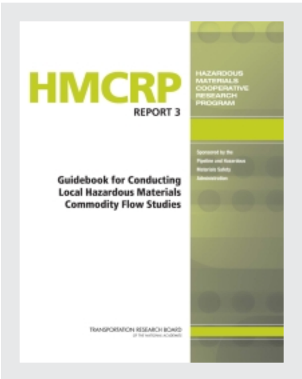

Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies

DETAILS

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HAZARDOUS MATERIALS COOPERATIVE RESEARCH PROGRAM

HMCRP REPORT 3

Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies

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HAZARDOUS MATERIALS COOPERATIVE RESEARCH PROGRAM

The safety, security, and environmental concerns associated with transportation of hazardous materials are growing in number and complexity. Hazardous materials are substances that are flammable, explosive, or toxic or that, if released, produce effects that would threaten human safety, health, the environment, or property. Hazardous materials are moved throughout the country by all modes of freight transportation, including ships, trucks, trains, airplanes, and pipelines.

The private sector and a diverse mix of government agencies at all levels are responsible for controlling the transport of hazardous materials and for ensuring that hazardous cargoes move without incident. This shared goal has spurred the creation of several venues for organizations with related interests to work together in preventing and responding to hazardous materials incidents. The freight transportation and chemical industries; government regulatory and enforcement agencies at the federal and state levels; and local emergency planners and responders routinely share information, resources, and expertise. Nevertheless, there has been a long-standing gap in the system for conducting hazardous materials safety and security research. Industry organizations and government agencies have their own research programs to support their mission needs. Collaborative research to address shared problems takes place occasionally, but mostly occurs on an ad hoc basis.

Acknowledging this gap in 2004, the U.S. DOT Office of Hazardous Materials Safety, the Federal Motor Carrier Safety Administration, the Federal Railroad Administration, and the U.S. Coast Guard pooled their resources for a study. Under the auspices of the Transportation Research Board (TRB), the National Research Council of the National Academies appointed a committee to examine the feasibility of creating a cooperative research program for hazardous materials transportation, similar in concept to the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP). The committee concluded, in *TRB Special Report 283: Cooperative Research for Hazardous Materials Transportation: Defining the Need, Converging on Solutions,* that the need for cooperative research in this field is significant and growing, and the committee recommended establishing an ongoing program of cooperative research. In 2005, based in part on the findings of that report, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) authorized the Pipeline and Hazardous Materials Safety Administration (PHMSA) to contract with the National Academy of Sciences to conduct the Hazardous Materials Cooperative Research Program (HMCRP). The HMCRP is intended to complement other U.S. DOT research programs as a stakeholder-driven, problem-solving program, researching real-world, day-to-day operational issues with near- to mid-term time frames.

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This project was conducted under HMCRP Project HM-01 by Texas A&M University (TAMU) and the Texas Transportation Institute (TTI). TAMU and TTI were the contractors for the project, with the Texas A&M Research Foundation serving as Fiscal Administrator. The project was sponsored by PHMSA of the U.S.DOT, and administered through TRB's HMCRP.

Project supervisors and authors of this guidebook are David Bierling, associate research scientist at TTI and George Rogers, professor of landscape architecture and urban planning at TAMU and senior fellow of TAMU's Hazard Reduction and Recovery Center. Dr. Rogers was project director and principal investigator for the project, and Mr. Bierling was co-principal investigator. Project participants include Debbie Jasek, Leslie Olson, Annie Protopapas, and Jeffrey Warner of TTI, and Gao Shan, graduate assistant researcher at TAMU and TTI.

The project team acknowledges the assistance of the National Organization of SARA Title III Program Officials (NASTTPO), which graciously provided time at organization conferences for survey pre-testing and review of results, and encouraged survey participation among its membership. The project team acknowledges the participation of survey respondents from Local Emergency Planning Committees (LEPCs), Tribal Emergency Response Commissions (TERCs), and State Emergency Response Commissions (SERCs), who provided valuable information about their needs, successes, and challenges. The project team acknowledges the participation of case study LEPCs for their willingness to provide documentation and describe the specific aspects of their projects. The project team also acknowledges the feedback and input from the LEPC and SERC community for their review of project results and input on findings. Finally, the project team acknowledges the constructive feedback and suggestions provided by TRB's project panel.

FOREWORD

By William C. Rogers
Staff Officer
Transportation Research Board

HMCRP Report 3: Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies presents a user-friendly guidebook to support risk assessment, emergency response preparedness, resource allocation, and analyses of hazardous commodity flows across jurisdictions. The guidebook, which updates the U.S. Department of Transportation's *Guidance for Conducting Hazardous Materials Flow Surveys,* is targeted at transportation planning and operations staff at the local and regional levels, as well as local and regional personnel involved in hazardous materials training and emergency response. All modes of transportation, all classes and divisions of hazardous materials, and the effects of seasonality on hazardous materials movements are discussed.

The contractor's final report and appendices (unedited by TRB) are available electronically at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1603. The final report documents the research supporting the development of the Guidebook.

Local and regional governments require information on the types, quantities, and locations of hazardous materials originating, terminating, or moving through their jurisdictions in order to plan for effective and appropriate emergency response to incidents. However, local planners often do not have access to reliable and comprehensive data on the flow of hazardous materials within their jurisdictions. By and large, existing data sources are too broad and cover flows at the national level and, to a limited extent, the state level. More detailed data involving all modes of transportation are required by local and regional governments in order to make informed decisions about hazardous materials training and emergency response preparedness.

Under HMCRP Project 01, Texas A&M University and the Texas Transportation Institute were asked to develop a guidebook to (1) explain data collection methodologies to obtain hazardous materials commodity flow data at the local level (from public and private sources); (2) describe methods that can be used by local and regional planners to identify and estimate hazardous materials flows in their jurisdictions; and (3) describe promising practices and suggestions to help local jurisdictions successfully plan for, conduct, and implement a hazardous materials commodity flow survey.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

SUMMARY

Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies

Purpose

Project HM-01, Hazardous Materials Flow Data and Analysis, was conducted for the Hazardous Materials Cooperative Research Program (HMCRP) of the National Academy of Sciences Transportation Research Board (TRB). The project was sponsored by the U.S.DOT's PHMSA. The research for this project included a review of freight and hazardous materials (hazmat) transport literature, a national survey of U.S. local emergency planning committees (LEPCs) and tribal emergency response commissions (TERCs), case studies, and contractor experiences with conducting hazardous materials commodity flow studies (HMCFS, which is used to denote either the singular and plural in this document). The results of the project were twofold:

- A comprehensive report that documents the scope of the project research and
- This guidebook, which updates U.S.DOT's 1995 *Guidance for Conducting Hazardous Materials Flow Surveys* (*1*).

Transportation of hazardous materials, by one mode or another, is present in nearly every community. The vast majority of hazmat shipments move safely and securely along the nation's transportation system. However, the threat of a hazmat transportation incident remains significant, with an average of at least two incidents per hour, or more than 50 per day, nationally. Incidents can occur in any jurisdiction at almost any time. Human behavior and technological failure cause many system failures or casualties. The consequences of hazmat incidents are potentially catastrophic to public safety, life and wellbeing, the environment, and infrastructure. This raises concern regarding the transportation of hazardous materials through populated or environmentally sensitive areas.

LEPCs are responsible for local emergency planning under the Emergency Planning and Community Right-to-Know Act (EPCRA). LEPCs develop emergency response plans for dealing with chemical hazards, either as stand-alone plans or often as part of a community's comprehensive emergency management plan (or emergency operations plan). An HMCFS provides critical information to the emergency planning process—specifically, understanding the situation, determining goals and objectives, and plan development as described in *Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining State, Territorial, Tribal, and Local Government Emergency Plans* (*2*) from the Federal Emergency Management Agency (FEMA), which is a part of DHS. An HMCFS applies to hazard-specific plan annexes focused on hazmat, and also to the basic plan and emergency support functions/functional annexes. HMCFS information can be used under the National Incident Management System (NIMS) framework, the Incident Command System (ICS), and the National Response Framework (NRF). Also, under 49 CFR Part 110 (*25*), LEPCs and TERCs that conduct an HMCFS are eligible for hazmat risk assessment grant funding, administered through PHMSA's Hazardous Materials Emergency Preparedness (HMEP) Grants Program.

This guidebook:

- Provides guidance for planning, conducting, and implementing a local-level HMCFS;
- Covers road, rail, pipeline, water, and air modes of transportation;
- Specifically focuses on the objectives, resources, data, analysis, and applications that are commonly found or actionable at local levels across the United States;
- Does not cover every possible type of commodity flow data source or analysis method, but rather provides a "toolbox" of different data sources and ways of evaluating information; and
- Was developed based on a comprehensive review of the literature, local practice, and available data resources.

The intended users of this guidebook are local government entities—including LEPCs, TERCs, counties, municipalities, councils of government, tribal councils, rural communities, and other similar authorities—but it also can be used at the state and federal levels. Upon completing an HMCFS, local planners, emergency managers, and emergency responders have a better understanding of hazmat transportation patterns and can use the data to estimate the risks facing their jurisdiction. The information can help users better prevent hazmat incidents from occurring, and more effectively protect, respond, and recover from them when they do.

The HMCFS Process

Figure S-1 illustrates the HMCFS process, which includes the following six major steps:

1. **Select HMCFS leadership, set objectives, and define data requirements—**LEPCs and other local entities select the HMCFS leadership. This includes core team members who provide oversight of the project, set project objectives, and implement project results. These objectives include hazmat awareness, scenarios definition, emergency and community planning, identification of equipment needs, resource scheduling, hazmat route designation, and legal takings. LEPC leadership also includes project team members who will coordinate and manage the project. HMCFS data requirements are determined by the project team based on the project's objectives.
2. **Collect and review baseline information and scope HMCFS project—**The project team collects and reviews readily available local information about hazmat transportation, including previous studies, transport modes and routes, incidents and accidents, and population locations. The project team scopes the HMCFS project by identifying the extent of additional information required for the HMCFS and the resources needed to obtain this information.
3. **Collect and review existing HMCFS data—**The project team collects and reviews existing data. They search prior HMCFS documents; local, state, and federal agency data; electronic databases and reports; trade, environmental, social advocacy, and academic sources; and other print sources of information about hazmat transport. The project team confirms that any new HMCFS data collection is based on gaps in existing data.
4. **Collect and validate new HMCFS data—**The project team collects and validates new HMCFS data. This step may be conducted concurrently with existing data collection. The team gathers information from key stakeholders and collects field data, as needed. Field data may include vehicle, placard, or shipping manifest surveys along various transportation routes and route segments.
5. **Analyze and document HMCFS data—**The project team analyzes existing and/or new HMCFS data to estimate hazmat flows. Spatial and/or temporal analysis may be con-

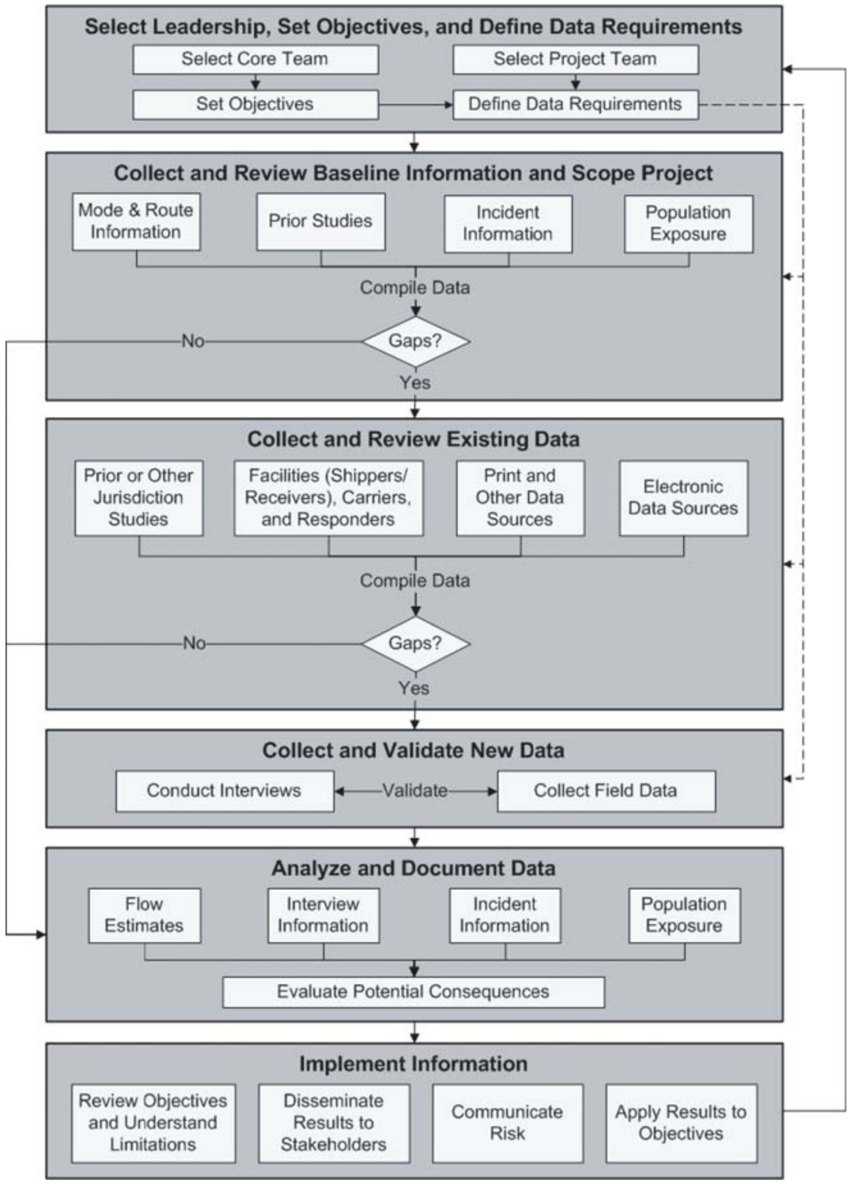

Figure S-1. The Hazardous Materials Commodity Flow Study (HMCFS) process.

ducted. The most important outcome of this step is an evaluation report that documents the results of the project.

