home, the team introduced themselves and the study to the dwelling unit occupant. Before entering, the team members put on paper slippers to avoid cross-contamination. The technician began the dust sampling after the interviewer obtained the resident's signed consent. The interviewer proceeded to identify and quantify all painted components, identify the substrate material, and identify the condition of the paint and substrate in the sampled wet and dry rooms.

Quantification of painted surfaces was accomplished in different ways on different architectural components. For example, painted ceilings were quantified by measuring and recording their length and width in the field and deriving the area during data analysis. Trim was quantified by recording the length while the analysis plan assumed a standard, average width. Doors and windows were quantified by recording the number of each in the field and assuming an average surface area for each. Table 5-1 details the field measurements and analytical estimation methodology for each component.

After the inventory was completed, the interviewer showed the technician what surfaces had been selected for testing with the MAP/XRF. The technician took the necessary readings and the interviewer recorded the results on the appropriate form.

The team then moved outside the dwelling unit to do the MAP/XRF test of the exterior walls and to collect the soil samples. At this point, multi-family dwellings, common rooms were inspected. If present, common rooms such as a mail room, laundry room, community room, etc., were inventoried. One was randomly selected and inspected according to the same protocol used for the wet and dry rooms. If present, playgrounds were inspected. Each type of playground equipment was quantified, described, and a convenient painted surface was chosen for MAP/XRF testing. A "type" of playground equipment was, for example, one or more slides that appeared to be produced by the same manufacturer, were installed at the same time, and shared a common painting history.

At the conclusion of all testing, the interviewer paid the $50 respondent incentive by check, to both private and public housing respondents.

TABLE 5-1
METHODOLOGY FOR ESTIMATING AREAS OF PAINTED COMPONENTS

Component	Data Recorded in Survey	Methodology for Estimating Painted Area
Interior		
Wall	Length, height;#doorways #windows, #fireplaces/other "holes"	Multiply; subtract 19 sq ft/doorway, 13 sq ft/ window, and 16 sq ft per fireplace/other "hole".
Ceiling, floor	Length, width	Multiply.
Baseboard trim	Length	Assume width = 4 inches. Multiply.
Stair trim	Length	Assume width = 10 inches. Multiply.
Door trim	Length	Assume width = 4 inches. Multiply.
Window sills	Length	Assume width = 4 inches. Multiply.
Window trim	Length	Assume width = 4 inches. Multiply.
Crown molding	Length	Assume width = 7 inches. Multiply.
Doors	Number of doors	Assume 17 sq ft per door.
Window casing	Number of windows	Assume 5 sq ft per window.
Air/heat vents	Number of vents	Assume 1 sq ft per vent.
Radiators	Number of radiators	Assume 8 sq ft per radiator.
Shelves	Length	Assume width = 12 inches. Multiply.
Cabinets	Number of cabinets	Assume 6.25 sq ft per cabinet.
Fireplace	Number of fireplaces	Assume 16 sq ft per fireplace.
Closets	Number of closets	Assume 19 sq ft per closet.
Exterior		
Wall	Length, height	Multiply.
Window sills	Length	Assume width = 4 inches. Multiply.
Window trim	Length	Assume width = 4 inches. Multiply.
Soffit and Fascia	Length	Assume width = 20 inches. Multiply.
Door trim	Length	Assume width = 6 inches. Multiply.
Doors	Number of doors	Assume 21 sq ft per door.
Columns	Number of columns	Assume 20 sq ft per column.
Railings	Length	Assume width = 10 inches. Multiply.
Porch	Length	Assume width = 5 feet. Multiply.
Balcony	Number of balconies	Assume 24 sq ft per balcony.
Stairs	Number of steps	Assume 4 sq ft per step. Multiply.

5.6 Field Technicians' Duties

The field technician's primary duty was carrying out the paint, dust, and soil sampling, as described in the protocols. He was also responsible for the transportation, storage, handling, and security of the sampling equipment. This included the assembly/disassembly of the MAP/XRF and HEPA vacuum equipment at each inspection. The technician also was responsible for cleaning the dust and soil collection equipment while following the strict survey protocols, that prevented sample contamination. This responsibility applied to cleaning between samples, between inspection visits, and before the start of each day, as prescribed by each appropriate protocol. Finally, the technician performed daily MAP/XRF readings of shims, in fulfillment of the protocols for checking the variability over time in each MAP/XRF device's calibration.

As a safety precaution, the technician carried a radiation meter and wore two radiation dosimeters. He was responsible for monitoring these devices, as well as the dosimeter worn by the interviewer.

Painted Surface Sampling

The Interior, Exterior, and Common Room Observation Forms were constructed to follow the four strata of architectural components detailed in Section 3.6. In each inspected room, the customized form guided the interviewer in inventorying all architectural components and identifying the randomly selected ones. The interviewer measured and assessed all existing painted components, and identified the sampled ones for the technician to test with the MAP/XRF. All sampled painted components on the sampled exterior wall were subjected to MAP/XRF testing, using the same protocols as the interior tests. The field technician then proceeded to perform the MAP/XRF tests on any sampled common room components and playground equipment identified by the field interviewer while following the inspection, observation, and sampling protocol for multi-family dwellings.

The paint sampling required the technician to make purposive MAP/XRF tests on one or two interior and exterior components which he judged as having a high likelihood of lead-based paint. (See Section 3.6.) Field experience showed that requests to wander about looking for lead-based paint were not always well received by the dwelling unit occupant. In these cases, teams were instructed to limit their search to either sampled room or areas/rooms entered while passing to and from the sampled rooms.

Dust Sampling

The field technician collected samples of dust by vacuuming in three locations in each sampled room: the floor, a window sill/stool, and a window well. He collected another dust sample from the floor near the most-used entrance to the dwelling unit. Two dust samples were taken from an interior common hall (if it existed) -- one just outside the sampled dwelling unit and one just inside the main entrance to the building. The technician followed the dust sampling protocol, as described in Section 4.4 and Appendix A of this document.

Soil Sampling

The field technician took soil samples at the specified locations. Three exterior soil samples were collected at the drip line along the sampled exterior wall, at a remote location away from the building, and at the most-used entrance to the dwelling unit. Each sample was a composite, consisting of three plugs of soil drawn from the ground at 20-inch intervals at the sampled location, and then blended. If present, three soil samples also were taken from the playgrounds. The soil sampling protocols followed by the field technician were described fully in Section 4.4 and Appendix A of this document.

5.7 Laboratory Analysis of Dust and Soil

The laboratory contractor logged in the dust and soil samples upon receipt from the field and followed testing protocols documented in the Dust and Soil Samples Analysis report cited in Section 1.2. The samples were sent to a laboratory to be analyzed for their lead content. The laboratory analyzed the dust by graphite furnace atomic absorption (GFAA) spectroscopy and the soil by inductively coupled plasma-atomic emission spectrometry (ICP-AES). The test results were reported to the laboratory contractor and the survey contractor on computer diskette. Following federal guidelines, dust loading was reported as the amount of lead vacuumed per square foot of surface ($\mu g/ft^2$),[26] usually measured in micrograms. Soil lead concentration was reported as the amount of lead per gram of soil (µg/g), usually measured in micrograms which is equivalent to parts per million (ppm). As discussed in the federal guidelines, dust lead loadings and soil lead concentrations are not comparable units of measurement. It is not possible to convert from $\mu g/ft^2$ to µg/g in any consistently reliable way.

[26] U.S. Department of Housing and Urban Development, "Lead-based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing," Federal Register, 55 (April 18):14557-14789.

6. QUALITY ASSURANCE PLAN

Quality assurance was an integral component of the study design and execution. This chapter describes the quality assurance procedures employed in each phase of the National Survey of Lead-Based Paint in Housing. Many QA procedures related to the collection and handling of survey data, such as measures to enhance participation of sample members, cross-checking of records, careful chains-of-custody, and independent re-keying of data. Other measures were instituted to help evaluate the new technologies and protocols utilized in the survey. A significant example of the first group was the verification of the PHA housing inventories; of the second group, extensive MAP/XRF baseline reading tests.

For all aspects of data collection, the principal source of quality assurance was the utilization of detailed, well-planned, and tested protocols for all methods of data collection. Designing workable and easily followed field procedures for implementing these protocols was the next step in this process. These procedures cover all aspects of telephone and in-person interviewing, in-field observation, measuring and recording physical data, collecting environmental samples, handling equipment, and handling and storing samples. Next, the thorough training of the interviewers and field staff in all data collection instruments and procedures, field operations procedures, and environmental sampling protocols was critical to the assurance of quality. For both training and operations, it was essential to have comprehensive and comprehensible documentation of these procedures and protocols for staff use during the survey. Finally, ongoing communication between the field and headquarters, between the survey contractor and the laboratory contractor, and among the various functional groups responsible for each stage of the survey was rigorously maintained to assure the quality of all information collected.

The following sections document specific quality assurance steps taken in the survey. Since the verification of the Public Housing frame was discussed in detail in Section 5.4, it will not be discussed further in this Chapter.

6.1 Measures to Enhance Response Rates

In the national survey, as any survey, maximizing response rates is critical to minimizing bias and maintaining the representativeness of the data. Maintaining participation at the point of the home inspections was particularly important because of the investment of effort that was required to reach that point. Fallback options in case of refusals were limited. Choices available were simply to do without the inspection, try to reschedule with a backup unit during the remaining time the team was in the county, or go to the expense of sending another team back to the county when a backup inspection could be scheduled.

For private housing, efforts to ensure participation began with in-person visits to homes for screening purposes. In addition to the personal contact initiated by the interviewer, a letter from HUD explaining the survey and verifying its legitimacy was left with the dwelling unit respondent.

After dwelling units were selected from among the eligible dwelling units, telephone calls were placed to the residents. The interviewers were trained to explain the survey and answer any questions or concerns the resident might have. One indicator of the success of the household interviewing effort was the interviewers' ability to gain the residents' confidence in the survey and their cooperation in providing detailed room inventories.

The telephone interviewer scheduled appointments for inspections to occur five to ten days after the phone call. Inspections were scheduled at times convenient to the respondents, resulting in some early evening and weekend inspections. Minimizing the delay between the call and the inspection reduced the opportunity for the respondents to reconsider their agreement to participate. The residents were informed at the time of this call that they would receive a $50 incentive for allowing the home inspection.

One day in advance of the inspection, the field interviewer called each dwelling unit to confirm the designated time of the inspection. Some minor rescheduling was done by the field interviewers during these calls.

6.2 Quality Assurance for Questionnaire Data

Training and Documentation. Telephone and field interviewers received extensive training in the content and administration of the various questionnaires used in the survey. Complete documentation of all data items and administration procedures was prepared for the training and retained as a reference by the interviewers during data collection.

Verification and Monitoring. The Field Director verified the work of the field interviewers by contacting participants after receiving the completed instruments. Telephone interviewers were regularly monitored for correct administration of the questionnaire.

Dwelling Unit ID. The dwelling unit identification number was designed to minimize error in data collection and processing and to allow easy recognition by data handlers. The first two positions of all IDs indicated the county (01-30). The third position was the assigned census block number (1 through 5 for private housing, 6 for public housing). The fourth and fifth positions were the sequence number of the dwelling unit within the census block (01, 02, ...). The sixth and seventh positions were computer-generated control digits.

6.3 Quality Assurance for Home Inspection Data

Customized Forms and Dwelling Unit Packets. Laser-printed customized forms were used for each dwelling unit room inspection. The form used, for example, to collect field measurements in the wet room included a preprinted ID, room identification information, and specific sampling procedures for that room. The dwelling unit packet contained only forms suitable for the dwelling unit, e.g., forms to collect samples in common areas were only included for multi-family settings. Adhesive labels preprinted with the 9-digit test sample number were included for all dust and soil samples.

Telephone Verification. Field supervisors from field operations headquarters contacted a number of inspected dwelling units to verify that the team had been there and acted appropriately.

800 Number. The survey contractor maintained a 24-hour 800-number to receive calls from interviewers and participants throughout the field period. In addition, the interviewers had the direct home and work telephone number for the Field Director. Her home phone was equipped with an answering machine and the work phone was backed up by a receptionist. Every effort was made to ensure that survey staff were available to take interviewer calls during inspections. This created the ability to provide rapid, centralized resolution of field problems.

6.4. Quality Assurance for Environmental Samples

6.4.1 Quality Assurance for MAP/XRF Data

Extensive quality assurance procedures were developed for use of the MAP/XRF in the national survey for a number of reasons. MAP/XRFs were a relatively untested technology for the detection of lead in paint, given the requirements of the National Survey. For example, Federal regulations define paint as lead-based if lead content is 1.0 mg/cm^2 or higher. The MAP/XRF was traditionally used to detect higher loadings, such as might occur in a mining environment. Furthermore, mining substrates affected the field measurements in a different way than common residential building material housing substrates. Second, the MAP/XRF has software that interprets the spectrum reading and generates a single reading. This software was developed shortly before the start of the survey field period. Thus, its evaluation and testing prior to the field period were limited. There were some indications that the equipment would perform better than other brands, based on testing by NIST, but there was still some uncertainty. These concerns led to the establishment of rigorous before, after, and in-field procedures to track the performance of each MAP/XRF used.

Training. The field technicians were trained by the MAP/XRF manufacturer in the correct use, handling, and maintenance of the MAP/XRF.

Baseline Validation Measurements. A detailed protocol was established to produce a baseline of 64 readings of different lead loadings on different substrate materials for each MAP/XRF used in the study. The testing helped establish that each MAP/XRF was ready to be used in the field.

Eight standards were developed to conduct the baseline validation measurements. A standard consisted of a small (3" x 4") plastic sheet (called a *shim*) painted with paint containing a known level of lead and placed tightly on a piece of background material (called a substrate). The shims used in the national survey were made by NIST. There were four substrates of interest (common dwelling unit building materials): wood, drywall, steel, and cement. All substrates used in the construction of standards had a smooth surface that allows the shim to be tightly and evenly affixed.

Two different shims were used. One shim contained 0.6 mg/cm^2 of lead, the other 2.99 mg/cm^2. The four substrates and two shims were layered to make eight test standards:

1. 0.6 mg/cm^2 shim on wood substrate
2. 2.99 mg/cm^2 shim on wood substrate
3. 0.6 mg/cm^2 shim on steel substrate
4. 2.99 mg/cm^2 shim on steel substrate
5. 0.6 mg/cm^2 shim on drywall substrate
6. 2.99 mg/cm^2 shim on drywall substrate
7. 0.6 mg/cm^2 shim on cement substrate
8. 2.99 mg/cm^2 shim on cement substrate

A set of these eight standards was assigned to each of the eight MAP/XRFs used in the study. All readings conducted with a specific MAP/XRF used only one set of standards.

Preparation of the MAP/XRF. Each MAP/XRF was delivered by the manufacturer with a fresh Co^{57} source and fresh batteries. Upon receipt from the manufacturer, each MAP/XRF console was initialized with the serial number of the MAP/XRF reader. Batteries were checked. The radiation detector was placed near the MAP/XRF during initial operation to establish that there was no radiation leakage.

Conduct of 64 Pre-Field Baseline Field Measurements and Data Transfer. The quality assurance test technician performed eight 60-second readings on each of the eight standards. The MAP/XRF readings were recorded on the XRF Baseline Reading Form.

Conduct of 64 Post-Field Close-out Field Measurements . The above procedures were repeated in full when an MAP/XRF was retired from the field, and before it was returned to the manufacturer.

In-Field Readings. In a scaled-down procedure, one reading was taken on each standard (for a total of eight readings) every day that the MAP/XRF was in the field and in use. This practice had the additional benefit of helping detect machine drift and malfunction. Technicians were instructed to call their supervisor if readings varied from original baseline readings by over 30 percent. The MAP/XRFs were designed so that they could be calibrated only by the manufacturer. Field technicians could not calibrate the devices. The procedure also helped detect if batteries had become low and needed replacement.

In-field MAP/XRF Quality Assurance Procedures. In addition to the MAP/XRF quality control procedures described above, technicians were instructed to observe the development of the spectrum on the MAP/XRF console display. An experienced technician could tell by the spectrum display if a MAP/XRF was acting irregularly. Additionally, technicians installed fresh batteries in the MAP/XRF after arriving in each county. The technicians were instructed to handle equipment gently and to store it within a specified temperature range.

Calibration of MAP/XRF. It is not possible to perform in-field calibration of the MAP/XRF as was possible with direct read MAP/XRFs. The only remedy available in the case of a mis-calibrated XRF was to return the MAP/XRF to the manufacturer for repair. This occurred once.

The in-field QA readings were not used by the technicians to adjust this field measurement. Rather, the raw field measurements were recorded. During the data analysis, the QA readings were used to develop recalibrated measurements. This analysis is described in Appendix II, Chapter 3.

6.4.2 Quality Assurance for Dust and Soil Samples (Field and Laboratory)

Field Quality Assurance Measures

Dust and Soil Sampling Protocol. The protocols used in the national survey were carefully designed and pretested. Once the protocols were finalized, the survey contractor prepared detailed instructions for the identification of, and administrative controls for, handling the samples. During the actual data collection phase, the field technicians followed procedures provided by the laboratory contractor. The four-day training session for the field teams held at the survey contractor's headquarters ensured comprehensive instruction and practice in the protocols, as well as consistent understanding and application of them by all the team members. A video was made of the training so additional or replacement inspectors could be trained at a later date with equal thoroughness and consistency.

Sample Custody Procedures. All samples were labeled with pre-printed labels using a standard numbering scheme. For example, the dust sample taken inside the main entry to the unit was *always* number 61. This helped minimize recording and handling error. The labeling of each sample by the field technician was checked by the field interviewer. All samples were carefully logged as they were collected. All were accompanied by a separate transmittal sheet (chain-of-custody form) whenever they were shipped. Copies of logs and transmittal sheets were submitted to the Field Director for entry into the tracking system. The survey contractor and laboratory contractor devised a joint system for test sample custody to ensure the integrity and location of all samples at all points in time. All contractors and testing laboratories utilized the survey contractor's sample numbering system, which was designed to accommodate the inconspicuous numbering of control samples inserted by the laboratory contractor.

Prevention of Contamination of Dwelling Units and Samples. There was concern that the inspection team might bring lead into the home. Of even greater concern was the possibility that the team members would introduce dust from a consistent non-dwelling unit source, e.g., the floor of their car. A number of measures were employed to help minimize this problem. Each team member put paper slippers over his or her shoes before entering the dwelling unit. Team members wore rubber gloves during the inspection. The technician discarded his gloves after he took each dust and soil sample, replacing them with new ones. He replaced the dust sampling vacuum nozzle with a clean one after collecting each sample. He cleaned the corer, inside and out, after each soil sample.

Quality Assurance for Field Equipment and Supplies. Efforts were taken to ensure that the equipment or supplies themselves did not introduce lead contamination. Wet wipes used to clean soil sampling equipment were tested for lead. Shavings from the soil sampling equipment, including the painted handle, were tested. Particular caution was observed in testing supplies that technicians were expected to purchase while in the field, e.g., wet wipes, plastic bags, etc. Several brands of plastic bags and wet wipes were tested to ensure that commonly available brands would not introduce any lead contamination.

Laboratory Quality Assurance Measures

Quality Control Samples. In coordination with the survey contractor, the laboratory contractor systematically introduced spikes and control samples among the soil and dust samples from each dwelling unit. To prevent detection of the control sample by laboratory technicians, the survey contractor prepared a mid-sequence sample ID label for each batch of field samples from a single dwelling unit. This label was sent along with the unit's samples to the laboratory contractor, who affixed it to a control sample that was transmitted to the lab along with rest of the samples.

Intra-Laboratory Quality Assurance. Techniques included analytical replicates, instrument performance testing, and the use of quality control samples. Careful sample custody procedures were observed throughout the survey. Details are provided in MRI's Dust and Soil Analysis Report.

6.5 Software Quality Assurance for Data Preparation and Analysis

100 Percent Verification of Keyed Data. All data that required key entry were subject to 100 percent re-keying. Any discrepancies uncovered in this process were immediately investigated and resolved. The re-keyed data was again subjected to 100 percent re-keying to ensure that errors were not introduced during the course of making the correction. The keyed data included the responses on the household questionnaire, the household data collected during the site visit, the painted surface inventory from each sampled interior room, exterior wall, common area room, and playground. Dimensions of vacuumed areas were keyed, as were ID numbers for each dust and soil sample collected.

The complete data base resulted from the merger of the household questionnaire data (telephone), additional household and painted surface data, plus test results that were provided on diskette from laboratories. The data and test results were submitted to computerized range and logic checks. All discrepancies and *out of range* values (e.g., no wet room data or extreme field measurements for sampled component) were investigated and resolved. The system developed to verify data remained stable and no systematic problems were encountered.

Bar Code IDs. To minimize key entry error, ID labels on soil and dust samples were printed as bar codes. The testing laboratories passed a bar code reader over the label to pick up the ID number. The bar code incorporated a "check digit" to help assure the accuracy of the bar code reader.

6.6 Calculation of Sample Weights

This section presents a description of the calculation of the sampling weights. In a complex survey it is necessary to apply sampling weights to each completed case.[27] A dwelling unit's sampling weight is, roughly, the number of pre-1980 dwelling units nationwide represented by the inspected unit. Sampling weights were calculated independently for public and private housing, using similar methodology. Sampling weights were calculated in this survey for two major reasons.

First, there was disproportionate sampling in the six design strata; multi-family dwelling units were sampled at about twice the rate as single family units (see Tables 3-2 and 3-3). Weights were therefore necessary to produce unbiased estimates. These initial weights are the ratios of the numbers in corresponding cells in Tables 3-2 and 3-3.

Second, the initial weights were often adjusted to balance differences in nonresponse and noncoverage. There were significant differences in the response rates in identifiable groups of this sample. Specifically, homes with children under age seven were over represented in the private housing sample. While these homes represent 18 percent of the nation, they represent 32 percent of the private housing sample. In addition, the regional distribution of the sample is disproportionate. The South is over represented while the West and Northeast were underrepresented. The private housing weights were therefore adjusted so that the estimated numbers of dwelling units with children under age seven would agree with the estimate in the 1987 American Housing Survey (AHS) (13,912,000 units), and so that the estimated numbers of dwelling units in each of the four census regions also would agree with the AHS's estimates. These two adjustments were not necessary for public housing sampling weights. However, the public housing weights were adjusted so that the estimated number of family housing units in each of the three construction year strata would agree with HUD's counts.

[27] Kish, L. (1965), *Survey Sampling*, (New York: John Wiley and Sons), Chapter 11.

7. LEAD-BASED PAINT DATABASE

This chapter provides a general description of the analytical data files developed and used for the National Survey of Lead-Based Paint in Housing. More detailed documentation, including file layouts and definitions of all variables may be found in the Westat report, *Documentation of Analytical Data Files*. These analytical data files have been used in the preparation of the *Comprehensive and Workable Plan for the Abatement of Lead-Based Paint in Privately Owned Housing: Report to Congress*. They have also been used in the analysis of the survey data as reported. The nine analytical data files are:

Occupant File
Interior Components File
Exterior Components File
Soil/Dust File
Common Areas File
Dwelling File
MAP/XRF Maximum File
Reading File
Soil/Dust/Paint (SDP) Files

These analytical data files were developed from information recorded on the data collection forms and the telephone questionnaire. The eight forms used in the survey are:

DU Form	Dwelling unit form. Contains data on dwelling unit, occupant, and the purposive MAP/XRF data
Interior Observation Form	Contains data on the painted component, substrate, and MAP/XRF data for interior surfaces
Exterior Observation Form	Contains data on the painted component, substrate and MAP/XRF data for exterior surfaces
Common Area Observation Form	Contains data on the painted component, substrate, and MAP/XRF data for common area surfaces
Common Area Collection Form	Contains data on playground equipment, common hall, and MAP/XRF data
Common Area Inventory Form	Contains inventory data on types/existences of common areas in multi family buildings
Soil/Dust Sampling Log	Contains data on soil/dust sampling (area sampled, sample location)
Telephone Questionnaire	Contains data on dwelling, occupant, and interior rooms

Copies of the blank data collection forms are provided in Appendix B of this document. Table 7-1 provides a cross reference of the analytical data files and the data collection forms from which data were extracted.