6. **Implement HMCFS information—**The core team uses the HMCFS project evaluation report to understand the limitations of the results, disseminate and communicate information, apply results toward objectives, and plan for future activities.

Select HMCFS Leadership, Set Objectives, and Define Data Requirements

LEPCs or other local entities select the HMCFS leadership. HMCFS leadership includes a core team and a project team. The core team is responsible for oversight of the project, setting objectives, and implementing results. Setting objectives by the core team is one of the most important steps of conducting an HMCFS and helps to answer the question of why to conduct an HMCFS. The following nine categories of HMCFS objectives are identified and discussed:

1. Awareness,
2. Minimum scenarios definition,
3. Maximum scenarios definition,
4. Emergency planning,
5. Comprehensive planning,
6. Equipment needs,
7. Resource scheduling,
8. Hazmat route designation, and
9. Legal takings.

Each category of objectives has different levels of complexity and data and resource requirements. The project team is responsible for coordinating and managing the project. The project team also determines how specific the HMCFS data should be based on the objectives set by the core team.

Collect and Review Baseline Information and Scope HMCFS Project

The project team reviews "baseline" information about hazmat transport in the area to identify data needs and guide further data collection efforts. Information review focuses on current "in-house" knowledge about hazmat transport and includes (but is not limited to) the following:

- Modes by which hazmat is transported and the relevant transportation network for each mode;
- Prior HMCFS developed for the jurisdiction or jurisdictions on connecting corridors;
- Information about fixed facilities, shippers, receivers, and carriers that produce, store, use, or transport hazardous materials;
- Information about population centers, critical infrastructures, and future developments relative to hazmat transport corridors; and
- Information from local and state agencies about the transportation network, commodity movements, traffic levels, incidents, etc.

Based on this review, the project team assesses their current state of knowledge about hazmat transport and identifies any information gaps. The preliminary inventory of hazmat flows, resulting from the baseline review, allows the project team to scope additional efforts for collection of data from all relevant external existing and new data sources, and focus on routes where

- There is reason to believe risks are high,
- Knowledge is limited or undocumented,
- Potential exposures are extreme, or
- Some combination of these elements is present.

Collect and Review Existing HMCFS Data

After reviewing the baseline information and scoping the data collection effort, the project team collects and reviews relevant existing data from all applicable sources. This effort may be conducted concurrently with collection of new HMCFS data. Existing data are information that have been previously collected and assembled. Collecting and validating existing data requires effort to obtain, compile, and evaluate the data, as well as to determine whether the data are sufficient to meet HMCFS objectives. Existing data represent a considerable resource-saving supply of information. However, the disadvantage of existing data is that they were not collected directly for the purpose of the local HMCFS, and the extent to which they are applicable to current community needs may be limited and depends on the source. Review of existing data includes a more in-depth evaluation of information covered in the baseline assessment. These data include (but are not limited to) other existing electronic databases and reports about:

- Transportation networks;
- Commodity movements;
- System performance (traffic levels);
- Population, environmentally sensitive areas, and critical facility locations;
- Historical incident and accident occurrences and locations; and
- Contact information.

During and after collecting existing data, the project team compiles and reviews the data to confirm that any new data collection efforts are needed and appropriately focused due to gaps in the existing data.

Collect and Validate New HMCFS Data

The project team may collect new data specifically for the HMCFS. These data have a disadvantage in that they require more effort and resources to collect than most existing data sources, but new data are directly applicable and require less manipulation. They also may be used for other local applications. New data collection includes interviews with key informants (hazmat shippers, receivers, and carriers, and emergency responders), traffic surveys, and examining shipping manifests to identify local patterns.

Collection of field data is driven by the level of precision required to meet HMCFS objectives. Traffic survey information can include the number of vehicles, type of vehicles, and—sometimes—the packages in a shipment. The content of the shipment can be observed for the presence of hazardous material, the class or division of hazardous material, the UN/NA placard ID, or the specific material. Origin–destination data are among the most comprehensive information about hazmat transport and can be obtained with a review of shipping manifest information. Unfortunately, these are also the most labor-intensive data to collect with enough precision to estimate hazmat traffic flows over a network. Also, they can be the most mathematically intensive to interpret. The validation of new data is an important step in the data collection process. Quality data allow for appropriate interpretation and implementation of the HMCFS results.

Analyze and Document HMCFS Data

The project team uses all compiled existing and new HMCFS data to describe hazmat flows. The ability to describe these flows depends on the relevance, sampling, and precision of the collected data. Analyzing HMCFS information for railways, pipelines, and waterways is generally straightforward because the existing flow information is based on a census of all hazmat transport or generally represents the extent of available information. Hence, sampling limitations are rarely associated with these data. Conversely, analysis of HMCFS commodity flow data for trucks/roadways (including roadways serving airport terminals) can range from simple to potentially complex.

The HMCFS data are summarized by the project team and presented to the core team in a report using lists, tables, charts, maps, and narrative description. Existing and new data can be collected at various levels, allowing alternative approaches for analysis that evaluate each type of source individually or combine information from different sources to generate estimates. The simplest analyses of HMCFS commodity flow data involve reviewing existing estimates for commodity flows and applying those estimates to hazmat flows in a community. The most complex analyses use locally relevant data to identify differences in commodity flows spatially, temporally, or both spatially and temporally.

Increasing knowledge of risks involves quantifying the frequency and magnitude of risk along a given route segment, route, or corridor. When detailed hazmat commodity flow data are available, they can be used to characterize commodity movements on a spatial and temporal basis. Procedures for conducting the risk assessment calculations are well established and can depend on specific characteristics of the local setting, commodities that are transported, modes of transport, and information about the likelihood of incidents and accidents.

Implement HMCFS Information

The core team is responsible for using the HMCFS to implement desired emergency planning outcomes. This step of the process is critical to making the effort worthwhile. It is important that the core team recognizes and appreciates the limitations of the study, informs decision makers about how actions required to implement study are affected by data limitations, and understands what additional information would be needed to make higher-level decisions.

Disseminating the HMCFS is a one-way communication of the results of the study to various audiences. Dissemination involves deciding what critical results to deliver, to whom they should be delivered, and then delivering the results. Communicating the HMCFS involves two-way communication of the study results with selected audiences through discussion and interpretation of results, sharing of more subtle information and higher-order interpretations, and receiving feedback about the results that draw on collective experience and expertise as well as direct observations. As part of the implementation process, the core team is responsible for both disseminating and communicating HMCFS results.

The HMCFS can contribute to several types of ongoing emergency and community planning processes. Merely putting the document on the shelf fails to stimulate discussion, decision making, or proactive response to impending situations. Implementation involves actively engaging various groups of interested parties, stakeholders, community leaders, industry, and other end users. It is important for the HMCFS documents and supporting data to be archived in a variety of locations at the local level to assure continuity.

An HMCFS is a static picture of an ongoing process. Hence, there is a need to consider when it should be revised or updated. Communities with complex flows may find it necessary to revise the HMCFS frequently, while those with less complex flows may find that a well-done HMCFS can last for years.

Case Studies

Seven case studies are included in this guidebook to illustrate how HMCFS have been conducted in local jurisdictions. These case studies represent a range of U.S. regions, geographic coverage, community population sizes, community types (rural and urban), transportation modes, transportation network components, traffic levels, data sources, project participants, and practices used.

Appendices

Guidebook appendices provide reference materials and further information about aspects of the HMCFS process. Appendices include examples of UN/NA placards, shipping manifest information, and types of vehicles that may be included in an HMCFS. Promising practices that can be used by LEPCs cover HMCFS planning, data sources, project resources, data requirements, data analysis, and implementation. Descriptions and analysis of existing HMCFS data sources, and collection sheet templates for different types of new data, are provided along with completed data sheet examples. A detailed description of different data analysis procedures also is provided and includes examples of calculations and interpretations.

Conclusions

The research conducted to support the development of this guidebook documents a wide variety of HMCFS objectives, existing and new data sources, methods for evaluating data, and ways of implementing outcomes and communicating results to a range of project participants and stakeholders. The research suggests that there is no clear-cut way of describing what an HMCFS project requires based on community size, economic base, or transportation network characteristics. However, it shows that the complexity of conducting an HMCFS project generally increases as

- Size of community increases, resulting in more diverse goods consumption;
- Proximity to major hazmat producers, processors, and consumers increases;
- Complexity of the local and regional economy increases, resulting in greater seasonal variations in hazmat transport for different sectors;
- Precision required to support HMCFS objectives increases, increasing the need for locally relevant, specific hazmat transport data;
- Number of different modes included in the HMCFS increases;
- Number of major roadway transport corridors or segments included in the HMCFS increases; or
- Availability of locally relevant existing data decreases, increasing the requirement for the collection of new data.

The following two general HMCFS practices can be recommended for all LEPCs:

1. Follow the HMCFS process. The HMCFS process identified in this guidebook is based on the previous U.S.DOT *Guidance,* incorporates contemporary literature, and builds upon practices reported by LEPCs that have been validated through experience.
2. Use the promising practices. The promising practices are based on feedback from LEPCs and direct experience conducting HMCFS about what works and does not work for an HMCFS project. Many of these practices are keys to successfully planning, conducting, evaluating, and implementing an HMCFS project.

Finally, 20 recommendations were identified from the case studies and project research for conducting an HMCFS. Project recommendations are summarized for HMCFS project funding and staffing, project planning and execution, use of existing data sources, new data collection, data validation, data presentation, and project implementation. Recommendations include the following:

- Funding and staffing the HMCFS project
  - Utilize available funding resources for conducting the study, such as HMEP or EPA grants. Be sure to understand grant requirements including tracking and reporting of volunteer effort.
  - Consider multi-jurisdictional efforts to help distribute the workload and increase the relevance of project outcomes to multiple communities.
  - Consider the use of contractors for data analysis and reporting. If contractors are used, involve the LEPC in major aspects of the project.
  - Utilize volunteer participation from community stakeholders, including emergency response, industry, and health professionals; as well as military personnel, business groups, and volunteer groups such as Community Emergency Response Teams or Citizen Corps Councils. Often, volunteers who participate in collecting HMCFS data will develop an understanding of how hazmat transport affects their professions in ways of which they were not previously aware.
  - Maximize volunteer participation through training, scheduling, and providing data count supplies, facilities, or equipment.
- Planning the HMCFS project
  - Identify desired outcomes of the study in advance, for example, confirming types of hazardous material transported, evaluating hazmat transport in specific risk areas, etc.
  - Be realistic—an HMCFS requires time and planning, which makes conducting one in a short timeframe less likely to be successful. Coordinating the project—especially volunteer data collection—requires advance planning and may involve delays due to weather, conflicting schedules, etc.
- Using existing data sources
  - Use existing local, state, and national information sources as much as possible. Although CFS from jurisdictions that do not share common corridors may provide examples of how to conduct a study, those project results may have little relevance to hazmat transport in your community.
- Collecting data
  - Begin data collection as early in the project as possible, and do it often, especially when volunteer effort is being used as in-kind grant matching funds. LEPCs that wait too long to begin data collection can easily find themselves "behind the 8-ball" for completing the project within given time limits or having a good set of reliable data.
  - Use multi-person teams for data collection on busy traffic corridors. Volunteer personnel time availability and attention for data collection may be limited.
  - Collect data at locations where traffic is either slowed or stopped, such as truck stops, rest areas, license and weight facilities, or signaled intersections.
  - Use the data collection effort as an opportunity to enhance emergency response training, such as responders' familiarity with the *Emergency Response Guidebook* (*ERG*) (*5*).
- Validating data
  - Validate results across different data sources, including regional/state traffic data, incident reports, and prior CFS conducted for the jurisdiction or surrounding areas.
  - Consider CFS information in terms of how reliable the data are and how they were collected (sampling and precision). Recognize limitations of the CFS.
  - Be aware that information is typically a snapshot of hazmat transportation for specific times and locations. Transport patterns may vary widely by time of day, day of week, and season of year.

- Presenting HMCFS results
  - Present project results using various formats, including tables, charts, graphs, and maps. Cross-referencing of hazmat transport information with spatial and temporal data of sensitive areas can be used to identify risk hotspots.
- Implementing the HMCFS
  - Distribute the CFS to appropriate community stakeholders.
  - *Use it.* CFS information does little good if it just "sits on the shelf." CFS information may be applicable to a wide range of applications. Consider potential applications for CFS information in addition to the project's original goals and for groups other than emergency management and response agencies.
  - Conduct an after-action analysis to identify lessons learned and potential modifications to future efforts.
  - Plan for follow-on efforts to evaluate hazmat transportation in the community. Jurisdictions are able to identify changes in hazmat transportation patterns by referencing previous studies. Do not wait too long to conduct subsequent studies.

CHAPTER 1

Introduction

1.1 Need for Document

A hazardous materials (hazmat) commodity flow study (CFS) is a special kind of transportation analysis project. It is intended to identify the types and amounts of hazardous materials transported through a specified geographic area—such as a single community, a large urban area, a region, or a state—and the routes used for transporting these commodities. It is a methodical way to identify and quantify the unique hazmat transportation hazards that may be present in a community.

This guidebook was developed to update the U.S.DOT's 1995 *Guidance for Conducting Hazardous Materials Flow Surveys* (*1*), using funds from U.S.DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA), administered through TRB's Hazardous Materials Cooperative Research Program (HMCRP). Its intended users are local government entities—including local emergency planning committees (LEPCs) and tribal emergency response commissions (TERCs), counties, municipalities, councils of government, tribal councils, rural communities, and other similar authorities. It also can be used at the state and federal levels. The guidebook

- Can be used by LEPCs and other local, state, tribal, and federal emergency planners and stakeholders for evaluating hazmat flows, as well as by metropolitan planning organization (MPO) or department of transportation (DOT) staff for hazmat-specific or similar commodity flow studies;
- Provides guidance for planning, conducting, and implementing a local-level hazmat commodity flow study (HMCFS, used to denote either the singular or plural in this guidebook);
- Covers road, rail, pipeline, water, and air modes of transportation;
- Focuses specifically on the objectives, resources, data, analysis, and applications that are commonly found or are actionable at local levels across the United States;
- Does not cover every possible type of commodity flow data source or analysis method but rather provides a "toolbox" of different data sources and ways of evaluating information; and
- Was developed based on a comprehensive review of literature, local practice, and available data resources.

1.1.1 Role of the HMCFS in Emergency Planning

An HMCFS is not a plan of itself, but it provides a knowledge basis for critical aspects of the emergency planning process. LEPCs have responsibility for local emergency planning under the Emergency Planning and Community Right-to-Know Act (EPCRA). LEPCs develop emergency response plans for dealing with chemical hazards, either as stand-alone plans or often as part of a community's comprehensive emergency management plan (CEMP), or emergency operations plan (EOP). Users of this guidebook who are involved in comprehensive emergency planning may be familiar with the *Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining*

State, Territorial, Tribal, and Local Government Emergency Plans (*2*), developed by the Federal Emergency Management Administration (FEMA), which is a part of DHS. *CPG 101* lays out guidelines for developing emergency plans at local, state, and federal levels.

An HMCFS informs on the following three key elements of the emergency planning process identified in *CPG 101:*

1. Understanding the situation,
2. Determining goals and objectives, and
3. Plan development.

An HMCFS can inform an emergency plan's hazard-specific annexes that are focused on hazardous material, and also the basic plan and emergency support functions/functional annexes. Figure 1-1 illustrates how an HMCFS can inform and be informed by the emergency planning process identified in *CPG 101.*

An HMCFS can be used for multiple purposes in emergency management and response, as well as in broader community planning and risk assessment. It provides information that can be used to help "anticipate conditions and systematically identify potential problems and workable solutions" (*2,* p 1-2) to hazmat incidents. In the absence of information that can be obtained through an HMCFS, emergency planners may need to make a great number of assumptions about hazmat transportation in their community. *CPG 101* urges planners "to use assumptions sparingly and to put greater effort into performing research and acquiring facts" (*2,* p 3-13). Information obtained through an HMCFS can

- Reduce uncertainty about which hazmat transport hazards are locally present;
- Help identify hazmat transportation risks that may present in a community; and
- Be validated by the experiences and knowledge of local responders, carriers, and other stakeholders when HMCFS results are communicated, reviewed, and implemented in the broader emergency and community planning context.

Information from an HMCFS helps inform the science of planning by providing quantifiable, measurable information about the types and levels of hazardous materials that may be expected to be transported through a community. Application of HMCFS information affects the art of

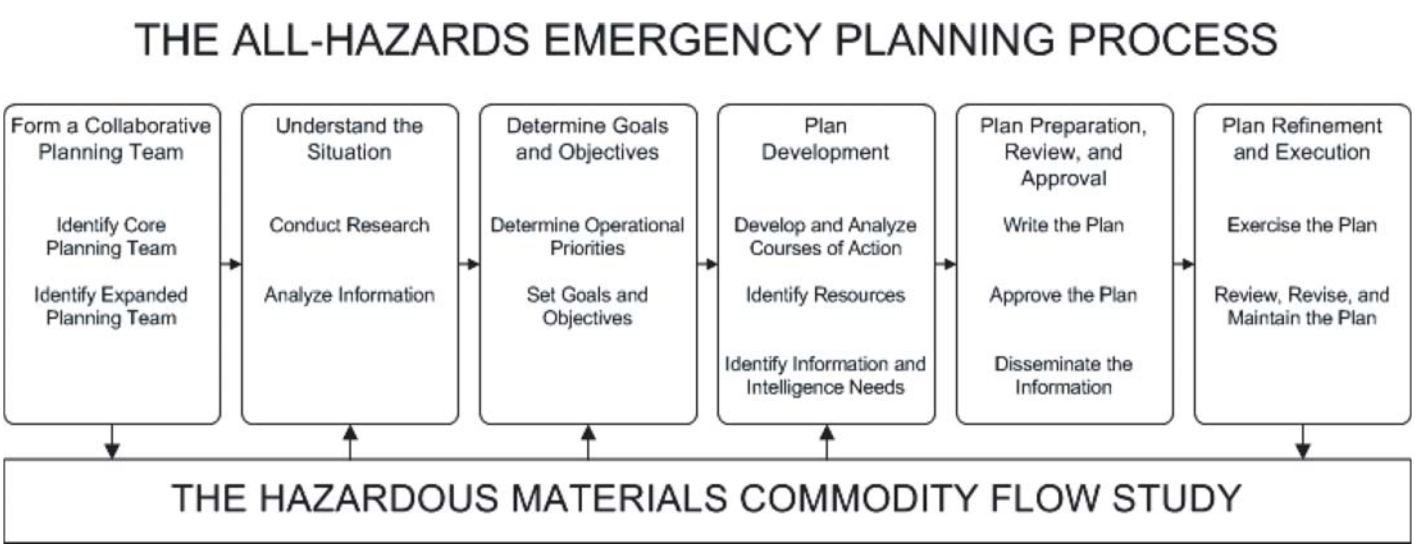

Figure 1-1. The HMCFS as part of the emergency planning process.
Source: Adapted from CPG 101, Figure 3.2

planning by informing about the potential conditions, complexity, and evolution of hazmat transportation incidents that may occur through scenarios development.

Conducting an HMCFS can help planners raise awareness about hazmat transport in a community, provide information for pre-incident operational response training, or assess needs for emergency response equipment or hazmat incident response teams. Some of these activities also are eligible for grant funding under federal programs. An HMCFS can provide a key component of needs justification for associated funding requests, although the HMCFS should not be conducted as a reason to justify new equipment. In addition, formal designation of hazmat transport routes requires analysis of risks, for which an HMCFS is an important part.

1.1.2 HMCFS Funding

PHMSA oversees a grants program that provides funding for local hazmat planning and training. The Hazardous Materials Emergency Preparedness (HMEP) Grants Program uses funds from hazmat transportation carrier registration fees under federal hazardous material transportation law (49 U.S.C. 5101 et seq.). Funds are administered in each state by the state emergency response commissions (SERCs), and by individual TERCs. LEPCs can apply for HMEP grant funding through their respective SERCs (eligibility also applies to TERCs). More information about the program is available from the HMEP grants manager at (202) 366–0001, on the HMEP Web site at http://www.phmsa.dot.gov/hazmat/grants, or by e-mail at hmep.grants@dot.gov. Other grant funds may be available from local, state, or federal agencies, and an HMCFS may be funded fully by a local government or other entity without any additional grant funds.

1.2 Hazmat Transportation Overview

Transportation of hazardous materials, by one mode or another, is present in nearly every community. According to the U.S. Bureau of Transportation Statistics (BTS)/U.S. Census Bureau's *2007 Commodity Flow Survey* (*3*), referred to as the *CFS,* 2.2 billion tons, corresponding to 323 billion ton-miles of hazardous materials, are shipped in the United States annually. Roadways (trucks) transport the majority—roughly 1.2 billion tons (about 54 percent of total tonnage) and 104 billion ton-miles (about 32 percent of total ton-miles) shipped. Railways are associated with 6 percent, waterways with 7 percent, and pipelines with 28 percent of total hazmat shipment tonnage. Although 2007 statistics for hazmat transport by air were not published in the *2007 CFS,* it comprised 0.02 percent of total hazmat shipment tonnage in 2002.

The majority of shipment tonnage represents a subset of the nine hazardous materials classes. Flammable-Combustible Liquids (Class 3) represent 78 percent of the total tons, over 56 percent of the total ton-miles, and almost 81 percent of the total value. Gases (Class 2) represent over 11 percent of the tons, 17 percent of the ton-miles, and 9 percent of the value. The remaining seven hazmat classes total around 11 percent of total tons, 27 percent of total ton-miles, and 10 percent of total shipment value. The U.S.DOT sets requirements for hazmat transportation in hazardous materials regulations (HMR) under 49 CFR. Under 49 CFR, Part 173 (*4*), hazardous materials are grouped into nine major classes, several of which are further subclassified into divisions, as shown in Table 1-1.

The HMR requires that hazmat shipments be designated by United Nations/North American (UN/NA) placards or labels when shipment quantities meet certain threshold criteria. Each class/division is characterized by a distinct graphic and numbering scheme. The UN/NA placards and labels and shipping manifests are important warning indicators by which first responders can identify initial isolation and response procedures when an incident involving hazmat transportation occurs. Examples of UN/NA placards from the *2008 Emergency Response Guidebook* (*5*),

The HMCFS and National Emergency Management Frameworks

HMCFS information can be used under the National Incident Management System (NIMS) framework, the Incident Command System (ICS), and the National Response Framework (NRF).

"NIMS provides a consistent framework for incident management at all jurisdictional levels, regardless of the cause, size, or complexity of the incident" (*2,* p 4-2). It builds on the ICS to provide first responders and authorities with the same foundation for emergency incident management. The HMCFS informs the NIMS and ICS frameworks at multiple levels, including the three that follow.

1. Command and management
   - The HMCFS can be used to help identify key risk and response areas that are impacted by ICS operations.
   - The HMCFS can be used to help identify response needs, personnel, equipment, and other resources that are affected by multiagency coordination systems (such as mutual aid agreements), regional hazmat teams, etc.
   - The HMCFS can be used to help identify information that may need to be communicated to the public during emergency situations in a timely, accurate, and accessible manner.
2. Preparedness
   - HMCFS information can be used to help identify training needs, response scenarios for exercises, technical certification needs for hazmat responders, and equipment needs.
3. Resource management
   - The HMCFS can be used to help identify specific needs for resource inventory, mobilization, tracking, and recovery for hazmat incidents.