TABLE 7-1
SOURCES OF DATA IN ANALYTICAL DATA FILES

Data Collection Form (Source of Data)	Analytical Data File: Occupant	Interior	Exterior	Soil/Dust	Common Areas	Dwelling	Reading	Soil/Dust Paint
DU (Dwelling Unit)	X					X	X	X
Interior Observation		X				X	X	X
Exterior Observation			X				X	X
Common Area Observation					X		X	X
Common Area Collection					X		X	X
Common Area Inventory					X		X	X
Soil/Dust Sampling Log				X				X
Telephone Questionnaire	X					X	X	X

Occupant File

One data record was developed for each dwelling unit occupant. It contains information on the occupant's age, sex, and race. These data were derived from the Telephone Questionnaire Form for private housing, and from the back of the Dwelling Unit Form for public housing.

Interior Component File

The interior rooms were classified as either a wet room or a dry room according to the presence or absence of plumbing in the room. One wet room and one dry room were randomly selected. All painted surfaces in each of the two rooms were identified and quantified; the substrate surfaces identified, the condition of the paint and substrate surfaces noted. Quantification of the painted surfaces by the inspection team was accomplished in different ways for different architectural components. For example, ceilings were quantified by recording their length and width, and walls by their length and height. Trim was recorded by length. Components such as doors, windows, fireplaces, and closets were quantified by their number.

If a room was a kitchen, bathroom, laundry, or utility room then it was classified as a wet room, otherwise it was classified as a dry room. If the room type could not be determined, then it was classified as a dry room.

There was one record for each painted architectural component in an interior room. These data were obtained from the Interior Observation Form. There was a total of 29 different architectural components possible for an interior room, including such items as ceiling, wall (separate components for each of four walls), metal window trim, nonmetal crown molding, and fireplace. Components which could not be assigned to one of the 29 categories were placed in an "other" category. There can be up to 60 records of this type for a single dwelling unit.

One complex derived variable in this file is COMP_QTY, the computed area of the painted surface for the architectural component. The following calculations were performed to obtain this variable using the raw data collected for the interior room. The basic unit of measurement is the foot.

Architectural Component	Method for Calculation of `COMP_QTY'
Air/heat vents	Calculate area as number of air/heat vents multiplied by representative area for such systems of 1 square foot
Baseboard trim	Calculate area as length multiplied by representative width of such trim of 1/3 foot (4 inches)
Cabinets	Calculate area as number of cabinets multiplied by representative area of 6.25 square feet
Ceiling	Calculate total area as product of length and width
Closets	Calculate area as number of closets multiplied by representative area of 19 square feet
Crown molding	Calculate area as length multiplied by representative width of such molding of 7/12 foot (7 inches)
Door systems	Calculate area as number of door systems multiplied by representative area for such systems of 17 square feet
Door trim	Calculate area as length multiplied by representative width of such trim of 1/3 foot (4 inches)
Fireplaces	Calculate area as number of fireplaces multiplied by representative area of 16 square feet

(continued:)

Architectural Component	Method for Calculation of `COMP_QTY'
Floor	Calculate total area as product of length and width
Other	The area of this undefined architectural component is set equal to recorded value for component, assuming a unit area of 1 square foot or width of 1 foot
Radiators	Calculate area as number of radiators multiplied by representative area of 8 square feet
Shelf	Calculate area as length of shelf multiplied by representative width of 1 foot
Stair trim	Calculate area as length multiplied by representative width of such trim of 5/6 foot (10 inches)
Wall	Calculate total area of wall from product of recorded height and width, then subtract 19 square feet for each doorway in the wall, 13 square feet for each window, and 16 square feet for each fireplace
Window sill	Calculate area as length multiplied by representative width of such sills of 1/3 foot (4 inches)
Window system	This item refers to the casing around the window. Calculate area as number of window systems multiplied by representative area of 5 square feet
Window trim	Calculate area as length multiplied by representative width of such trim of 1/3 foot (4 inches)

The substrate category variable (SUB_CAT) takes on one of four code values depending upon the identified architectural component:

= 1 for walls, ceiling, or floor
= 2 for metal substrate surfaces
= 3 for nonmetal substrate surfaces
= 4 for shelves, cabinets, fireplaces, closets, and `other' components

There are 0, 1, or 2 nonmissing field measurements for each of the above four values of SUB_CAT in each inspected dwelling unit. For each value of SUB_CAT (each architectural component stratum) within a room, the average of the nonmissing values was computed. This average was then applied to each component in the room with the same SUB_CAT value (i.e., in the same stratum) that had no recorded field measurement. This imputation was repeated for all interior rooms and exterior walls in the sample. The following is a hypothetical example of this procedure:

MAP/XRF data as read for a wet room in a single hypothetical dwelling unit:

Component	Surface	SUB_CAT	MAP/XRF data
Walls, ceiling, floor:	Wall 1	1	(missing)
	Wall 2	1	1.0
	Wall 3	1	(missing)
	Wall 4	1	0.8
	Ceiling	1	(missing)
Non-metal substrate:	Baseboard trim	3	2.3
	Door trim	3	(missing)

The average value for the SUB_CAT=1 data in this room is 0.9, and the average for the SUB_CAT=3 is 2.3. The imputation procedure then yields the following data set for this wet room example:

Component	Surface	SUB_CAT	MAP/XRF data	
Walls, ceiling, floor:	Wall 1	1	0.9	(imputed)
	Wall 2	1	1.0	
	Wall 3	1	0.9	(imputed)
	Wall 4	1	0.8	
	Ceilin	1	0.9	(imputed)
Non-metal substrate:	Baseboard trim	3	2.3	
	Door trim	3	2.3	(imputed)

The variable XRF_VALU indicates whether the corresponding XRF data value is actual (XRF_VALU=1) or imputed (XRF_VALU=2).

This data file contains both raw MAP/XRF field measurements, and recalibrated MAP/XRF measurements adjusted for bias by surface component, as described in Appendix II, Chapter 3 of this report. It is strongly recommended that the recalibrated MAP/XRF measurements be used in any analysis work.

Exterior Component File

Quantification of the exterior component painted surfaces by the inspection team was accomplished in different ways for different architectural components. For example, walls were quantified by recording their length and height, and trim was recorded by length. Components such as doors, columns, and balconies were quantified by their number.

There is one record for each painted architectural component. These data were obtained from the Exterior Observation Form. There is a total of 21 different architectural components possible for a unit exterior, including such items as wall, metal window trim, nonmetal column, and porch. There is one additional category "other" for components which can not be assigned to one of the 21 categories. There can be up to 21 records for the exterior components for a dwelling unit.

One complex derived variable in this file is COMP_QTY, the computed area of the painted surface for the architectural component. The following calculations were performed to obtain this variable using the raw data collected for the exterior components. The basic unit of measurement is the foot.

Architectural Component	Method for Calculation of `COMP_QTY'
Balcony	Calculate area as number of balconies multiplied by representative area for balconies of 24 square feet
Column	Calculate area as number of columns multiplied by representative area for columns of 20 square feet
Door systems	Calculate area as number of door systems multiplied by representative area for such systems of 21 square feet
Door trim	Calculate area as length multiplied by representative width of such trim of 1/2 foot (6 inches)
Other	The area of this undefined architectural component is set equal to recorded value for component, assuming a unit area of 1 square foot or width of 1 foot
Porch	Calculate area as number of porches multiplied by representative area for such systems of 5 square feet
Railing	Calculate area as length multiplied by representative width of railing of 5/6 foot (10 inches)
Soffit/fascia	Calculate area as length multiplied by representative width of such systems of 5/3 foot (20 inches)
Stairs	Calculate area as number of steps multiplied by representative area for such systems of 4 square feet
Wall	Calculate total area of wall from product of recorded height and width
Window sill	Calculate area as length multiplied by representative width of such sills of 1/3 foot (4 inches)
Window trim	Calculate area as length multiplied by representative width of such trim of 1/3 foot (4 inches)

The substrate category variable (SUB_CAT) takes on one of four code values depending upon the identified architectural component:

= 1 for walls
= 2 for metal substrate surfaces
= 3 for nonmetal substrate surfaces
= 4 for porch, balcony, stairs, and `other' components

There are 0, 1, or 2 nonmissing field measurements for each of the above four values of SUB_CAT in each inspected dwelling unit. An imputation procedure was used to develop field measurements for components which had no direct field measurements. This procedure is discussed in detail in the preceding section.

This data file contains both raw MAP/XRF field measurements, and recalibrated MAP/XRF measurements for bias by surface component. It is recommended that the recalibrated MAP/XRF measurements be used in any analysis work.

Soil/Dust File

There is one record for each soil and each dust sample taken. Data in this file were derived from the soil/dust sampling log and match-merged with the lab data file.

Common Area File

There are three types of common areas in the multi-family buildings: common room, common hall, and playground. The common room category includes laundry room, mail room, and similar types rooms. A common room was examined using the same protocol as for a dry or wet room within a dwelling unit. The common hall category indicates a hallway adjacent to the entrance to an apartment. The playground category includes playground equipment outside of the apartment building.

There is one record for each painted architectural component. These data were obtained from the Common Area Observation Form, the Common Area Inventory Form, and the Common Area Collection Form. For a common room, there is a total of 29 different architectural components possible, including such items as ceiling, wall (separate components for each of four walls), metal window trim, nonmetal crown molding, and fireplace. There is one additional category "other" for components which cannot be assigned to one of the 29 categories.

One complex derived variable in this file is COMP_QTY, the computed area of the painted surface for the architectural component. Calculations are performed to obtain this variable using the raw data collected for the common areas. The basic unit of measurement is the "foot" for common room components. Refer to the previous section "Interior Component File" for definitions of COMP_QTY if the common area is a `room'. For the two other types of common areas, the following definitions are used:

For playgrounds, COMP_QTY = number of pieces of equipment
For common hall, COMP_QTY = 1

For an adjacent hallway (COMPON=51) and the EXISTS variable = "1", then the variable COMP_QTY is computed assuming an average of 80 square feet of painted hallway walls and ceiling per apartment (floors are not usually painted).

If PUBLIC=0 (private housing) Then COMP_QTY=80*CI6NEW
If PUBLIC=1 (public housing) Then COMP_QTY=80*FAMILYU

otherwise COMP_QTY=0

The variable CI6NEW is the number of dwelling units in building for private housing. The variable FAMILYU is the number of family units in a public housing unit.

The substrate category variable (SUB_CAT) takes on one of six code values depending upon the identified architectural component:

= 1 for walls, ceiling, or floor in a common area room
= 2 for metal substrate surfaces in a common area room
= 3 for nonmetal substrate surfaces in a common area room
= 4 for shelves, cabinets, fireplaces, closets, and `other' components in a common area room
= 5 for playground equipment
= 6 for common hall

For common area rooms, there are 0, 1, or 2 nonmissing field measurements for each of the above values of SUB_CAT (1, 2, 3 or 4) in each inspected dwelling unit. An imputation procedure was used to develop XRF measurements for components which had no field measurements.

For common area halls and playgrounds, the imputation procedure was not needed. For these areas, XRF_VALU=1 for nonmissing field measurements, and MAP/XRF_VALU=2 for missing MAP/XRF field measurements.

This data file contains both raw MAP/XRF field measurements, and MAP/XRF measurements recalibrated for bias by surface component. It is recommended that the recalibrated MAP/XRF measurements be used in any analysis work.