The NRF builds on NIMS and "guides governments at all levels, the private sector and NGOs, and individual citizens toward a shared and effective response" (*2,* p 4-6) to incidents. Under the NRF, state, territorial, tribal, and local jurisdictions are responsible for developing all-hazards emergency operations plans, including identifying specific technological hazards that may be present in a community. This, in turn, affects required leadership and responsibility roles for different threats as well as evacuation strategies for potentially impacted populations. Jurisdictions may need to determine the level of multi-agency integration likely to be required for hazmat incident response, develop public information systems, identify and characterize resources, and provide training. An HMCFS also can be used to inform about resources, support, and assistance needed to augment local response at state and federal levels.

or *ERG*, are shown in Appendix A. Hazardous materials also must be identified in papers that document specific information about the shipment. These documents are called shipping manifests. Shipping document (manifest) information and an illustration of placard numbering from the *2008 ERG* are shown in Appendix B.

The vast majority of hazardous materials shipments move safely and securely along the nation's transportation system. However, the threat of a hazmat transportation incident remains significant, with at least two incidents per hour on average, or more than 50 per day, nationally. Incidents

Table 1-1. The hazardous materials classification system.

Class/Division Number	Name of Class or Division
None	**Forbidden materials**
None	**Forbidden explosives**
1	**Explosives**
1.1	Explosives (with a mass explosion hazard)
1.2	Explosives (with a projection hazard)
1.3	Explosives (with predominantly a fire hazard)
1.4	Explosives (with no significant blast hazard)
1.5	Very insensitive explosives; blasting agents
1.6	Extremely insensitive detonating substances
2	**Gases**
2.1	Flammable gas
2.2	Non-flammable compressed gas
2.3	Poisonous Gas
3	**Flammable and combustible liquids**
4	**Flammable solids**
4.1	Flammable solid
4.2	Spontaneously combustible material
4.3	Dangerous-when-wet material
5	**Oxidizers**
5.1	Oxidizer
5.2	Organic peroxide
6	**Poisons**
6.1	Poisonous materials
6.2	Infectious substance (etiologic agent)
7	**Radioactive materials**
8	**Corrosive materials**
9	**Miscellaneous hazardous materials**
None	**Other regulated material: ORM-D***

*Note: ORM-D stands for other regulated materials—domestic.

can occur in almost any jurisdiction at almost any time. Human behavior and technological failure cause many system failures or casualties. Some well-publicized events in the last decade include the following:

- In January 2004, a gasoline tanker truck left the I-895 roadway on the I-95 overpass in Elkridge, MD, went over the bridge rail, and into the northbound I-95 lanes. The tanker exploded and four vehicles on I-95 were driven into the resulting fire, killing the drivers of three vehicles. NTSB concluded that the likely cause was failure of the tanker truck driver to maintain control of his vehicle (*6*).
- In January 2005, a Norfolk Southern train collided with another train parked on a siding at Avondale Mills, Inc. in Greenville, SC, after a train crew failed to realign a track switch. A chlorine tank railcar ruptured in the collision, releasing an extensive vapor cloud. The accident caused 9 deaths, 75 hospital admissions, and evacuation of 5,400 people (*7*). The total cost of the incident was estimated at $126 million by FRA (*8*).
- In November 2007, a 12-inch-diameter liquid propane pipeline ruptured near Carmichael, MS. The gas cloud resulting from the breach enveloped nearby homes and ignited, killing two and injuring seven people. Property damages alone were estimated over $3 million. The NTSB determined the cause of the incident was due to pipeline weld failures (*9*).
- In July 2008, a barge tow on the Mississippi River (which was improperly piloted) turned into the path of an oil tanker. The collision split the barge in two, resulting in spillage of nearly 300,000 gallons of fuel oil, closing the river for nearly 100 miles from New Orleans to Louisiana

and the Gulf of Mexico, and shutting it down for six days (*10*). The spill caused concerns about environmental damage and drinking water quality (*11*).

- In July 2009, a passenger vehicle collided with a gasoline tanker truck on I-75 in Hazel Park, MI, causing the tractor and trailer to separate. The trailer struck an overpass bridge support and exploded. Although no one was killed, the recently completed overpass was destroyed. Reconstruction took several months and cost nearly $12 million (*12*), not including costs due to roadway user delays.

As these examples show, the consequences of hazmat incidents are potentially catastrophic to public safety, life and well-being, the environment, and infrastructure. This raises concern over transportation of hazardous materials through populated or environmentally sensitive areas. Upon completing an HMCFS, local planners, emergency managers, and emergency responders can have a better understanding of hazmat transportation patterns and can use the data to estimate the risks facing their jurisdiction. The information can help users better prevent hazmat incidents from occurring, and more effectively protect, respond, and recover from them when they do.

1.3 Organization of this Report

This report covers the HMCFS process in six major steps, shown in Figure 1-2. Each step is covered in a separate chapter. The six HMCFS process steps follow procedures identified in previous HMCFS guidance, and integrate concepts from emergency planning. They include the following:

- **Select HMCFS leadership, set objectives, and define data requirements**—This step is discussed in Chapter 2. LEPCs and other local entities select the HMCFS leadership. This includes core team members who provide oversight of the project, set project objectives, and implement project results. HMCFS project objective categories include hazmat awareness, scenarios definition, emergency and community planning, equipment needs, resource scheduling, hazmat route designation, and legal takings. LEPC leadership also includes a project team that will coordinate and manage the project. HMCFS data requirements are determined by the project team based on the project's objectives.
- **Collect and review baseline information and scope HMCFS project**—This step is discussed in Chapter 3. The project team collects and reviews readily available local information about hazmat transportation, including previous studies, transport modes and routes, incidents and accidents, and population locations. The project team scopes the HMCFS project by identifying the extent of additional information required for the HMCFS and the resources needed to obtain them.
- **Collect and review existing HMCFS data**—This step is discussed in Chapter 4. The project team collects and reviews existing data. They search prior HMCFS documents; local, state, and federal agency data; trade, environmental, social advocacy, and academic sources; other printed sources of information about hazmat transport; and electronic databases and reports. The project team confirms that collection of new data for the HMCFS is based on gaps in existing data.
- **Collect and validate new HMCFS data**—This step is discussed in Chapter 5. The project team collects and validates new HMCFS data. This step may be conducted concurrently with existing data collection. The team gathers information from key stakeholders through interviews and collects field data, as needed. Field data may include vehicle, placard, or shipping manifest surveys along various transportation routes and route segments.
- **Analyze and document HMCFS data**—This step is discussed in Chapter 6. The project team analyzes existing and/or new HMCFS data to estimate hazmat flows. Spatial and/or temporal analysis may be conducted. The outcome of this step is an evaluation report that documents the results of the project.

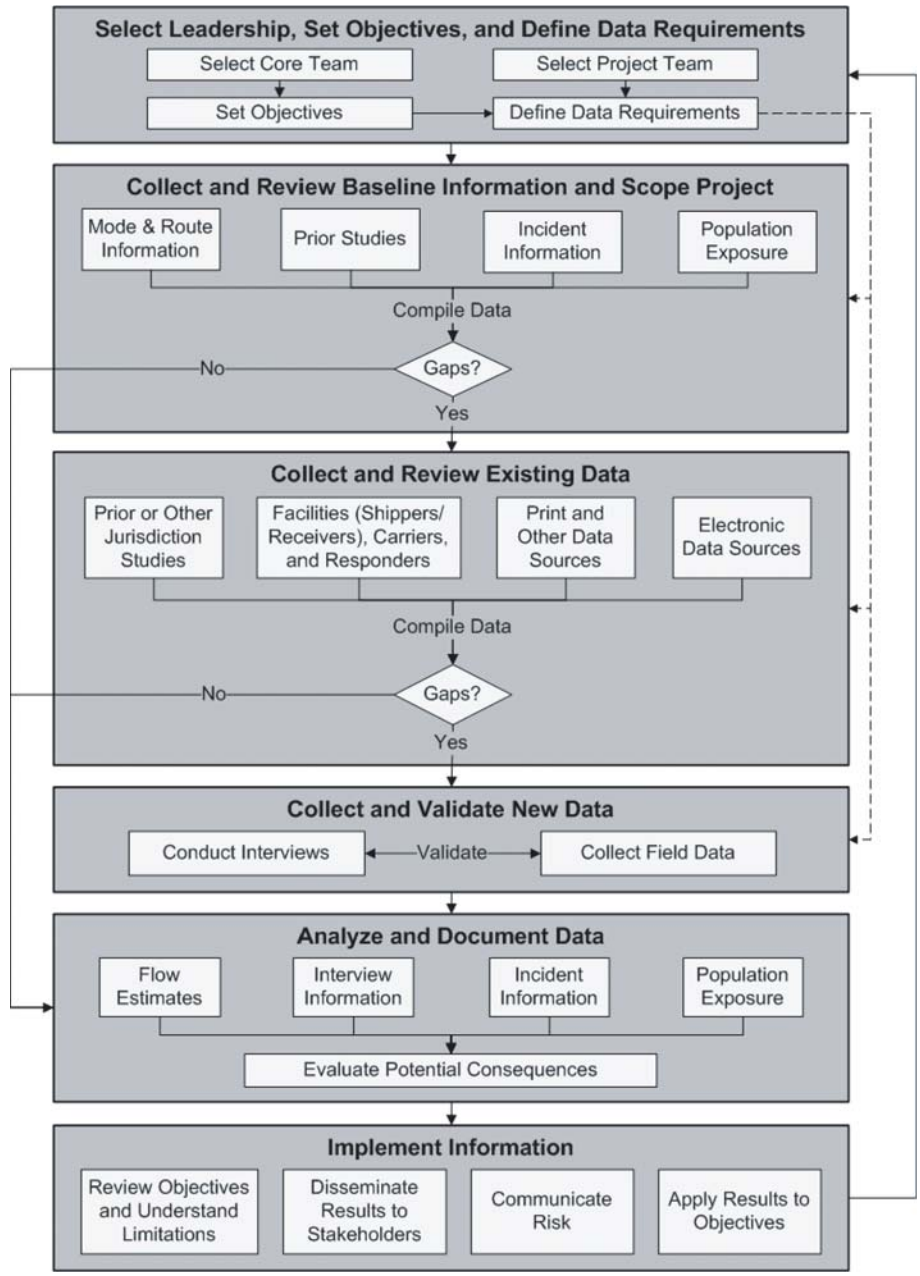

Figure 1-2. The hazardous materials commodity flow study (HMCFS) process.

- **Implement HMCFS information**—This step is discussed in Chapter 7. The core team uses the HMCFS project evaluation to understand limitations of the results, disseminate and communicate information, apply results toward objectives, and plan for future activities.

Chapter 8 provides conclusions and HMCFS recommendations. Additional guidance and information that may be applied to an HMCFS by some users is provided in the appendices. Case studies, presented in Appendix C, illustrate how and why HMCFS were conducted by seven LEPCs from across the United States. The appendices also include reference materials and charts, a discussion of promising practices used by LEPCs from across the country, descriptions of data sources, and examples of HMCFS data analysis and applications.

CHAPTER 2

Select Leadership, Set Objectives, and Define Data Requirements

The first step of an HMCFS involves selecting the project's leadership, setting objectives, and defining data requirements based on the project's objectives. A flow chart of the HMCFS process focusing on HMCFS leadership, objectives, and data requirements is shown in Figure 2-1.

2.1 Select Leadership

The leadership of the HMCFS project consists of two groups. One group is the core team, which is responsible for "the big picture" with respect to the HMCFS project. Another group is the project team, which is responsible for coordinating and managing the HMCFS project.

2.1.1 HMCFS Core Team

The first step in conducting an HMCFS is identifying the core team. The responsibilities of the HMCFS core team include the following:

- Oversight of the HMCFS project,
- Identification of HMCFS project objectives,
- Review of HMCFS results, and
- Implementation of HMCFS results.

Selecting the core team is an opportunity to involve major hazmat transportation, responder, and community stakeholders in the project. The core team may involve the same individuals who participate in core planning for a jurisdiction's emergency plan. Some or all of the following individuals, agencies, or sectors may be included:

- LEPC executive members;
- Elected officials;
- Emergency management;
- Fire services;
- Hazmat response teams;
- Law enforcement;
- Emergency medical services;
- Public health, hospitals, and health care facilities;
- Transportation, public works, or utilities;
- Social services and environmental protection;
- Private sector (industry, hazmat carriers, etc.);
- Local planning agencies and metropolitan planning organizations (MPOs); and
- Non-government offices or economic, environmental, or social advocacy groups.

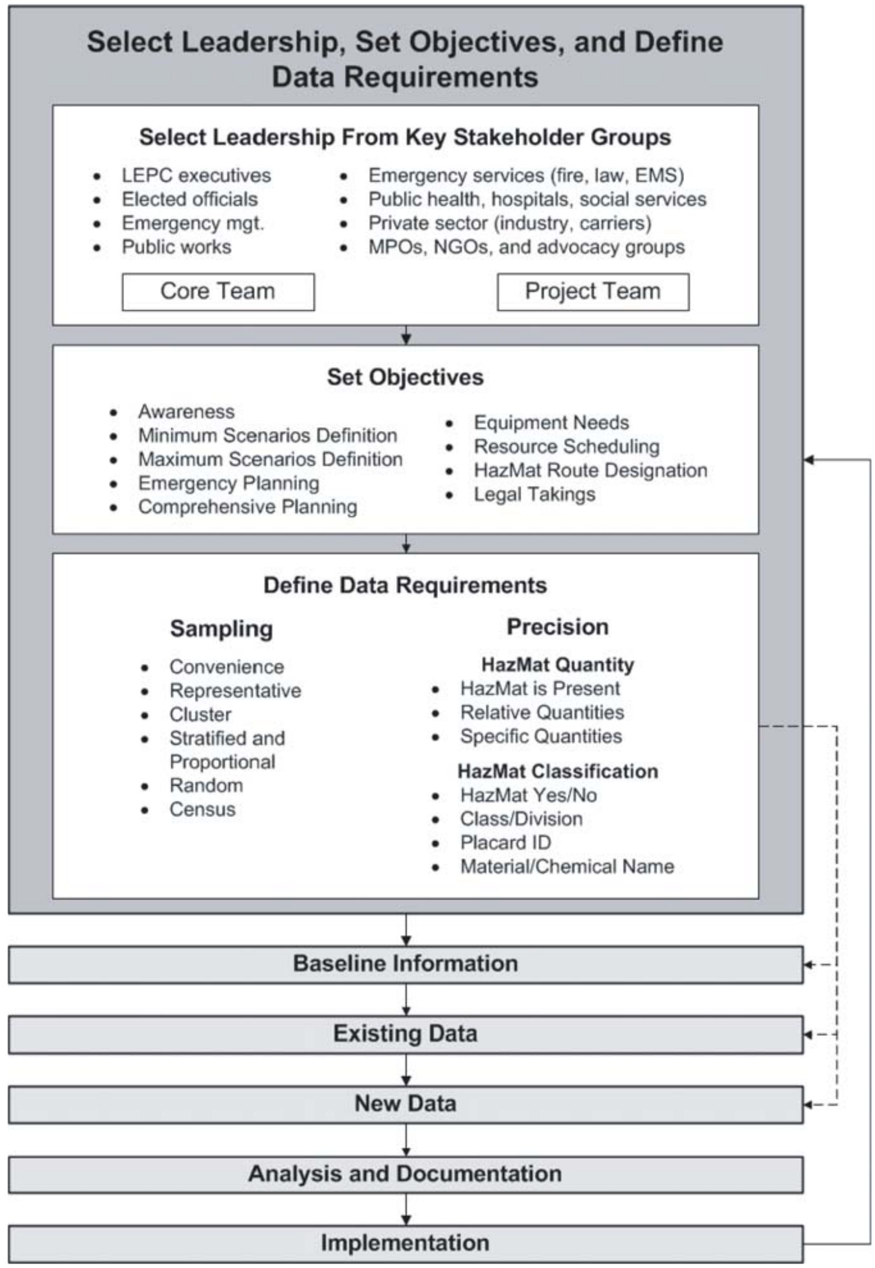

Figure 2-1. The HMCFS leadership, objectives and data requirements process.

Involvement of the core team is directly relevant to the direction of the HMCFS project through objectives setting. It is also important for reviewing project information, implementing it into the broader context of emergency planning, and building local support of public officials, the private sector, and general public.

2.1.2 HMCFS Project Team

The HMCFS project team will be responsible for coordinating and managing the HMCFS project, based on the objectives identified by the HMCFS core team. These responsibilities may include the following:

- Identifying data requirements for the HMCFS project, based on the objectives;
- Identifying volunteers and other resources available for collecting HMCFS data;
- Scoping and scheduling the HMCFS project tasks;
- Coordinating volunteer and other data collection activities;
- Compiling and reviewing baseline and existing HMCFS data;
- Compiling and validating new HMCFS data;
- Analyzing HMCFS data;
- Documenting HMCFS results; and
- Presenting HMCFS results to the HMCFS core team.

The HMCFS project team should be identified at the same time as, or soon after, the core team is identified. The project team may include some or all of the core planning team members, as well as other individuals who have time, interest, and capability for a leading role in the HMCFS project. An LEPC or TERC might assign HMCFS project leadership to a transportation- or hazmat-focused subcommittee. A local government agency might assign HMCFS project leadership to a planner or planning group. To the degree that consultants, university faculty, and state or federal agency officials are involved in the project, they may be included in, or even lead, the HMCFS project team.

> Many LEPCs obtain professional assistance for conducting their HMCFS. Victoria County, Texas, LEPC members worked with state agency staff to conduct their HMCFS project in 2009. LEPC executive staff from Victoria City and County Emergency Management and the Victoria Citizens Medical Center identified project objectives and local resources, and coordinated data collection by volunteer participants from local industry, hospitals, the fire department, and other groups. State agency staff processed and evaluated the data and prepared the project report. Over 330 hours of truck traffic data were collected for the major roadway segments around and through Victoria, Texas.

2.2 Set Objectives

The goal of the HMCFS should be to inform emergency and community plans so that they are adequate, feasible, acceptable, complete, and in compliance with guidance and doctrine. Setting specific objectives for the HMCFS project helps LEPCs, TERCs, and other local entities meet this goal. The core team is responsible for setting the objectives of the HMCFS project. This is one of the most important steps of the HMCFS process, and helps answer the question of why to conduct an HMCFS. Local entities may misdirect or misallocate resources and fail to achieve desired results by not understanding the information that is needed to support the project's objectives.

Local entities conduct an HMCFS for a variety of reasons to support strategic, tactical, and operational planning for emergency response, transportation, and broader community planning applications. HMCFS information can be applied to scenario-, function-, and capabilities-based planning as well. Different HMCFS objectives can be used in the frameworks of prevention, protection, response, and/or recovery in emergency planning. The following sections describe the objectives categories in further detail in order of their complexity (from least to most): awareness, minimum scenarios definition, maximum scenarios definition, emergency planning, comprehensive planning, equipment needs, resource scheduling, hazmat route designation, and legal takings. Other HMCFS applications may coincide with these categories.

These objectives categories are used throughout this guidebook as they apply to the HMCFS process. Note that this guidebook

> HMCFS can provide information to support a wide range of emergency planning and training applications. Peninsula LEPC in Virginia used the information for emergency planning by different local governments in the area. Vermont's LEPC #3 wanted to identify possible traffic disruptions and environmental risks to area watersheds. Lewis/Upshur Counties LEPC focused on prevention and mitigation of hazmat incidents. A regional HMCFS in Arizona was used for resource allocation and informing agencies about risks. Cambria County LEPC in Pennsylvania focused on identifying response needs as well as enhancing education and awareness of hazmat risks. Victoria County LEPC in Texas was interested in changes in hazmat transport patterns and considering the need for hazmat route designations. How would you use HMCFS information in your community?

focuses on collecting and evaluating HMCFS information to support these objectives, not on processes for achieving those individual objectives per se.

Promising practices that have been identified for conducting HMCFS are provided as a resource in Appendix D. These practices were identified in extensive research that was conducted for this guidebook, including a survey of LEPCs about how they conducted HMCFS and detailed examinations of HMCFS case studies. Appendix D.1 includes the first of these promising practices, an HMCFS Objectives Checklist.

2.2.1 Awareness

A frequent concern for LEPCs and local planners is that local officials and the general public "don't know and don't care" about hazmat transport risks in their community, except when it "becomes a crisis." Documenting hazmat risks, such as through an HMCFS, can highlight needs for attention to hazmat transport emergency planning and preparedness. This does not have to be extremely complex. Identifying that hazardous material is present can help draw attention to the potential impacts of hazmat transport on a community and the need to plan, staff, equip, and train accordingly.

2.2.2 Minimum Scenarios Definition

Scenarios definition is focused on training for the safety of emergency responders and their ability to provide effective response. This is grounded in part on knowing what operational requirements are anticipated. At a minimum, identifying that hazardous materials are transported in the community can guide definition of training scenarios and incident preplanning, although scenarios that are developed with less specific information also may be less likely to reflect actual operational conditions should they occur.

2.2.3 Maximum Scenarios Definition

As additional information about hazmat transport becomes available, the ability to define operational scenarios and conduct incident preplanning based on traffic patterns, specific commodities, and specific locations and conditions becomes enhanced. Training can be focused on specific risks—for example, intersections/choke points, time of day/year, and certain materials or vehicle types. By using HMCFS information to identify specific hazard scenarios, emergency planners can describe either the most likely and/or most hazardous conditions of operating environments that may be expected in a community, enhancing both community protection and incident response capabilities.

2.2.4 Emergency Planning

Understanding hazmat transport risks is important for all aspects of emergency planning—prevention, protection, response, and recovery. Although planning for hazmat transport incidents can be done with any level of knowledge, effective use of resources requires sufficient knowledge to avoid misdirected efforts. As certainty increases about the hazards that may be faced, emergency planning can become more focused and specific. Strategic response goals include identifying public safety requirements, potential casualties, fatalities, property damage, business and financial losses, transportation delays, environmental harm, and community disruption associated with various incidents and response strategies. HMCFS information can be used for designing emergency warning and notification systems, shelter-in-place or evacuation procedures, and necessary technologies and supplies. The HMCFS can also inform tactical planning to identify where and how hazmat incidents may be most effectively handled and help assure that the resources for effective response (i.e., appropriately trained personnel and equipment) are available at the time and place they are needed. An HMCFS also can help a local agency understand whether mutual aid or other types of assistance will be required from outside agencies and provide information regarding specific resource needs of that assistance.

2.2.5 Comprehensive Planning

Comprehensive community plans use a broad range of information to identify, prioritize, and plan for community needs. Local and regional planners may focus on land use, development, zoning, transport corridor development, and environmental planning but fail to account for hazmat transport risks in these plans. In addition, HMCFS information—for example, truck traffic levels and patterns or truck type information—also may be useful for other community planning applications. These include local, state, or federal requirements to address hazards due to effects of hazmat transport incidents on infrastructure and environmental protection (e.g., municipal or storm water pollution prevention requirements). Since comprehensive planning can be controversial, HMCFS information should be as specific and detailed as practicable to maximize usability and prevent criticism or dismissal of its value.

2.2.6 Equipment Needs

Equipment used to respond to, and recover from, hazmat incidents can include not only reusable tools and materials but also expendable supplies. These may include the following:

- Personal protective equipment;
- Chemical detection sensors;
- Equipment for spill confinement and containment (e.g., tractors, dozers);
- Equipment for neutralization, extinguishing, and dilution (e.g., hoses, pumps, nozzles, tanks, apparatus);
- Decontamination and cleanup equipment (e.g., showers, storage bags);
- Supplies for spill confinement and containment (e.g., tarps, soil, drums, plugs/patches);
- Neutralization, extinguishing, and dilution agents (e.g., foam, bases); and
- Decontamination and cleanup supplies (e.g., brushes, soaps).

Stocking and maintaining adequate levels of equipment for supporting emergency response capabilities for hazmat transport incidents can be greatly enhanced by knowing how much of what type of hazardous material is being transported in a community. Locating resources also is dependent on where those resources are needed. Expenditure of public funds for procurement of equipment and supplies affects the ability to adequately protect responders, property, the general public, and the environment. An HMCFS also can provide information to support requests for needed equipment and supplies through budgetary and grants funding processes.

2.2.7 Resource Scheduling

Risks of hazmat incidents may be particularly high at certain times of the day, days of the week, or seasons of the year. These patterns often vary from location to location within a jurisdiction. Scheduling resources (e.g., personnel, apparatus, equipment, supplies, etc.) to support emergency response capabilities for potential incidents provides a greater level of community protection. Adjusting resource levels according to risk can save scarce budget dollars but requires detailed information to ensure that the risk/resource level is consistently applied. Understanding of resource needs also will assist logistics personnel with incident response, should an incident occur.

2.2.8 Hazmat Route Designation

Designating routes over which hazardous material may not be transported can help prevent incidents from impacting local populations or sensitive environmental areas, and federal law authorizes states to designate highway routes over which the transport of hazardous materials may be permitted or prohibited. The requirements for route designation, restriction, or prohibition for transport of non-radioactive hazardous materials (NRHM) are defined in 49 CFR, Part 397, et seq. Local communities and states may have additional requirements for hazmat route designation. As with comprehensive planning, hazmat route designation can be a very controversial topic for a community. HMCFS information should be sufficiently detailed and specified to maximize usability and prevent criticism or dismissal. FHWA's *Highway Routing of Hazardous Materials: Guidelines for Applying Criteria* (*13*) is one source of guidance for conducting a hazmat route assessment. The information collected for an HMCFS can directly support many of the most important routing analysis considerations, including type of roadway, accident history, type and quantity of hazardous material, and amount of through routing. Other information that may be included in an HMCFS consists of population densities, locations of special populations, and locations of critical infrastructures. Further risk analyses can identify relative impact zones and risks for different hazardous materials.