Dwelling File

This data file contained one set of data for each dwelling unit. The records were developed from the Telephone Interview Questionnaire and the Dwelling Unit Form. Because certain fields contained were meant only for renters, this data file contained some variables only pertinent to renters. Similarly, variables related to market value of the dwelling unit only contain data if the occupant was the dwelling unit owner. There also are variables identifying the age and race of the youngest occupant of the dwelling unit. They were obtained from data in the Dwelling Unit Form.

MAP/XRF Maximum File

This data file contained one record of corrected MAP/XRF measurements for each dwelling unit.

There were two MAP/XRF type variables in this data file. One type contains the maximum corrected measurement (i.e., corrected measurement) by location (exterior, interior, common area, playground, and entire dwelling unit). The other type was a corrected MAP/XRF measurement for the entire dwelling unit adjusted for MAP/XRF bias and incomplete sampling in a dwelling unit.

Reading File

This data file contained one set of data for each painted architectural component. They contained interior, exterior, and common area data and represent a convenient composite data set of information from the interior, exterior, and common area data files. The reading files also contained the purposive MAP/XRF data obtained from the interior and exterior surfaces of the dwelling unit.

Soil/Dust/Paint File

This data file contained one record for each dwelling unit. The data set contained separate variables for the dust on the wet and dry room floors, on window sills, and in window wells. There also are variables for the estimated area of intact and nonintact (damaged or peeling) paint in the rooms and on exterior walls. Some of the variables are quantitives while others are flags, e.g., denote the presence or absence of lead-based paint in the wet room.

Certain variables were assigned a minimum value of 0.025. That is, if the value was less than 0.025, then it was set to 0.025. The variables thus adjusted are DSTWT_xx and MAP/XRF_xxx, where xx and xxx denote suffixes defining sample location (e.g., `WS' for window sill and `DRY' for dry room). This adjustment was made before the natural logarithm of the variable was taken. Therefore, the minimum natural logarithm for these variables is ln(0.025) or -3.6889.

XRF Adjustments to Eliminate Substrate and Instrument Bias

The recalibrated XRF measurements were obtained from the field measurements using the methodology described in Appendix II, Chapter 3. Four equations were used to correct the field measurements for substrate bias and for the specific MAP/XRF machine used. The four substrates are: wood, steel, drywall, and concrete. The equations have the form:

XRFA = constant + XRFCoef*XRF + DateCoef*daysince

where
XRFA is the recalibrated measurement (mg/sq cm)
XRF is the field measurement (mg/sq cm)
daysince is the number of days from 2/2/90 (the date of beginning of data collection) to the date that the measurement was taken

Values of `constant', `XRFCoef', and `DateCoef' are listed in Table 7-2 for the different MAP/XRF machines and for the four substrates.

TABLE 7-2
COEFFICIENTS FOR XRF BIAS ADJUSTMENTS

Serial	Substrate	Constant	XRFCoef	DateCoef
32	2	0.57926289	0.61607564	0.00060991
34	2	-0.94722461	1.07477134	0.00106402
35	2	-2.38953999	1.98292590	0.00196310
36	2	-1.02852647	1.05800227	0.00104742
37	2	-0.92737469	1.23514212	0.00122279
38	2	-2.88539502	2.00489039	0.00198484
39	2	-0.98324686	1.12735849	0.00111608
41	2	-0.31665053	1.33451777	0.00132117
32	1	0.57728690	0.67478026	0.00066803
34	1	0.51080053	0.77666059	0.00076889
35	1	0.57764705	0.68420416	0.00067736
36	1	0.57789670	0.69770523	0.00069073
37	1	0.23897089	0.88792570	0.00087905
38	1	0.58492849	0.70808139	0.00070100
39	1	0.42144247	0.75301015	0.00074548
41	1	0.09328605	1.46462396	0.00144998
32	4	0.54396423	1.66475841	0.00164811
34	4	0.56782847	1.41289116	0.00139876
35	4	0.54346480	1.73049289	0.00171319
36	4	0.56921937	1.55457732	0.00153903
37	4	0.54754401	2.25471698	0.00223217
38	4	0.57533900	1.15860912	0.00114702
39	4	0.55145354	1.48596447	0.00147110
41	4	0.56350756	0.86731876	0.00085865
32	3	0.56839751	0.93887384	0.00092949
34	3	0.57154194	0.82130029	0.00081309
35	3	0.57302341	0.80144343	0.00079343
36	3	0.16940757	0.82195767	0.00081374
37	3	0.23107495	0.91864190	0.00090946
38	3	0.58393402	0.75480287	0.00074725

(continued:)

Serial	Substrate	Constant	XRFCoef	DateCoef
39	3	0.33891181	0.79428126	0.00078634
41	3	-0.31529249	1.49587482	0.00148092

The four substrate categories used in the bias adjustments are determined from the observed substrate as follows:

Observed Substrate	Substrate for Bias Adjustment
"PLASTER"	DRYWALL
"GYPSUM (DRYWALL)"	DRYWALL
"CONCRETE BLOCK"	CONCRETE
"CONCRETE CAST"	CONCRETE
"CONCRETE, PRECAST"	CONCRETE
"BRICK"	CONCRETE
"WOOD PANELING"	WOOD
"WOOD, SMOOTH"	WOOD
"WOOD, ROUGH"	WOOD
"WALL PAPER"	DRYWALL
"OIL CLOTH"	DRYWALL
"CERAMIC TILE"	DRYWALL
"METAL, SMOOTH"	STEEL
"METAL, ROUGH"	STEEL
"WAINSCOT"	STEEL
"STONE"	CONCRETE
"VINYL SIDING"	WOOD
"ALUMINUM SIDING"	STEEL
"SHINGLE, WOOD"	WOOD
"SHINGLE, ASBESTOS"	DRYWALL
"STUCCO"	CONCRETE
"CEILING TILE"	DRYWALL
"LINOLEUM"	WOOD
"FIBERGLASS"	WOOD

Paint Damage

The amount of paint damage (as a percentage) was estimated from recorded categories for paint condition on architectural components as follows:

Recorded Paint Condition Code	Estimated Paint damage percent
"1" (All paint intact)	0
"2" (Up to 10 percent not intact)	5
"3" (10-25% not intact)	17.5
"4" (Over 25% not intact)	35
"5" (Wallpaper)	0
"6" (No paint)	0
"9" (Not ascertained)	0

APPENDIX A

SOIL AND DUST SAMPLING PROTOCOLS

SOIL AND DUST SAMPLING PROTOCOLS

The following protocols were established by MRI Laboratories in January 1990 as documented in the MRI final report titled Analysis of Soil and Dust Samples for use in the National Survey of Lead-Based Paint in Housing. The first protocol concerns dust sampling procedures. The second concerns soil sampling. These protocols provided detailed instruction for Survey inspectors. In addition to written instructions, MRI provided in-person training for the inspectors.

Household Dust Protocol

The following protocol is for the sampling of household dust for lead (Pb). This protocol is intended to allow for the sampling of a representative sample of surface dust on most surfaces including heavy carpet. The dust thus collected will be used for the determination of the surface loading of Pb in households.

Sampling Equipment

1. Pump - Gast rotary-vane vacuum pump operated at approximately 16L/min. with the sample cassette attached.

2. Sample Cassette - Gelman GN-4, 37mm, mixed cellulose ester (MCE) filter cassettes (0.8um pore size) connected to the vacuum pump via thick walled Tygon tubing.

3. Pick-up Nozzle - Teflon pick-up nozzle ("Blue Nozzle") designed and supplied by MRI.

4. Template - 1 Sq.Ft. template for defining the sampling area. Alternately, an area can be sampled and then measured to determine the actual sample area. This number is very important because surface loading of lead can only be determined if the sampling area is known.

5. Miscellaneous equipment - Tape to seal and mark the cassettes, a small screwdriver for prying loose jammed cassettes, a marking pen, 1-qt and 1-gal ziplock plastic bags, plastic trash bag, vinyl gloves (powderless), sampling data forms, sampling traceability forms, shoe covers, steel measuring tape.

Sampling Procedures

1. Place your shoe covers on when entering the front door to prevent contamination of sampling areas.

2. Place the template over the area of interest or define the area to be sampled in some fashion (e.g., a window sill top surface).

3. Holding the nozzle with the open cassette upright, turn on the pump.

4. Vacuum the area of interest in overlapping passes first left to right over the entire area and then front to back over the entire area. Care should be taken to hold the nozzle level to the surface and move the nozzle at a steady rate. If the nozzle becomes stuck, twist loose and continue. Do not turn off pump.

5. Turn the nozzle back upright and then turn off the pump.

6. Continue holding the nozzle upright and remove the cassette gently being careful not to allow dust to spill from the cassette.

7. Place the top back on the cassette and insert the colored plugs back into the small holes on the cassette.

8. Tape the cassette over the long axis being certain to tape down both small plugs in the process.

9. Label the cassette and bag with additional label for shipment.

10. If multiple areas are being done with a single cassette, do not turn off the vacuum between areas but hold the cassette upright as you move from one area to the other.

Also note that you should change nozzles when you change cassettes to collect a new sample.

Soil Sampling Protocol

The following is for the sampling of soil for lead. This protocol is intended to allow for the sampling of a representative sample of soil around the dwelling unit.

Sampling Equipment

Corer

Lab Approved Wet Wipes

Latex Gloves

Plastic Sampling Bags

Sampling Data Forms

Sampling Traceability Forms

Plastic Trash Bags

Sampling Procedures

- The technician will always wear the latex gloves when taking soil samples.
- The technician will change gloves after each composite soil sample is taken.
- It is important that the technician always use the wet-wipes that are approved by MRI labs.
- When using wet-wipes, always wipe in one direction.
- Never reuse a wipe unless the contaminated or dirty side of the wipe is folded to the inside.

- Clean hands (gloves) with a wipe before and after the decontamination process.
- The technician will insert core into ground approximately 10 centimeters.
- The technician will put the three core sub-samples in a plastic bag (one composite sample) and hand it to the team leader who will double bag the sample, and attach the label to the inside bag.
- The technician will clean the core with a baby wipe after each composite soil sample is taken.
- The technician will note the location of the sample, and make remarks regarding exceptions to normal procedures on the Sampling Data Forms.
- If soil samples cannot be taken as outlined in the procedures, use the following guidelines: If there is soil within twenty-five (25) feet of the sampled building, take a soil sample at the location and treat it as a remote sample.

Below are the procedures to follow to insure that the equipment is decontaminated.

After each composite soil sample is taken, the technician will

- Clean hands (gloves) with wipe,
- Clean the plunger,
- Wad a wet-wipe into the sample tube, starting in the bore and using the plunger to push the wipe through the tube,
- Remove the wipe from the tube, if the wipe is dirty, repeat the second and third steps and continue until the wipe comes out of the plunger clean,
- Clean the external part of the bore with a wipe, and
- Clean hands (gloves) with wet-wipe and dispose of gloves in plastic trash bag.