2.2.9 Legal Takings

As local entities seek to prevent hazmat incidents from occurring in populated areas or implement comprehensive plans, properties may be restricted to uses compatible with those plans. Current owners may suffer a loss in opportunity costs. These legal takings (eminent domain), although very rare, can end in serious proceedings that can be controversial and quite costly. HMCFS data that may be used to support such limitations are likely to require a high level of detail and precision to maximize utility, prevent criticism, and hold up in legal proceedings.

2.3 Define Data Requirements

The project team defines the data requirements of the HMCFS project based on the objectives set by the core team. The data requirements include sampling (where, when, and how often data are collected) and precision (characterization of hazmat flows and flow mechanisms by type and quantity). As the data requirements increase according to the level of HMCFS objectives, the number of applicable data sources decreases. This is because many data sources, such as national-level flow estimates, are collected using techniques that are not appropriately matched to the sampling or precision required to support the objectives at the local level. These data should only be used to develop very general ideas about the nature and patterns of what might be travelling through a local jurisdiction such as a city or county. Other data provide enough information to understand the local nature and patterns of hazmat transport in a jurisdiction, but not for specific times, locations, or individual hazmat commodities. At the highest level, data are very locally detailed and can be used to identify the particular nature and patterns of what has been observed in a jurisdiction, even for a specific network location, time of day, or hazmat commodity.

Sampling and precision requirements for HMCFS data are discussed in Chapter 5. Appendix D.2, Let HMCFS Objectives Guide Sampling, suggests some guidelines for sampling hazmat transport data (that is, where, when, and how often data should be collected) according to project objectives. Appendix E provides further information about sampling frameworks.

The level of precision used to conduct HMCFS can vary in terms of describing how much (quantity) and what kind (characterization) of hazardous materials are transported. Because achieving higher levels of data precision usually requires more effort, Appendix D.3, Let HMCFS Objectives Guide Precision suggests a classification system that helps determine when the additional precision is warranted. It can be used to define data collection requirements for hazmat quantity (e.g., hazmat presence, relative hazmat quantity—small, medium, or large quantities—or specific hazmat quantity such as number of gallons or pounds transported) and hazmat classification (e.g., whether or not it is hazardous material, chemical/material class/division, UN/NA placard ID, or specific chemical/material name).

2.4 HMCFS Objectives and Public Protection Goals

Local entities are often overwhelmed when trying to provide the best possible protection with extremely limited resources. Trying to plan for every possible risk is not only impossible, but also may limit the usefulness of any efforts that are attempted. Appendix D.4, Match Protection Level with HMCFS Objectives, is provided for local entities that are interested in a better understanding of public protection goals and how HMCFS objectives are related to those goals.

CHAPTER 3

Collect and Review Baseline Information and Scope Project

After the HMCFS project team defines the data requirements, it identifies baseline information about hazmat transportation in the area, reviews and evaluates the information, and scopes the HMCFS project. A flow chart of the HMCFS process focusing on baseline information and HMCFS project scoping is shown in Figure 3-1.

3.1 Collect Baseline Information

Collecting baseline information is the next step after HMCFS data requirements are defined. Baseline information includes what is immediately and locally known about the following:

- How hazmat is transported in the study area,
- Where hazmat is transported in the study area, and
- The characteristics of hazmat transported in the study area.

This includes the following, as available:

- Previous emergency response or planning efforts such as a prior HMCFS that have been conducted to identify hazmat, industrial, or other commercial transportation activities in the area;
- Modes and routes by which hazmat is transported in the area;
- Locations of facilities that produce, store, use, or transport hazardous materials; population centers and future developments; and critical infrastructures; and
- Information about transportation incidents and accidents in the area.

It is important to note that the baseline information is focused on current "in-house" knowledge. It is a review for the local jurisdiction to assess its current state of knowledge about hazmat transport and identify associated information gaps.

3.1.1 Previous Emergency Response or Planning Documents

Identifying previous, locally available documents about an area's transportation patterns, hazmat emergency response needs and guidelines, and similar types of information may be useful for an HMCFS, both as information sources and document templates. Identifying these documents should be a first step in identifying baseline knowledge for an HMCFS. A prior HMCFS, if available, can be an especially important baseline data source.

3.1.2 Modes and Routes

Modes by which hazardous materials are transported include roadway, railway, pipelines, waterways, and airways.

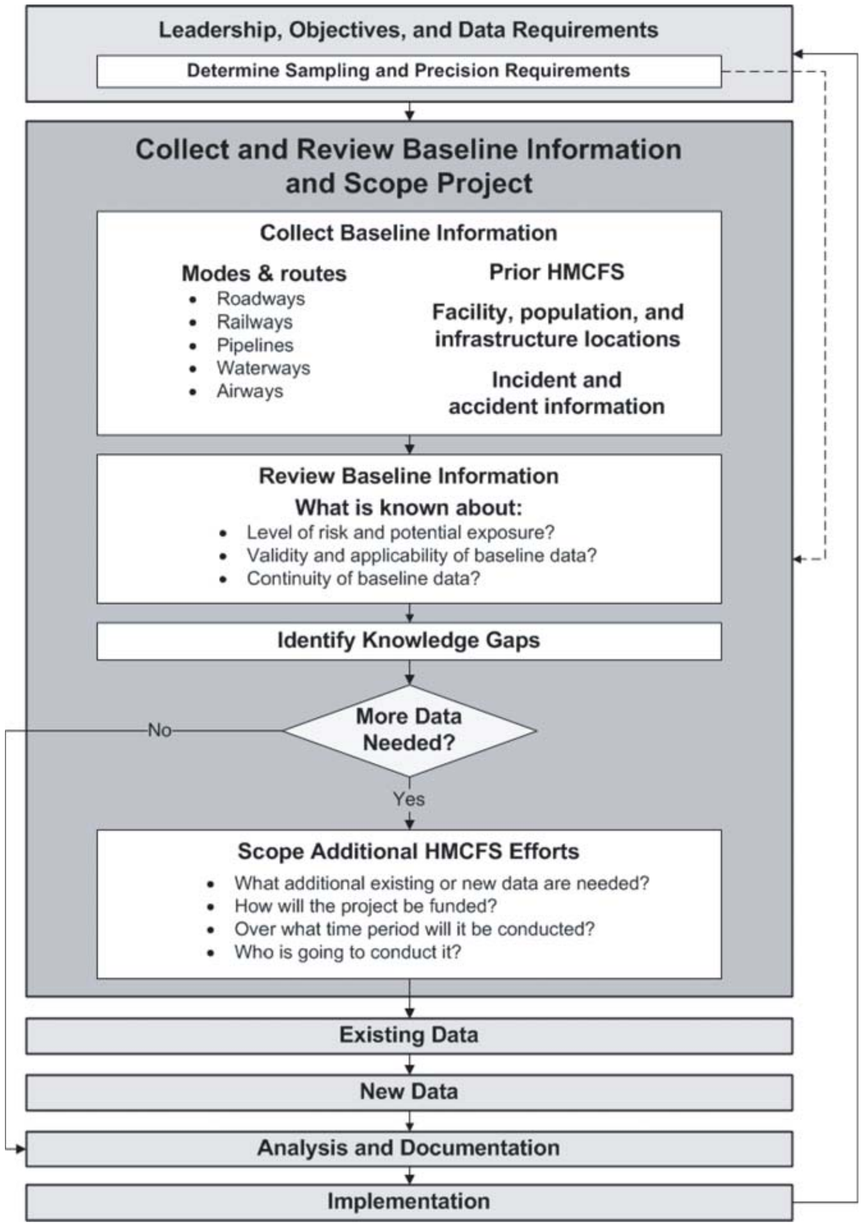

Figure 3-1. The HMCFS baseline information and project scoping process.

3.1.3 Facility, Population, and Critical Infrastructure Locations

Fixed facilities that produce, store, or use hazardous materials can be identified by local industry partners and from reported information about storage of hazardous substances (such as Tier II reports). Hazardous materials may be transported by different modes to these facilities. Population centers, critical infrastructure, and future developments may be affected by, or alter patterns of, hazmat transport associated with such facilities.

3.1.4 Incident and Accident Information

Emergency managers and responders are likely to have experiential knowledge of previous incidents and accidents on hazmat transport routes. Even if accidents have not previously involved

Classifying Transportation Modes and Routes

- Roadways include, but are not limited to, Interstate highways, U.S. highways, state highways, urban arterials, and secondary roads such as county roads, farm roads, and forest roads.
- Railways include Class I railroads that operate over large portions of North America, regional Class II railroads, shortline Class III railroads, and port, terminal, and industrial railroads.
- Pipelines include petroleum crude pipelines, petroleum product pipelines, natural gas transmission lines, natural gas collection and distribution lines, carbon dioxide lines, and other hazardous liquids lines.
- Navigable waterways are those that can accommodate either shallow draft vessels such as barges and tow/push-boats, or deep draft vessels. Shallow draft channels, generally 15 feet deep or less, serve smaller ports as well as industrial facilities. Deep draft waterways serve larger ports as well as industrial facilities.
- Airline terminals include intercontinental, international, national, and regional airports. Many airports have designated cargo facilities served by airlines that focus on cargo transportation. However, passenger airlines also offer cargo services.

hazmat transport, high-risk locations such as hairpin turns, steep curves, or blind intersections and entrances can increase the likelihood of incident occurrence. Including this experiential knowledge does not require a formal assessment and documentation—that may be covered as part of the new data collection (discussed in Section 4.2.3). However, discussing this information with local emergency managers and responders as part of the baseline knowledge assessment can help identify whether and where additional information is needed.

3.2 Review and Evaluate Baseline Information

The project team reviews and evaluates the baseline information to identify a preliminary inventory of what is immediately and currently known about hazmat flow into, out of, within, and through the study area. The review will help the project team scope the HMCFS existing data collection, new data collection, and analysis.

Things to Look for in the Baseline Information Review

The preliminary inventory of hazmat flows allows planners to focus on routes as follows where:

- There is reason to believe risks are high (e.g., high frequency or volume, high traffic counts, or recent accidents, especially those involving hazmat);
- Knowledge is limited or undocumented (i.e., there is little or no empirical evidence);
- Potential exposures are extreme (i.e., large populations, special needs populations, or large congregations of people are frequently or routinely present); or
- Some combination of these is present.

Ideally, previous documentation (such as a prior HMCFS) would be recent and specifically focused on hazmat transport over the corridors of concern. However, even an HMCFS that was not conducted recently can be useful for developing a baseline of existing knowledge.

Routes or route segments can be classified by mode of transport, frequency and volume of hazardous materials, and extent of knowledge currently available. Hazmat transport is possible along any route, but the amount and frequency varies with mode and class.

Characteristics of Hazmat Transport by Types of Roadways

- Large quantities of hazardous materials are frequently transported on the nation's highways. The primary function of many highways is transporting through traffic. This often makes Interstates, freeways, highways, and other limited-access roadways the highest priority for study. Routes may be identified as permitting or restricting hazmat transport.
- Because primary or arterial roadways provide through movement with some access to adjacent land, they also typically receive high priority for study. To the extent that flows on limited access roadways are already understood, they may receive lower consideration.
- Secondary or collector roadways provide access to the adjacent land and links to primary roadway and highway networks. Understanding these connections may be relevant to locations serving major industrial or transportation hubs in the area.
- Local or tertiary streets are primarily for land access and likely represent the fixed facilities they directly serve.

Railways transport very high quantities of commodities per unit, and although in many areas the transport of hazardous materials by railway may be less frequent than by roadways, it still may be significant. Hazardous materials are frequently transported throughout the Class I rail system. Regional railroads (Class II), because of the exchange of traffic with the Class I system, are considered very likely to handle hazardous materials with considerable volume and frequency. Many shortline railroads carry only a limited variety of commodities. For some shortlines, this will generally exclude hazardous materials, but hazardous material may make up almost all of the carload shipments for others. This generally holds for switching and terminal or port railroads as well, which are the smallest of the rail system types. Railways designated only for passenger railroads can be eliminated from consideration, except where they may intersect other hazmat corridors (e.g., a highway–rail grade crossing in an industrial area).