APPENDIX B

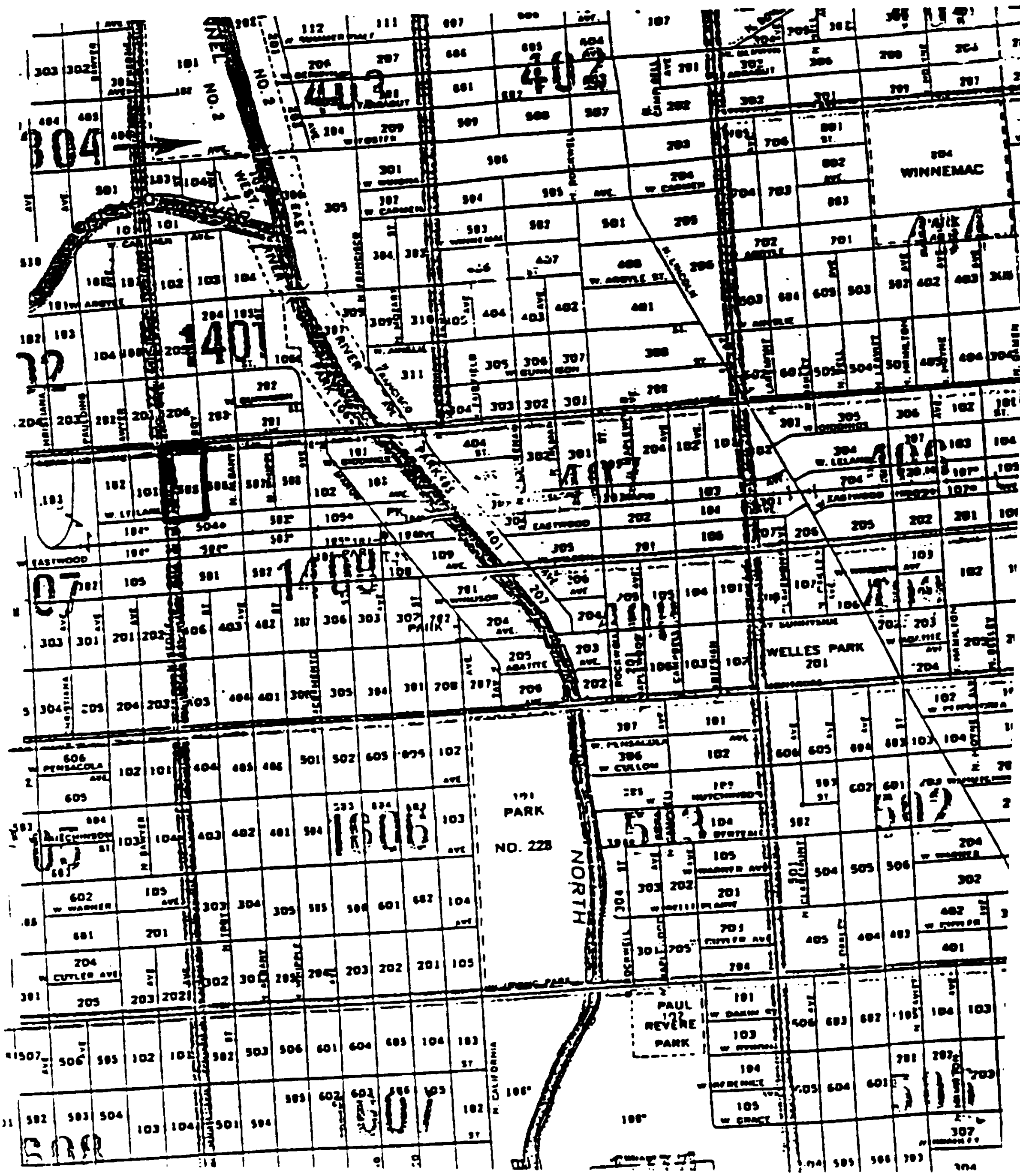
SURVEY MATERIALS

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

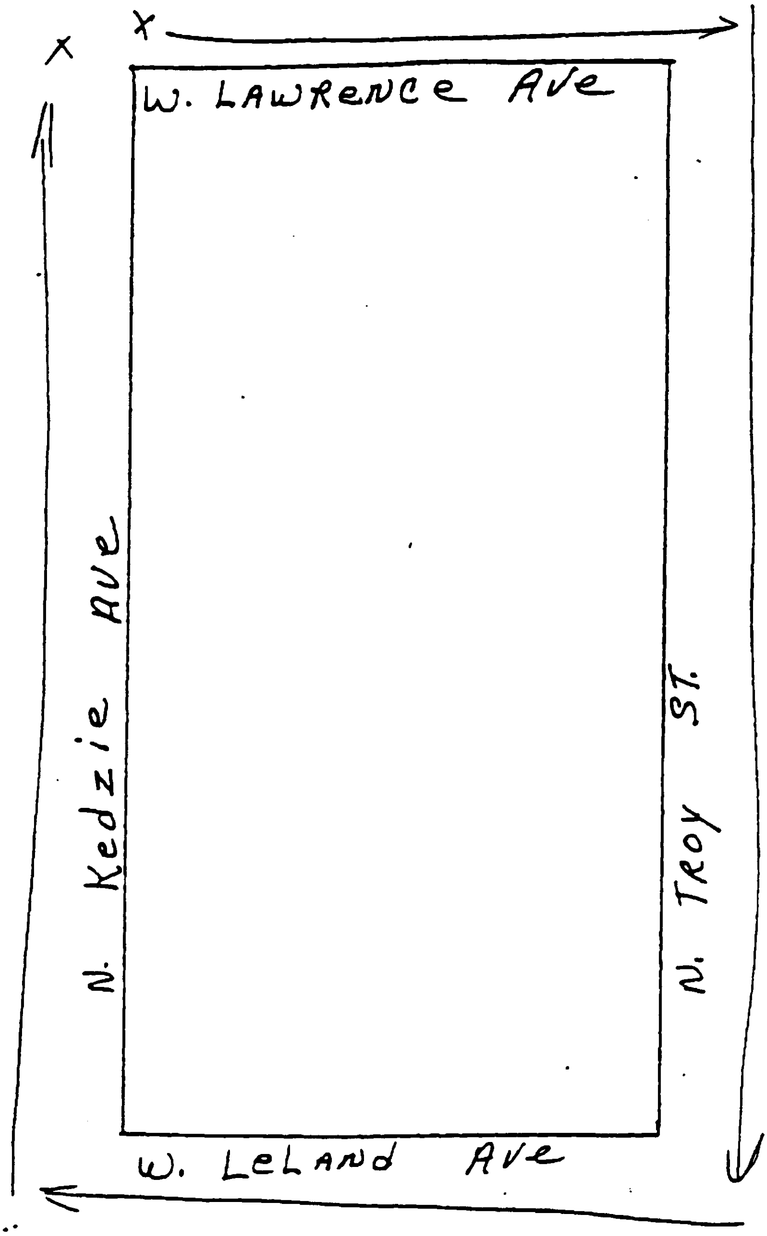
O. 07 PLACE Chicago, IL COUNTY

NUMBER OF DU'S 65 SEGMENT NUMBER 02



o. 07 PLACE Chicago, IL

NUMBER OF DU'S 65 SEGMENT NUMBER 02



LISTING ROUTE FORM

Page ___ of ___

PSU ______ Seg ______

Lister ______

Date ______

List All Streets in the Order Traveled	Between: Beginning Intersection	Between: Ending Intersection
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
NATIONAL SURVEY OF LEAD-BASED PAINT IN HOUSING

MAIN LISTING SHEET

Page ____ of ____ pages
PSU #: ____________
Segment #: ____________

Listed by: ____________

MAILING INFORMATION FOR SEGMENT

Name of City, Township, etc.: ____________
Zip Code: ____________

(a) Office Use Only	(b) Line #	(c) Street Name	(d) House #	(e) Apt. #	(f) Description or Location	(g) # Grp. Qtrs. (✓)	(h) Remarks
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	0						

SPECIAL INSTRUCTIONS AND GENERAL COMMENTS

SPECIAL INSTRUCTIONS:

GENERAL COMMENTS:

OFFICE OF THE ASSISTANT SECRETARY
FOR POLICY DEVELOPMENT AND RESEARCH

November 29, 1989

Dear Resident:

I would like your help in an important national study. The United States Department of Housing and Urban Development (HUD) is conducting a survey of homes throughout the Nation to examine them for the possible presence of lead in paint, dust, and soil. Unsafe levels of lead are associated with many debilitating diseases, particularly in children and unborn babies. Public health officials know the dangers of lead poisoning but not the extent of the problem in our homes. Congress mandated this study of homes across America to learn just how widespread the problem of lead-based paint is in our country.

Your home may be randomly selected from among all homes in America for inclusion in this survey. HUD has asked Westat, Inc., a large statistical survey company, to conduct the survey. This Westat interviewer wants to ask you a few questions about your home. If you are selected for the survey, Westat will schedule an appointment for the interviewer and a technician to visit your home again. They will measure painted surfaces for lead and will collect small samples of dust and soil from your home. We don't know if any measurable amounts of lead will be found. The data for your home will be combined with data for many other homes across the Nation to estimate the extent of lead in American homes. Your information is totally confidential and will never be associated with you individually. If you wish, you personally may obtain the records of your test results.

Your voluntary cooperation in this survey is essential. Please take the time to cooperate with the survey staff in their questions and testing needs. All survey staff carry picture identification authorized by HUD.

Thank you for helping in this effort to reduce the problem of lead poisoning in our country. If you have any questions or concerns that the interviewer is unable to answer, please call Westat's National Field Director at 1-800-937-8284 or call HUD at 1-202-755-4370. (The HUD number is not toll free.)

Very sincerely yours,

Ronald J. Morony

Ronald J. Morony, P.E.
Director of Innovative Technology
Office of Research

WASHINGTON, D.C. 20410

INTRODUCTION LETTER, VERSI

FFICE OF THE ASSISTANT SECRETARY
OR POLICY DEVELOPMENT AND RESEARCH

November 24, 1989

Dear Resident:

I would like your help in a study of importance to our Nation. The United States Department of Housing and Urban Development is conducting a survey of homes throughout the Nation to examine them for the possible presence of lead in paint, dust, and soil. Unsafe levels of lead are associated with many debilitating diseases, particularly in children and unborn babies. Public health officials know the dangers of lead poisoning but not the extent of the problem in the environment. Congress mandated this study of homes across America to learn just how widespread the problem of lead-based paint is in our country.

Your home has been randomly selected from among all homes in America for inclusion in this survey. The Department has asked Westat, Inc., a large statistical survey company, to conduct the survey. A Westat interviewer wants to visit you to ask you a few questions about your home. In addition, a technician will measure selected painted surfaces for lead, and will collect small samples of dust from your home and soil from the outside. The survey team does not know if any measurable amounts of lead will be found. The results for your home will be combined with the results for many other homes across the Nation to estimate the extent of lead in American homes. Your test results are totally confidential and will never be associated with you individually. If you wish, you personally may obtain the records of your test results.

Your voluntary cooperation in this survey is essential. This study is very important to the public health of this country. Please take the time to cooperate with the survey interviewer and technician in their questions and testing needs. All survey staff carry picture identification authorized by HUD.

Thank you for helping in this effort to reduce the problem of lead poisoning in our country. If you have any questions or concerns that the interviewer is unable to answer, please call Westat's National Field Director at 1-800-937-8284 or call HUD at 1-202-755-4370.

Very sincerely yours,

Ronald J. Morony

Ronald J. Morony, P.E.
Director of Innovative Technology
Office of Research

OMB 2528-1037:3
Expires August 31, 1990

Screener
ID_______________

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

NATIONAL SURVEY OF
LEAD-BASED PAINT IN HOUSING

SCREENING QUESTIONNAIRE

Assurance of Confidentiality

The information you provide will be used for research purposes only. Your answers will be kept strictly confidential and protected from disclosure as specified by the privacy Act of 1974 and as required by law. The information you provide will never be identified with you or your family.

S1. Interviewer: Verify that the DU address is the same as that on the label on back of questionnaire.

1 Yes, address same
2 Not same (Contact HQ)

[Hand respondent HUD letter] Hello, my name is ________. I am with Westat. Westat is assisting the U.S. Department of Housing and Urban Development (HUD) with a national housing survey designed to collect information about lead-based paint in housing. I would like to ask you a few questions about your house.

S2. Is this house/apartment primarily a residence or business?

1 Business (Code P10; end)
2 Residence

S3. Is this a year-round residence or is it a vacation home?

1 Year-round residence
2 Vacation home (Code P10; end)

S4. How many apartments/dwelling units are in this building?

|__|__|__|__| (S6)
Enter number

9998 Don't know

S5. Would you say that there are...

1 4 or fewer units
2 5 units or more

S6. Interviewer: Unit count is...

1 1 to 4 units
2 5 or more units

S7. When was this building/home constructed?

|__|__|__|__| (If 1980 or later, code P10; end)
(If before 1980, S10)

9998 Don't know

S8. Was it constructed in...