Generally, pipelines are constructed to carry liquid commodities with consistently high volume and frequency. Petroleum crude pipelines, petroleum product pipelines, natural gas transmission lines, and pipelines that carry other hazardous liquids (e.g., ammonia) often are of high interest for an HMCFS, given the nature of their hazards and the volume of hazardous material each carries. Waterways are especially well suited to transporting large quantities of commodities. Airport terminals may be used for transport of hazmat cargo, although the volume of hazmat air cargo transport is much lower than that of other modes, and airports are accessed by connecting roadways. Airport terminals may also receive aviation fuels by different modes.

Major shipping routes into or out of fixed facilities that produce, store or use hazardous materials within the study area are highly likely to exhibit significant volumes or frequency of hazmat transport. Routes and facility locations may be classified in terms of the potential exposure

Understanding your information baseline helps guide the HMCFS project. The Lewis/Upshur Counties LEPC in West Virginia reviewed a prior HMCFS as part of their baseline information assessment. It showed that local rail traffic was for coal transport. The LEPC determined that little had changed with rail shipments since the previous study, so collection of new railroad data was not necessary.

of nearby populations. Incident and accident information and previous analysis may identify areas of particular concern.

Many jurisdictions feel that they have a good handle on hazmat traffic that originates in, is destined for, or transported entirely within their jurisdictions, but they lack a good understanding of hazardous material that is transported *through* their communities. Other jurisdictions, especially those that are larger and more complex, may require a detailed analysis of all types of hazmat transport.

If risks are known to be low, knowledge is solid and well documented, potential exposures limited, and there is no reason to believe any of these have changed significantly over time, then the baseline level of knowledge may be sufficient. If, however, there are gaps in knowledge or information is not current or relevant, then additional HMCFS efforts may be required. In this case, baseline information assessments provide considerable insight for conducting the HMCFS and focusing it on high-priority issues or locations.

3.3 Scope the HMCFS Project

The project team scopes the HMCFS project after reviewing the baseline information and identifying gaps in hazmat transport knowledge or information. An HMCFS can range from a simple, low-cost effort using existing data sources, to one that is much more complex, involving collection of new data and expenditure of a large amount of effort and resources. A review of Chapters 4, 5, and 6 is suggested before attempting to scope the HMCFS project. This will help the reader understand the kinds of information available from already existing data sources, information that can be obtained from new data sources, and whether they are applicable to the HMCFS project's objectives. Local jurisdictions should check with state (e.g., SERC) or federal entities about content requirements for an HMCFS and emergency plans to ensure that all required information is obtained and documented.

After identifying what needs to be done, the next step is to plan for the HMCFS—identify how and when it is going to be done, and who is going to do it. Funding is a key question for the project. Appendix D.5, Stretch Limited Time and Resources, discusses options for funding an HMCFS. Appendix D.6, Consider Consecutive-Year Studies, covers how an HMCFS can be scheduled over several years to address resource limitations. This may be particularly applicable to large jurisdictions with complex transportation systems. Keep in mind that grant funding for conducing HMCFS, such as the HMEP Grants Program, may have specific requirements that must be met to utilize funding. These requirements may result in significant impacts and limitations on the timing of HMCFS activities and deliverables.

The question of who will participate in the HMCFS project is also important. Some LEPCs have availability and interest of their membership, but minimal funds for hiring an outside contractor. Since LEPCs and TERCs are made up almost exclusively of volunteers, Appendix D.7, Use Volunteers to Conduct HMCFS, presents issues particularly relevant to these entities. Others have funds available for hiring a contractor, but minimal availability of their members for participating in data collection or evaluation.

Regardless of whether the HMCFS is conducted entirely internally, or if an external entity such as a contractor is brought in, an HMCFS requires the oversight of a manager or coordinator who can provide a central point for direction of the project, periodically review progress on the effort, provide input about direction of the project relative to objectives, and review project results. It is likely that this function will be made up of one or more members of the HMCFS project team.

Participation by local entities such as LEPCs in the commodity flow study is critical to the success of the study. The roles of the LEPC and its members change only slightly with the method chosen for conducting the HMCFS. Even if the LEPC chooses to hire an outside entity to conduct the study, the LEPC still has a vital role. In this case, the role(s) of the LEPC and its members may include the following:

- Providing input to the contractor about the purpose and use of the study;
- Providing input about known historical data and special local situations that may not be readily known;
- Assisting the contractor in the acquisition of data. For example, in comparison to contractors, LEPCs are able to more readily access data from Tier II reports from fixed facilities and request information from transporters such as railroads;
- Providing input on data collection site locations to ensure collected data covers the needs of the jurisdiction; and
- Interpreting results of the HMCFS, disseminating information to stakeholders, and implementing changes to local emergency and community planning practices as a result of project objectives.

An outside entity contracted to conduct an HMCFS also has defined roles. The roles of the contractor may include the following:

- Conducting preliminary meetings with the LEPC to ensure that the study is designed to meet the identified needs,
- Acquiring historical data and requesting assistance from the LEPC if necessary,
- Designing a study to meet the needs of the LEPC,
- Coordinating and conducting data collection, and analyzing data; and
- Documenting HMCFS results.

A local entity that conducts the study internally is also responsible for data collection and analysis. This will require, at a minimum, personnel who are experienced in the use of spreadsheet software such as Microsoft Excel®. Involvement of personnel with technical writing experience will help ensure that the information is accurately and effectively communicated through HMCFS documents. Although not critical to the HMCFS, experience with Geographic Information Systems (GIS) will be very beneficial because GIS allows for hazmat transport information to be communicated using maps, in addition to lists, charts, and tables.

CHAPTER 4

Collect and Review Existing Data

After reviewing the baseline information and scoping the HMCFS project, the project team collects and reviews existing data. The project team may enlist volunteers or other project participants to assist with existing data collection. A flow chart of the HMCFS process, focusing on collection and review of existing data, is shown in Figure 4-1.

4.1 Existing Data Overview

Existing data have been previously collected and assembled for some purpose. They can represent a resource-saving supply of information because collection of new data is often expensive, difficult, and/or time consuming. A disadvantage to existing data is that the data collection, analysis, and presentation may not apply directly to the local HMCFS, and the data may have limited applicability to current community needs, depending on the source. Existing data include the following:

- Locally or institutionally available data sources
  - Prior HMCFS that have been conducted by the LEPC;
  - HMCFS that have been conducted by other adjacent LEPCs or those that share common transport corridors;
  - Information maintained by local, state, or federal agencies;
  - Information maintained by local hazmat facilities and carriers;
  - Trade, environmental, and social advocacy organizations; and
  - Printed maps and academic journals.
- Electronic databases and reports that have information about
  - Transportation networks;
  - Commodity movements;
  - System performance (traffic) levels;
  - Population and critical facility locations;
  - Historical incident and accident occurrences and locations;
  - Contact information; and
  - Geographical and environmental data.

Appendix D.8, Use Existing Data Sources, includes a checklist that can help users identify and track the applicability of some of the existing data sources for an HMCFS. Remember that all existing data sources should be appropriately credited when they are used.

4.2 Locally or Institutionally Available Data Sources

Identifying locally available data sources is similar to the baseline information review but should be revisited by the project team during the existing data collection step to ensure that nothing important was missed. It also may be possible to drill down deeper during the existing

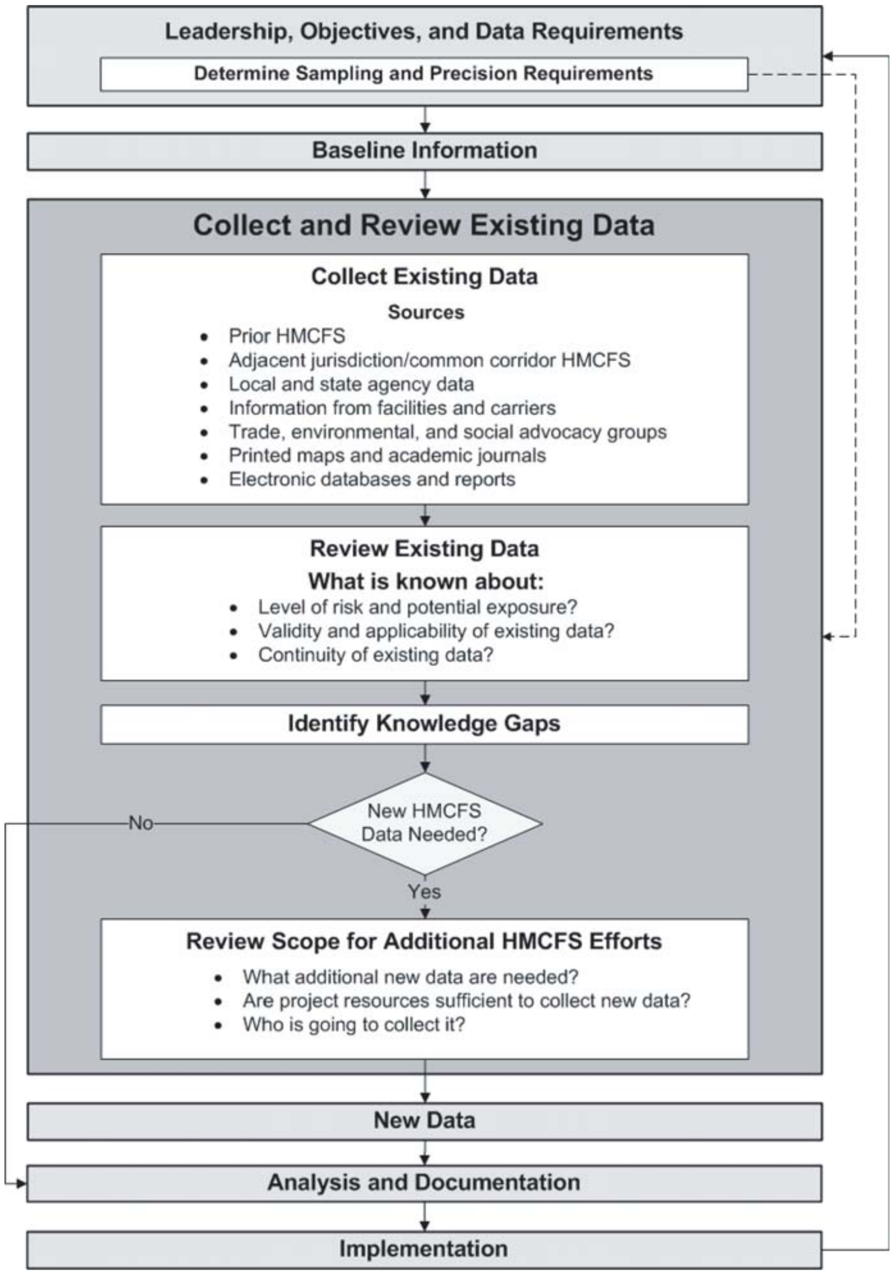

Figure 4-1. The HMCFS existing data collection and review process.

data collection phase than during the baseline information review. Institutional data from non-local agencies, industries, and organizations also should be considered.

4.2.1 Prior HMCFS

Sometimes knowledge of existing resources may become lost, blurred, or develop gaps with changes in organizational leadership and membership. This makes it important to thoroughly review previous documentation, especially if the organization has experienced recent turnover in membership. Information from a CFS that did not focus on hazmat transport, such as a general commodity flow or traffic study for a community or region, also can be useful for identifying hazmat risks or areas of particular interest or concern.

State and federal agencies can be important sources of information. Vermont's LEPC #3 used state DOT reports to identify crash locations. Information about hazmat incidents was provided by Vermont's Department of Emergency Management. Local traffic counts were compared with BTS 2002 *Commodity Flow Survey* data for Vermont for consistency. Peninsula LEPC in Virginia used truck inspection records from Virginia DOT. Another source of hazmat incident information is PHMSA's Incident Reports Database. Lewis/Upshur Counties LEPC in West Virginia compared national and state incident data in their analysis.

4.2.2 Adjacent Jurisdiction/Common Corridor HMCFS

Jurisdictions that are adjacent or nearby and share common transport corridors are another good, but often overlooked, source of HMCFS data. Traffic levels and cargo characteristics on shared transport corridors such as rural Interstates and other highways, railways, waterways, and pipelines are likely to be very similar unless there are major traffic diversion points.

4.2.3 Local and State Agency Data

Local and state planning, public safety, transportation and public works, environmental and natural resources, and other agencies also may have information about transportation networks, system information such as traffic levels, commodity movements, population demographics, and environmentally sensitive areas. Jurisdictions that are conducting an HMCFS should develop a list of local and state agencies, and contact them to identify what information may be available. Internet searches can help in this effort. Federal agencies are another source of information. Existing data sources from federal agencies that were identified as particularly relevant to a local HMCFS are also discussed in Section 4.3.