1 1980 to present (Code P10; end)
2 1960-1979 (S10)
3 1940-1959 (S10)
4 Prior to 1940 (S10)
8 Don't know

S9. Would you say the building is...

1 Less than 10 years old (Code P10; e
2 10 to 29 years old
3 30 to 49 years old
4 At least 50 years old or older
8 Don't know

S10. Interviewer: Indicate construction year...

1 1980 - present
2 1960 - 1979
3 1940 - 1959
4 Prior to 1940
8 Don't know

S11. Do you own or rent?

1 Own (S13)
2 Rent (S13)

S12. Interviewer: Is this an owner-occupied single fami home?

1 Yes (Go to S15)
2 No

S13. Is this a condominium or cooperative?

1 Yes
2 No (Go to S15) if own, then go to S16; if rent go to S14

S14. If your home is selected for the full survey, we will w to visit and take dust and soil samples from comm areas. We will need to contact the managem company or owners' association about visiting in the areas. Who should we contact?

Name:

____

Address:

____

____

Telephone:

____
area code

S15. Interviewer: Circle the correct code:

1 Publicly owned
2 Privately owned

S16. Are there any children 6 years or younger living in this building/home?

1 Yes (S19)
2 No
8 Don't know

S17. Are there any rules or regulations prohibiting children from living in this building or neighborhood?

1 Yes
2 No (S19)
8 Don't know

S18. Do the rules prohibit adults under the age of 50 from living in this building or neighborhood?

1 Yes (Code P10; end)
2 No
8 Don't know

S19. If we need to call again, who should we contact?

Name:

____

Telephone:

Home:______________________________
area code

Other:______________________________
area code

S20. When would be a good time to contact ________ (above named person)?

Days/Dates: ______________________________

Times: ______________________________

Thank the respondent for time and participation.

OMB # 2528-0137:35

Contact Record

ID

Interviewer Initials ______________

Respondent: ______________________________

Address: ______________________________

____

CONTACT RECORD

	Date	Time	Result code	Comments
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				

In-Person Result Codes

P1 - No one home
P2 - Vacant
P3 - Would not answer door
P4 - Refusal
P5 - No adult home
P6 - Language problem
P7 - Breakoff/Friendly/Revisit
P8 - Breakoff/Friendly
P9 - Completed screener/inspection
P10 - Not eligible
P11 - Other

Telephone Result Codes

T1 - Ring, no answer
T2 - Wrong number
T3 - Language problem
T4 - Callback needed
T5 - Refusal to allow inspection
T6 - Appointment rescheduled
T7 - Appointment confirmed/ call completed successfully
T8 - Other

OMB 2528-[illegible]

HUD NATIONAL SURVEY OF LEAD-BASED PAINT IN HOUSING

PRIVATE HOUSING QUESTIONNAIRE

LABEL

INTRODUCTION:

May I speak to (________________________________)?
(Screener Respondent)

My name is (________________________________). I'm calling from Westat in Rockville, Maryland on behalf of the U.S. Department of Housing and Urban Development. You may remember on ________________ (Date of Screener) a Westat interviewer spoke with you or someone in your household concerning a national survey on lead-based paint in housing. Do you remember that visit and the letter from HUD explaining the survey?

If Respondent Does Not Remember Visit Or Letter:

Have I reached (____________________________) at (____)?
(Telephone Number) (Address)

TELEPHONE NUMBER CORRECT............................	YES NO	
ADDRESS CORRECT...	YES NO	(TERMINATE. SHOW TO SUPERVISOR)

If Respondent Remembers Visit And/or Letter

Your home was selected to be part of this survey. At this time I have a few questions I would like to ask you. Let me assure you that your answers will be kept strictly confidential. The information you provide will be combined in statistical form with similar information from across the country. While your participation is voluntary, your cooperation is very important to the success of the survey.

ASSURANCE OF CONFIDENTIALITY

The information you provide will be used for research purposes only. Your answers will be kept strictly confidential and protected from disclosure, a as specified by the privacy Act of 1974 and as required by law. The information you provide will never be identifiable with you or your family. Your answers will be available only to the researchers in the study or as required by law, and will only be used for the purposes of this research. While your participation is voluntary, your cooperation in this survey is very important to the success of the survey.

Time Begun ________________ AM / PM

I would like to verify one question from the interview to make sure we recorded the information correctly?

1. ——————————▷ 1. How many dwelling units are in this building?

|__|__|__|
Number
Don't know.............. 9998

2. When was this building constructed?

|__|__|__|__| (5)
Year
DON'T KNOW..............9998

3. Was it constructed in...

1980 to present	1	(End interview)
1970-1979	2	(5)
1960-1969	3	(5)
1950-1959	4	(5)
1940-1949	5	(5)
1920-1939	6	(5)
1919 or earlier	7	(5)
DON'T KNOW	8	

4. Would you say this building is...

Less than 10 years old	01	(End interview)
10 to 19 years old	02	
20 to 29 years old	03	
30 to 39 years old	04	
40 to 49 years old	05	
50 to 59 years old	06	
60 to 69 years old	07	
At least 70 years old	08	
DON'T KNOW	98	

I have a few other questions I would like to ask.

5. How many stories are in the building, including the basement? (If split level, count the greatest number of stories on top of each other.)

|__|__|
Number of Stories

6. Does this building have central air conditioning?

Yes	1	(8)
No	2	

7. Does this building have forced hot air heat?

Yes 1
No 2

8. How many people live in this household?

|__|__|
Number

9. For each person, please tell me their age and sex?

	Sex	Age	Race
1.			
2.			
3.			
4.			
5.			
6.			

	Sex	Age	Race
7.			
8.			
9.			
10.			
11.			
12.			

10. Would you please tell me the race or ethnic background of (ask person no. 1; then person no. 2; etc.) Is he/she...

READ LIST AND ENTER CODE F OR RACE/ETHNIC BACKGROUND

01. AMERICAN INDIAN OR ALASKA NATIVE
02. ASIAN OR PACIFIC ISLANDER
03. BLACK/AFRO AMERICAN (NON-HISPANIC)
04. WHITE (NON-HISPANIC)
05. HISPANIC
06. OTHER
97. REFUSED

CHECKPOINT

DOES NUMBER OF PEOPLE IN Q8 EQUAL THE NUMBER LISTED IN Q9? IN NO, RECONCILE.

11. In the last six months, or less if you have recently moved to this address, have you or anyone in your household worked at any of the following jobs?

READ LIST. AT THE FIRST YES ANSWER, CIRCLE 1 AND GO TO NEXT QUESTION.

Paint removal including scraping and sanding
Building Demolition
Welding
Plumbing
Sandblasting
Auto body work
Salvage (i.e., batteries/radiators

Chemical plant work
Glass work
lead Smelter work
Foundry work
Oil Refinery work
Battery Manufacturing Plant work
Other Lead-Related Industry work

Yes	1
No	2
DON'T KNOW	8

12. In the last six months, or less if you have recently moved to this address, have you or anyone in your household participated in any of the following activities?

READ LIST. AT THE FIRST YES ANSWER, CIRCLE 1 AND GO TO NEXT QUESTION.

Removed paint from furniture in the house
Painted cars
Painted bicycles
Soldered pipes
Soldered electronic parts
Worked with stained glass
Painted pictures with artists' paint
Removed paint, sanded or painted any part of the house

Yes	1
No	2
DON'T KNOW	8

13. Do you own or rent?

Own	1 (16)
Rent	2

14. What is the total monthly rent?

$ |__|.|__|__|__| (18)

Dollars

DON'T KNOW	98
REFUSED	97

15. Which of the following categories best describes your total monthly rent payment?

Less than $200	01	(18)
$200 - $299	02	(18)
$300 - $399	03	(18)
$400 - $499	04	(18)
$500 - $699	05	(18)
$700 - $999	06	(18)
Over $1,000	07	(18)
DON'T KNOW	98	
REFUSED	97	

16. If you were to put your home on the market today, what do you estimate the current value to be?

$ |__|.|__|__|__|.|__|__|__| (18)

Estimated Dollar Value

DON'T KNOW	98
REFUSED	97

17. Which of the following range of estimates best describes the current market value of your property?

0 to $40,000	01
$40,000 to $60,000	02
$60,000 to $79,000	03
$80,000 to $99,000	04
$100,000 to $149,000	05
Over $150,000	06
DON'T KNOW	98
REFUSED	97

18. Which of the following best describes your 1988 household income? Was it...

$10,000 or less	01
$10,000 to $19,999	02
$20,000 to $29,999	03
Over $30,000	04
DON'T KNOW	98
REFUSED	97

19. We need now to create a list of the rooms in your home. As I read the list please tell me if such a room exists, and if the room has plumbing. Also if the room has been added since the house or building was constructed.

ROOM NAME AND DESCRIPTION

Room	Exists		Plumbing		Is this *addition?		
	Yes	No	Yes	No	1980 + Yes	1979 or before Yes	No
1. Parlor/Sitting/Living Room	1	2	1	2	1	2	
2. Den/Rec/Family/Florida/Great Room	1	2	1	2	1	2	
3. Den/Rec/Family/Florida/Great Room	1	2	1	2	1	2	
4. Breakfast Room	1	2	1	2	1	2	
5. Kitchen	1	2	1	2	1	2	
6. Dining Room	1	2	1	2	1	2	
7. Bathroom (Specify)	1	2	1	2	1	2	
8. Bathroom (Specify)	1	2	1	2	1	2	
9. Bathroom (Specify)	1	2	1	2	1	2	
10. Bedroom (Specify)	1	2	1	2	1	2	
11. Bedroom (Specify)	1	2	1	2	1	2	
12. Bedroom (Specify)	1	2	1	2	1	2	
13. Bedroom (Specify)	1	2	1	2	1	2	
14. Study/Office	1	2	1	2	1	2	
15. Laundry/Utility Room	1	2	1	2	1	2	
16. Other Room (Specify)	1	2	1	2	1	2	
17. Other Room (Specify)	1	2	1	2	1	2	
18. Other Room (Specify)	1	2	1	2	1	2	
19. Other Room (Specify)	1	2	1	2	1	2	

19a. Have any of these rooms been added since the original construction date?

*Addition: 1. Totally new construction
2. Conversion of porch or garage into enclosed room which is used for living purpose.

The room inventory ends the question section of the survey.

A two member Westat team will visit your home to measure the painted surfaces and take dust samples in two randomly selected rooms inside the house. The team will also measure painted surfaces and take soil samples outside. Westat will give you fifty dollars ($50.00) to help compensate for your time and any inconvenience.

At this time we would like to make an appointment for the visit to your home. We are scheduling the visits beginning ______________________________.
(Inspection Date)

What day and time would be convenient for you?

DATE________________________________

TIME________________________________ AM / PM

TRANSFER APPOINTMENT TIME TO BACK COVER

Time Ended __________________ AM / PM

OMB # 2528-0137:35

Control Log and
In-Person Contact Record

ID

Interviewer Initials_______________

Respondent:_______________________________

Address:_________________________________

____

CONTACT RECORD

	Date	Time	Result code	Comments
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				

In-Person Result Codes

P1 = No one home
P2 = Vacant
P3 = Would not answer door
P4 = Refusal
P5 = No adult home
P6 = Language problem
P7 = Breakoff/Friendly/Revisit
P8 = Breakoff/Friendly
P9 = Completed screener/inspection
P10 = Not eligible
P11 = Other

Telephone Result Codes

T1 = Ring, no answer
T2 = Wrong number
T3 = Language problem
T4 = Callback needed
T5 = Refusal to allow inspection
T6 = Appointment rescheduled
T7 = Appointment confirmed/ call completed successfully
T8 = Other

OMB #2528-0137:6 WAIVER

ID:

U.S. Department of Housing and Urban Development

National Survey of Lead-Based Paint in Housing

INFORMED CONSENT RELEASE AND WAIVER FOR RESIDENT

Westat, Inc. is conducting a nationwide study to assess the presence of lead in painted surfaces and dust and soil of dwellings in the United States. This study is being conducted for the U.S. Department of Housing and Urban Development (HUD) to help develop a strategy to reduce the risk of lead-based paints in homes.

Your home has been randomly selected for possible participation in this study. Your participation in the study is entirely voluntary. You may refuse at any time to allow the employees to perform the tests. The information gathered about your home and information about this study will be provided via certified mail to you free of charge. All information will be handled in confidence. Other than information provided to you about your dwelling, information will be reported only as group statistics and not by name or address. You may call (800) 937-8284 in regard to this study, its results, or your particular dwelling. You will be provided with a HUD pamphlet with information regarding lead-based paint in dwellings.

I/WE consent to have my/our dwelling entered by representatives of Westat to measure the existence and amount of lead, if any, in the paint present on the interior surfaces, walls, doors, moldings, floors, baseboards and attached fixtures, such as cabinets and bookcases; in interior dust; and to have exterior surfaces, including the soil surrounding the dwelling, sampled.

I/WE understand that neither HUD nor Westat nor their agents will perform any abatement or correcting activities upon my dwelling.

This statement does not operate to remove responsibility from Westat or its employees or agents for negligence while present during the sampling study.

WITNESS MY/OUR HAND this _____ day of __________, 19 _____.

PLEASE READ THE ABOVE COMPLETELY BEFORE SIGNING

____

____

Witness:

____

OMB #2528-0137:6 WAIVER

ID:

U.S. Department of Housing and Urban Development

National Survey of Lead-Based Paint in Housing

INFORMED CONSENT RELEASE AND WAIVER FOR OWNER/MANAGER

Westat, Inc. is conducting a nationwide study to assess the presence of lead in painted surfaces and dust and soil of dwellings in the United States. This study is being conducted for the U.S. Department of Housing and Urban Development (HUD) to help develop a strategy to reduce the risk of lead-based paints in homes.

Your building has been randomly selected for possible participation in this study. Your participation in the study is entirely voluntary. You may refuse at any time to allow the employees to perform the tests. The information gathered about your building and information about this study will be provided via certified mail to you and the resident tenant free of charge. All information will be handled in confidence. Other than information provided to you and your resident tenant about their dwelling, information will be reported only as group statistics and not by name or address. You may call (800) 937-8284 in regard to this study, its results, or your particular building. You will be provided with a HUD pamphlet with information regarding lead-based paint in dwellings.

I/WE consent to have my/our owned building entered by representatives of Westat to measure the existence and amount of lead, if any, in the paint present on the interior surfaces, walls, doors, moldings, floors, baseboards and attached fixtures, such as cabinets and bookcases; in interior dust; and to have exterior surfaces, including the soil surrounding the building, sampled under the described procedures.

I/WE understand that neither HUD nor Westat nor their employees nor agents will perform any abatement or correcting activities upon my building.

This statement does not operate to remove responsibility from Westat or its employees or agents for negligence while present during the sampling study.

WITNESS MY/OUR HAND and SEAL this ____ day of _________, 19 ____.

PLEASE READ THE ABOVE COMPLETELY BEFORE SIGNING

____________________________ (SEAL)

____________________________ (SEAL)

Witness:

____

OMB #2528-0137:9 RECEIPT

ID:

U.S. Department of Housing and Urban Development

National Survey of Lead-Based Paint in Housing

PARTICIPANT RECEIPT

I, ______________________________, hereby acknowledge the receipt of $50.00 from Westat, Inc. acknowledging my participation in this research project. The payment is based on my dwelling being sampled for lead in the paint, soil, and dust.

____
Participant's Signature

____
Representative

Date ____________________

OMB 2528-0137:13

DU Form

ID:

1. Respondent: ______________________

2. Address: ______________________

3. Phone: ______________________

4., 5. Appointment Date/Time: ______________________

6., 7. Rescheduled for: ______________ Date (MM/DD/YY) ______________ Time

8. Sampled Dry Room: Room # __________ Name __________________

9. Backup Dry Room: Room # __________ Name __________________

10. Sampled Wet Room: Room # __________ Name __________________

11. Backup Wet Room Room # __________ Name __________________

12. Sampled Exterior Wall: Wall # __________

13. Backup Exterior Wall: *(Proceed counter clockwise from sampled wall)* __________ (Enter wall #)

Interviewer Initials/Name

14. _____/__________________ 15. Actual Time In: __________

Technician Initials/Name

16. _____/__________________ 17. Time Out: __________

XRF INFORMATION: 18. XRF Serial Number: __________________

20-22 XRF Verification Time/XRF#: Before Insp: __________ time __________ first #

23-25 After Insp: __________ time __________ last #

PURPOSIVE XRF READING					
Reading	A B Room # /Wall #	C Component	D Substrate	E XRF #	F XRF Reading
26. Interior 1					
27. Interior 2					
28. Exterior 1					
29. Exterior 2					

FLOATING XRF READING: Selected strata: __________________ (wall/metal/non-metal/shelf)

30. Dry Room: XRF #: __________

31. Wet Room: XRF #: __________

DU32 In the last six months, (or fewer if you have recently moved to this area) have you or anyone in your household worked at any of the jobs on card A?

Yes 1
No 2
Don't Know 8

Paint removal including scraping and sanding	Building Demolition	Glass work
Welding	Foundry work	Lead Smelter work
Oil Refinery work	Sandblasting	Plumbing
Salvage (i.e., batteries/ radiators	Auto body work	Battery Manufacturing Plant work
	Chemical Plant work	Other Lead-Related Industry work

DU33 In the last six months, (or fewer if you have recently moved to this area) have you or anyone in your household done any of the following activities listed on Card B at home?

Yes 1
No 2
Don't Know 8

Removed paint from furniture	Soldered electronic parts
Painted cars	Worked with stained glass
Painted bicycles	Painted pictures with artists' paint
Removed paint, sanded or painted any part of the house	Soldered pipes

DU34 How many people live in this household?

|__|__| (Ø = vacant)
Number

DU35 For each person, please tell me their age and sex?

Would you please tell me the race or ethic background of (ask person no. 1; then person no. 2; etc.) Is he/she...

	Sex	Age	Race		Sex	Age	Race
1.				7.			
2.				8.			
3.				9.			
4.				10.			
5.				11.			
6.				12.			

READ LIST AND ENTER CODE F OR RACE/ETHIC BACKGROUND

01. AMERICAN INDIAN OR ALASKA NATIVE
02. ASIAN OR PACIFIC ISLANDER
03. BLACK/AFRO AMERICAN (NON-HISPANIC)
04. WHITE (NON-HISPANIC)
05. HISPANIC
06. OTHER
97. REFUSED

ID: ____________

1..2. Room # / Type: ____________

3. What floor is room on (vis a vis building): Basement ... B Attic ... A Level # ... ______

4. If this is a dry room, is a wet room immediately adjacent? Yes ... 1 No ... 2

5. What year was this room last renovated? ________

Component	A. Exist / Painted YP NP N	B C Dimensions / Quantity	D Sub-Code	E Condition Paint	F Condition Substrate	G Access Y N	H Select Code	I XRF #	J XRF Reading
6. Wall #1 D___ W___ F___	1 2 3	•				1 2	4		
7. Wall #2 D___ W___ F___	1 2 3	•				1 2	6		
8. Wall #3 D___ W___ F___	1 2 3	•				1 2	1		
9. Wall #4 D___ W___ F___	1 2 3	•				1 2	5		
10.Ceiling	1 2 3	•				1 2	2		
11. Floor	1 2 3	•				1 2	3		

Metal Substrate

12. Baseboard trim	1 2 3	ft				1 2	5		
13. Stair trim	1 2 3	ft				1 2	7		
14. Door trim	1 2 3	ft				1 2	10		
15. Window sills	1 2 3	ft				1 2	9		
16. Window trim	1 2 3	ft				1 2	6		
17. Crown molding	1 2 3	ft				1 2	8		
18. Door systems	1 2 3	#				1 2	1		
19. Window systems	1 2 3	#				1 2	3		
20. Air / heat vents	1 2 3	#				1 2	2		
21. Radiators	1 2 3	#				1 2	4		

Non-Metal Substrates

22. Baseboard trim	1 2 3	ft				1 2	5		
23. Stair trim	1 2 3	ft				1 2	8		
24. Door trim	1 2 3	ft				1 2	7		
25. Window sills	1 2 3	ft				1 2	1		
26. Window trim	1 2 3	ft				1 2	2		
27. Crown molding	1 2 3	ft				1 2	6		
28. Door systems	1 2 3	ft				1 2	9		
29. Window systems	1 2 3	#				1 2	4		
30. Air / heat vents	1 2 3	#				1 2	3		

Shelves / Other

31. Shelves	1 2 3	ft				1 2	5		
32. Cabinets	1 2 3	#				1 2	1		
33. Fireplace	1 2 3	#				1 2	3		
34. Closet	1 2 3	#				1 2	2		
35. Other (Specify)	1 2 3					1 2	4		

ID: ____________________

1. Wall #: ________

2. Building conditions: T = 1 = True, F = 2 = False

	T	F	
a)	1	2	Roof, gutters, downspouts: Roof missing parts of weathering surfaces, or has holes or cracks. Gutters or downspouts broken.
b)	1	2	Chimney: Masonry cracked, bricks or coping loose or missing. Obviously out of plumb and not stable.
c)	1	2	Walls and siding: Obvious large cracks or holes in masonry or plaster, requiring more than routine painting. Siding has boards or shingles broken or missing. Obviously out of plumb or with bulges and not stable.
d)	1	2	Windows and doors: Two or more windows or doors broken, missing, or boarded up.
e)	1	2	Porch or steps: Major elements broken, missing, or out of plumb.
f)	1	2	Foundation: Foundation has major, visible cracks, missing material. Structure leans or is visibly unsound.

Component	A. Exist / Painted YP NP N	B C Dimensions / Quantity	D Sub-Code	E Condition Paint	F Condition Substrate	G Access Y N	H Select Code	I XRF #	J XRF Reading
Wall Strata									
3. Wall	1 2 3	•				1 2	1		
Metal Substrate									
4. Window sills	1 2 3	ft				1 2	5		
5. Window trim	1 2 3	ft				1 2	1		
6. Soffit and facia	1 2 3	ft				1 2	4		
7. Door trim	1 2 3	ft				1 2	3		
8. Door systems, sub #1	1 2 3	#				1 2	8		
9. Door systems, sub #2	1 2 3	#				1 2	7		
10. Columns	1 2 3	#				1 2	6		
11. Railings	1 2 3	ft				1 2	2		
Non-Metal Substrates									
12. Window sills	1 2 3	ft				1 2	4		
13. Window trim	1 2 3	ft				1 2	6		
14. Soffit and facia	1 2 3	ft				1 2	8		
15. Door trim	1 2 3	ft				1 2	2		
16. Door systems, sub #1	1 2 3	#				1 2	1		
17. Door systems, sub #2	1 2 3	#				1 2	3		
18. Columns	1 2 3	#				1 2	5		
19. Railings	1 2 3	ft				1 2	7		
Porches / Other									
20. Porch	1 2 3	ft				1 2	2		
21. Balcony	1 2 3	#				1 2	3		
22. Stairs	1 2 3	#				1 2	4		
23. Other (Specify)	1 2 3					1 2	1		

INTERIOR DUST SAMPLES						
Location	A Carpet Yes	No	B Direct access to outside Yes	No	C Sample no.	D Area
1. Inside entry	1	2	1	2	61	sq. ft.
2. Floor of dry room	1	2	1	2	62	sq. ft.
3. Floor of wet room	1	2	1	2	63	sq. ft.
4. Sills wet room	1	2	1	2	64	ln. ft.
5. Wells wet room	1	2	1	2	65	ln. ft.
6. Sills dry room	1	2	1	2	66	ln. ft.
7. Wells dry room	1	2	1	2	67	ln. ft.
8. Hall adj. to sampled DU	1	2	1	2	68	sq. ft.
9. Common entryway	1	2	1	2	69	sq. ft.

EXTERIOR SOIL SAMPLES		
DWELLING UNIT SOIL SAMPLES		
Location	A Sample No.	Comments
10. Front entryway to structure	81	
11. Drip line	82	
12. Remote	83	

Location of drip line of tested painted surface and remote soil samples: ____________________

RECREATION/PLAY AREA SOIL SAMPLES		
A Location	B Sample No.	Comments
13.	84	
14.	85	
15.	86	

COMMON ROOM DUST SAMPLES						
	A		B		C	D
Location	Carpet Yes	No	Direct access to outside Yes	No	Sample no.	Area
1. Floor	1	2	1	2	70	sq. ft.
2. Window sill	1	2	1	2	71	in. ft.
3. Window well	1	2	1	2	72	in. ft.

OMB #2528-0137:25

COMMON AREA INVENTORY

ID: ____________________

1. Permission to test: Not needed...1 Provided...2 Denied...3
2. In what year was this building built? __________
3. Is this a single family unit? Yes...1 No...2
4. Does the complex have any of the following common areas?

For each "Yes, Exists", ask for the number of each. Then use the Select Code to pick the area to be sampled. Circle the Select Code for the selected area. For each sampled area, determine if it is located in a separate building and if access is possible (i.e., the room is not locked). Lastly, determine how many DU's utilize the selected area.

* 5. Area	A Exists? Y N	B If "Yes" How Many?	C Select Code	D Separate Bldg? Y N	E Is Area Accessible? Y N
(1) Laundry room	1 2		4	1 2	1 2
(2) Indoor stairwell	1 2		5	1 2	1 2
(3) Outdoor stairwell	1 2		8	1 2	1 2
(4) Clubhouse/Community rm	1 2		2	1 2	1 2
(5) Office	1 2		6	1 2	1 2
(6) Lobby	1 2		7	1 2	1 2
(7) Daycare	1 2		3	1 2	1 2
(8) Public bathroom	1 2		10	1 2	1 2
(9) Common mailbox area	1 2		11	1 2	1 2
(10) Other (Specify)	1 2		1	1 2	1 2
(11) Other (Specify)	1 2		9	1 2	1 2

6. How many dwelling units utilize the selected area? __________

* Put an asterisk (*) next to the name of the selected area, e.g., * office.

ID: ____________

1.,2. Area # / Name: ____________

3. What floor is room on (vis a vis building): Basement ... B Attic ... A Level # ... ______

4. If this is a dry room, is a wet room immediately adjacent? YES ... 1 NO ... 2

5. What year was this room last renovated? ________

Component	A. Exist / Painted YP NP N	B C Dimensions / Quantity	D Sub-Code	E Condition Paint	F Condition Substrate	G Access Y N	H Select Code	I XRF #	J XRF Reading
6. Wall #1 D___ W___ F___	1 2 3	•				1 2	4		
7. Wall #2 D___ W___ F___	1 2 3	•				1 2	6		
8. Wall #3 D___ W___ F___	1 2 3	•				1 2	2		
9. Wall #4 D___ W___ F___	1 2 3	•				1 2	5		
10. Ceiling	1 2 3	•				1 2	3		
11. Floor	1 2 3	•				1 2	1		

Metal Substrate

12. Baseboard trim	1 2 3	ft				1 2	2		
13. Stair trim	1 2 3	ft				1 2	4		
14. Door trim	1 2 3	ft				1 2	6		
15. Window sills	1 2 3	ft				1 2	5		
16. Window trim	1 2 3	ft				1 2	1		
17. Crown molding	1 2 3	ft				1 2	7		
18. Door systems	1 2 3	#				1 2	8		
19. Window systems	1 2 3	#				1 2	3		
20. Air / heat vents	1 2 3	#				1 2	10		
21. Radiators	1 2 3	#				1 2	9		

Non-Metal Substrates

22. Baseboard trim	1 2 3	ft				1 2	1		
23. Stair trim	1 2 3	ft				1 2	3		
24. Door trim	1 2 3	ft				1 2	5		
25. Window sills	1 2 3	ft				1 2	2		
26. Window trim	1 2 3	ft				1 2	9		
27. Crown molding	1 2 3	ft				1 2	7		
28. Door systems	1 2 3	ft				1 2	6		
29. Window systems	1 2 3	#				1 2	8		
30. Air / heat vents	1 2 3	#				1 2	4		

Shelves / Other

31. Shelves	1 2 3	ft				1 2	4		
32. Cabinets	1 2 3	#				1 2	5		
33. Fireplace	1 2 3	#				1 2	2		
34. Closet	1 2 3	#				1 2	3		
35. Other (Specify)	1 2 3	#				1 2	1		

Identify types of recreation/play equipment. Record what the component is (e.g., slide, swings), how many there are, what they are made of, what condition the paint and substrate are in. Indicate accessibility. Perform XRF readings then record XRF # and reading.

PLAY EQUIPMENT								
A Equipment Type	B Quantity	C Substrate Code	D Paint Condition	E Substrate Condition	F Access Y	 N	G XRF #	H XRF Reading
1.					1	2		
2.					1	2		
3.					1	2		
4.					1	2		
5.					1	2		
6.					1	2		
7.					1	2		
8.					1	2		

Complete items below describing the condition of the walls in the common hall. Record XRF # and XRF readings.

COMMON HALL									
Location	A Paint? Y	 N	B Substrate	C Paint Condition	D Substrate Condition	E Access Y	 N	F XRF #	G XRF Reading
9. Hallway adj to sampled DU	1	2				1	2		
10. Just inside front door to building	1	2				1	2		

OMB # 2528-0137:35

Control Log and
In-Person Contact Record

ID_______________

Interviewer Initials_______________

Respondent:_______________

Address:_______________

____

CONTACT RECORD

	Date	Time	Result code	Comments
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				

In-P rson Result Codes

P1 - No one home
P2 - Vacant
P3 - Would not answer door
P4 - Refusal
P5 - No adult home
P6 - Language problem
P7 - Breakoff/Friendly/Revisit
P8 - Breakoff/Friendly
P9 - Completed screener/inspection
P10 - Not eligible
P11 - Other

Telephone Result Codes

T1 - Ring, no answer
T2 - Wrong number
T3 - Language problem
T4 - Callback needed
T5 - Refusal to allow inspection
T6 - Appointment rescheduled
T7 - Appointment confirmed/ call completed successfully
T8 - Other

TO: Ms. Frankie Robinson
Westat Field Director
1650 Research Boulevard
Rockville, MD 20850

My home was inspected as part of the Department of Housing and Urban Development's Study of Lead-Based Paint in Housing. I wish to receive a copy of the results of the inspection. I understand that these results alone will neither confirm nor deny if lead poses a hazard in my home.

The ID number associated with my inspection results is: ____________________

The person and address to whom I wish the results sent:

Name: ____

Address:____

____

____

Daytime Telephone: (   ) ______________________

The inspection results based on this survey will be available approximately 12 weeks after the date of inspection.

______________________________ Signature of Respondent

____________________ Date

OMB #2528-0137:21

Transmittal Form

ID: ____________________

In case this transmittal package
is lost, please return to:
Ms. Frankie Robinson
1650 Research Boulevard
Rockville, MD 20850
or call: 1-800-937-8284

- ☐ Listing materials
- ☐ Screening materials
- ☐ Inspection document
- ☐ Samples
- ☐ Inspection document
- ☐ Timesheets, reports, etc.

	ID NUMBERS	COMMENTS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Sent by: ______________________________

Date: ______________________________

SAMPLE LABELS FOR SOIL AND DUST

PSU = 28 SEG = 4 DU = 01	PSU = 28 SEG = 4 DU = 01	PSU = 28 SEG = 4 DU = 01
DUST	DUST	SOIL
284010661	284010667	
284010662	284010668	284010682
284010663	284010669	284010683
284010664	284010670	284010684
284010665	284010671	284010685
284010666	284010672	284010686

Interviewer's Responsibility/Need (# following required at each inspection)

Clipboard (1)
Pens (2)
Calculator (4-function) (1)
Personal ID badge (Westat issued) (1 for interviewer)
Identification tags on all items (4)
Large baggies (Ziploc 1 gal. freezer) (4)
Small baggies (Ziploc sandwich) (30)
Note paper
Post-its (1 pad)
Tape measure (Sears Craftsman 30') (1)

Technician's Responsibility/Need

Clipboard (1)
Personal ID badge (Westat issued) (1 for technician)
Pens (2)

Scitec XRF (1)
Unpowdered gloves (10)
Paper booties (1)
Vacuum pump and attachments (1)
    tubing (one 5 ft., one 25 ft.)
    nozzle (9)
Vacuum cassettes (9)
Template (1)
Masking tape (1 roll)

Corer (1)
Baby wipes (J&J, alcohol free) (5)
Bottle brush (1)

Flashlight (1)
Putty knife (1)
Brick hammer (Sears Craftsman 9-6546) (1)
Trowel (Sears 71-85510) (1)
Extension cord (one - 25 feet)
Electric plug adapter (Sears Leviton 9-83815)
Ladder (3 ft.)
Docimeter, personal (1-3)

OMB 2528-0137:53

XRF Validation Form
ID:

1. Scitec MAP serial #: ______________________
2. Technicians Initials/Name: ______________________
3, 4. Time: ______________________
5. Date: ______________________

	Substrate	Shims Lead Concentration mg/cm2	A Reading mg/cm2		B Baseline mg/cm2		C Difference mg/cm2
6.	Wood	0.6	________	-	________	=	________
7.	Wood	2.99	________	-	________	=	________
8.	Steel	0.6	________	-	________	=	________
9.	Steel	2.99	________	-	________	=	________
10.	Drywall	0.6	________	-	________	=	________
11.	Drywall	2.99	________	-	________	=	________
12.	Concrete	0.6	________	-	________	=	________
13.	Concrete	2.99	________	-	________	=	________

Sub Codes (Substrates)

20	Plaster
21	Gypsum (dry wall)
22	Concrete block
23	Concrete (cast)
24	Concrete. Precast
25	Brick
26	Wood paneling
27	Wood smooth
28	Wood rough
29	Wall paper
30	Oil cloth
31	Ceramic tile
32	Metal smooth
33	Metal rough
34	Wainscot
35	Stone
36	Vinyl siding
37	Aluminum siding
38	Shingle. wood
39	Shingle. asbestos
40	Stucco
41	Ceiling tile
42	Linoleum floor covering

Paint Condition Codes

1	All paint intact
2	Up to 10% not intact
3	10% to 25% not intact
4	Over 25% not intact
5	Wallpaper
6	No paint

Substrate Condition Codes

1	Satisfactory
2	Needs repair
3	Needs replacement

Exists/Painted

1	YP:Yes. exists and is painted and/or wallpapered
2	NP:Yes. exists but not painted
3	N:No. does not exist

D____ W____ F____

D___ # of doors, doorways, closets
W___ # of windows, pass thrus
F___ # of fireplaces, large attached wall covers (e.g., book shelves with back built in)

Playground Equipment

1	Swings
2	Slides
3	Jungle gym
4	Merry-go-round
5	Horses on springs
6	Sandbox

Wall/Ceiling/Floor Codes

1	Wall facing street named in address
2	Moving counter clockwise from Wall 1, the next wall
3	Moving counter clockwise from Wall 2, the next wall
4	Moving counter clockwise from Wall 3, the next wall
5	Ceiling
6	Floor

Component Codes

1	Wall #1
2	Wall #2
3	Wall #3
4	Wall #4
5	Ceiling
6	Floor
7	Baseboard trim
8	Stair trim
9	Door trim
10	Window sills
11	Window trim
12	Crown molding
13	Chair rail
14	Air/heat vents
15	Radiators
16	Interior doors
17	Downspouts
18	Shelves
19	Facia
20	Exterior doors
21	Exterior door systems
22	Wood siding