Local and State Agency Data Considerations

- State transportation agencies conduct traffic counts, including truck counts that are used to provide information for federal transportation databases. They may have additional information available beyond that reported to federal agencies.
- Local and state emergency management, emergency response, and environmental agencies may have information about facility locations, incidents and accidents, and company contact information. Although an incident may not be required to be reported at the federal level, information is often required to be submitted to these agencies for hazmat or other types of incidents.
- An incident does not have to involve hazmat to indicate risks. Accidents that occur in the general driving population or for non-hazmat-carrying trucks may also provide an indication of likely incident locations or incident rates.
- In the absence of detailed agency records, historical newspaper reports also may provide incident information.
- Planning and zoning commissions or departments may have data on community demographics and land use. Local transportation agencies may have traffic study information available that specifically addresses truck traffic.
- Chambers of commerce or other local business groups may have information about local hazmat users or transporters, as well as business trends and planned developments.

4.2.4 Information Maintained by Facilities and Carriers

Local shippers and receivers may maintain records about hazmat transport that can be used for an HMCFS. This data source may be particularly useful for hazmat transport that is within, originating in, or destined for a jurisdiction. These types of sources can include manufacturing facilities, petrochemical plants, hospitals, public utilities, public institutions (schools), retail facilities such as fueling stations, and military facilities. Local entities may have a better understanding about local hazmat shipments than about hazmat shipments that are travelling through their jurisdictions. Shippers and receivers in a jurisdiction are either known or can be relatively easily identified. Carriers serving these associated facilities can be identified through cooperation by shippers and receivers, or may be known to local agencies (e.g., emergency response, public works, planning agencies, etc.).

4.2.4.1 Facilities

Facilities that store certain quantities of hazardous materials are required under EPCRA to report hazardous chemical inventories using Tier I or Tier II forms to their state's SERC, their LEPC, and local fire department. Although only facilities that store hazardous chemicals above certain threshold levels are required to report storage information and not transportation information on the forms, these forms do provide a means to identify significant users of such chemicals. Local or state jurisdictions may have additional reporting requirements for facilities that store hazmat quantities at less than EPCRA thresholds.

Facilities are likely to have information about types, frequencies, and quantities of hazmat shipments. LEPCs can contact facilities that are subject to EPCRA reporting requirements to request information about hazmat transportation that will be used for emergency planning, as provided by EPCRA Section 303(d)(3):

> Upon request from the emergency planning committee, the owner or operator of the facility shall promptly provide information to such committee necessary for developing and implementing the emergency plan. (42 U.S.C. 11003(d)(3))

Keep in mind that a detailed analysis of existing facility information may be very labor intensive, particularly for very industrialized jurisdictions, because it requires an identification of applicable facilities, contacting them, obtaining the information, and processing the information. Information may not be in a format that is readily usable for analysis (e.g., paper copies of shipping documents that need to be converted to electronic format).

4.2.4.2 Carriers

Roadway carriers that operate within a jurisdiction may be well known to community officials, but carriers who operate mostly outside of, or through, a jurisdiction may be difficult to identify. One possible solution for identifying roadway carriers is to work with commercial vehicle inspection agencies.

Major (Class I) railroads are part of the Association of American Railroads (AAR) and partners in the TRANSCAER® (Transportation Community Awareness and Emergency Response) Outreach Effort. LEPCs can request hazmat transport information from Class I rail carriers using AAR's standardized form (see Appendix F). Hazmat transport data provided by most railroads is essentially a census of hazmat commodities transported by rail over a time period such as a calendar year. The rail traffic data may be indicated for specific rail segments or for the overall jurisdictional area.

Pipeline operators and commodities can be identified by using PHMSA's National Pipeline Mapping System (NPMS) or local knowledge, with additional details requested from pipeline operators as needed. For HMCFS purposes, generally it may be assumed that a pipeline is full and operational, and represents a release risk should the pipeline's integrity be compromised.

The U.S. Army Corps of Engineers (USACE) publishes a *Vessel Company Summary* that can be found at http://www.ndc.iwr.usace.army.mil/veslchar/veslchar.htm. The summary lists vessel company names, contact information, commodities carried, locations of vessel operation, and operating fleet size. Users can identify which companies may be operating in their areas, what types of commodities they are carrying, and whether they are likely to be hazardous. These companies can then be contacted to request information on specific commodities and tonnage carried during specific timeframes, such as a previous calendar year.

As with railroads, there are a limited number of air carriers that focus exclusively on cargo transport. In addition, airlines focusing on passenger transport also handle air cargo, especially on international flights. In general, availability of air cargo data is extremely limited. Release of air cargo shipment information is highly guarded by air cargo carriers, and many airports do not maintain statistics on hazmat shipments through their facilities, other than aviation fuels. This creates a challenge for obtaining existing information about hazmat transport by air, and the best option available may be to collect new data for roadway corridors serving airport cargo terminals.

4.2.4.3 Sensitive and Proprietary Information

As noted, EPCRA provides LEPCs with authority for implementing emergency plans. This notwithstanding, many private or military information sources are sensitive to providing information that may affect public safety and security, as well as proprietary concerns. Some will provide information for an HMCFS as "good corporate citizens," but others may have reservations about doing so. For these, a request can be made such that the information provided for the HMCFS is at a more general level, instead of information about specific commodities. Although this does not provide information about specific hazards, it does at least provide some information. Another potential method is for an entity to provide information with the source or specific location of that entity redacted from the record, so that specific hazard information can be included in the HMCFS.

As a quasi-public entity, LEPCs may or may not be subject to Freedom of Information Act (FOIA) requirements. An LEPC's ability to establish a formal legal mechanism that exempts the LEPC from disclosure requirements for proprietary information may be an option that must be validated through legal means if it is to be used. Some information provided to LEPCs (e.g., railroad hazmat transportation data) must be labeled as sensitive security information (SSI) under 49 CFR, Part 1520. This designation effectively limits any release of data and corresponding information to entities with a need to know.

Obtaining information from sources that are hesitant to provide information may require some legwork on the part of local jurisdictions. It is also likely to be difficult to obtain their participation during the study timeframe of a single year (or less) and is probably more suitable for an HMCFS effort conducted over several years, or continuously. This will allow for the development of procedures to address disclosure requirements; identify shippers, receivers, and carriers; and bring these participants on board for cooperation in the effort.

4.2.5 Trade, Environmental, and Social Advocacy Organizations

Hazmat manufacturing and transportation industry trade organizations are numerous and have a vested interest in safe, efficient movements of commodities. Such associations may be able to provide further information about hazmat transport in general and many maintain membership listings on their Web sites, which can be used to augment local contact information. The associations identified in this chapter are not an exhaustive list. Hazmat roadway carrier associations include the following:

- American Trucking Association (http://www.truckline.com);
- National Tank Truck Carriers, Inc. (http://www.tanktruck.org); and
- National Association of Chemical Distributors (http://www.nacd.com).

National-level statistics about railcar transportation are available from AAR at http://www.aar.org. These statistics can be used to provide a very general sense of the proportion of chemical railcars that make up overall rail traffic in an area. Some regions may have very high levels of certain types of rail traffic (e.g., coal traffic in the Powder Basin region, grain traffic in the U.S. Midwest, and chemical cars in petroleum refining regions) and very little of other types of traffic depending on the season and economic conditions.

The American Waterways Operators (http://www.americanwaterways.org) is the national trade association for the tugboat, towboat, and barge industry in the United States. The American Association of Port Authorities (http://www.aapa-ports.org) is an international organization representing deep-draft and shallow-draft ports, including the largest ports in the United States. These associations maintain information about their industries, including transportation statistics, on their Web sites. Regional waterway operator and port associations may be contacted as well.

A large number of national and regional trade associations represent the pipeline industry. National associations include the following:

- Pipeline Association for Public Awareness, which maintains information about pipeline emergency response (http://www.pipelineawareness.org);
- Association of Oil Pipe Lines (http://www.aopl.org); and
- American Gas Association (http://www.aga.org).

A good list of regional pipeline operators is maintained on the Energy Personnel/Energy Associations/Crude Oil and Natural Gas Associations' Web page at http://www.energypersonnel.com/CrudeOilandNaturalGasAssociations.html.

Airline associations may be able to provide information about hazmat transport by air or air cargo carrier contact information. These associations include the following:

- Cargo Airlines Association (http://www.cargoair.org), which has nine all-cargo airline members;
- Air Transport Association (http://www.airlines.org), which has 19 passenger and freight airline members; and
- International Air Transport Association (http://www.iata.org), a trade organization that sets guidelines and standards for the airline industry.

Manufacturer trade associations include the following:

- American Chemistry Council (http://www.americanchemistry.com), formerly the Chemical Manufacturers Association;
- American Petroleum Institute (http://www.api.org); and
- American Coatings Association (http://www.paint.org).

TRANSCAER® is an effort that was started by the Chemical Manufacturers Association. The organization "is a voluntary national outreach effort that focuses on assisting communities prepare for, and respond to, a possible hazardous material transportation incident" (http://www.transcaer.com) and is well known in the LEPC community as an important partner in emergency planning. TRANSCAER® has a Web page with guidance for planning an HMCFS and examples of HMCFS results. This page can be found at http://www.transcaer.com/resources/planning-flow-studies.

Environmental and social advocacy organizations focus on the conservation and preservation of the environment and equity and protection of people, including historically disadvantaged populations. These types of organizations also may have information on impacts of hazmat transport relative to population and ecological vulnerability and risks. These organizations include, but are not limited to, the following:

- Pipeline Safety Trust (http://www.pstrust.org/), a pipeline safety advocacy organization that maintains information about pipeline operations safety and databases of hazardous liquids and natural gas pipeline incidents;
- Sierra Club (http://www.sierraclub.org);
- National Resources Defense Council (http://www.nrdc.org); and
- Communities for a Better Environment (http://www.cbecal.org).

4.2.6 Printed Maps and Academic Journals

Print maps can be a source of transportation network information that may be used when mapping using electronic data is not an option. These sources include the following:

- Rand McNally's *Motor Carriers' Road Atlas* is available at retail outlets and on the Internet at http://store.randmcnally.com.
- Print railroad system maps are available from DeskMap Systems, Inc. Pricing and map availability information can be found online at http://www.deskmap.com/railroad.html.
- Pennwell Books' MAPSearch (http://www.pennwellbooks.com/mapsearch.html) is a print mapping source for pipeline systems.
- Print maps of the waterway system can be ordered from the U.S. Maritime Administration on the Internet at http://www.marad.dot.gov/index.htm.

Academic journals publish studies conducted by researchers, such as college and university faculty members, government employees, and private-sector employees including those of industries and consulting firms. Some of this research may specifically focus on transport of hazardous materials; other research may be more general and concern transportation and commodity movements. Access to academic journals may be by subscription, purchase of individual articles, via Internet search engines, or through college and university libraries. There are many academic journals, and those with information about hazmat transportation may include, but are not limited to, the following:

- *Hazardous Materials Control,*
- *International Journal of Mass Emergencies and Disasters,*
- *International Journal of Risk Analysis,*
- *Journal of Environmental Planning and Management,*
- *Journal of Hazardous Materials,*
- *Journal of Transportation Safety and Security,*
- *Transportation Research* (there are several parts), and
- *Transportation Research Record.*

4.3 Electronic Databases and Reports

The project team can use existing electronic data sources to cover a wide variety of HMCFS information areas. Table 4-1 lists electronic database and mapping sources, and Table 4-2 lists electronic reports and other documents. The sources in these tables are maintained by federal agencies. Mode applicability is indicated for highways, railways, pipelines, waterways, airways, and other classifications. Check marks indicate that a source provides information about transport networks, commodity movements, general system information (such as traffic levels, population and critical facility locations), incidents, points of contact, and geographical and environmental data. Both Tables 4-1 and 4-2 indicate the smallest jurisdictional size applicability by local, regional/state, and national scale levels. General relevance to local hazmat transport is indicated

Table 4-1. HMCFS electronic database and mapping sources.

Source	Mode(s)	Information Type							Smallest Jurisdiction Size Applicability	Local Hazmat Relevance	Technical Expertise Level	Notes
		Networks	Commodity Movements	System Information	Population, Critical Facility Locations	Incidents	Point of Contact	Geographic and Environmental Data				
FEMA HAZUS-MH Software	H, R, W, P, A, O (facilities, critical infrastr., population)	√			√				L	H	H	Spatial data, for use with a desktop GIS
FHWA Freight Analysis Framework (updated annually)	H, R, W, P, A	√	√	√					R/S	L	M H	Spatial data, for use with a desktop GIS; datasets can be accessed independently
BTS National Transportation Atlas Database (updated annually)	H, R, W, A, O (critical infrastr.)	√			√				L	H	H	Spatial data, for use with a desktop GIS
PHMSA Incidents Reports Database Search Web Page (updated continuously)	H, R, W, A					√	√		L	H	L	New online search system; can query incidents by many criteria
FMCSA National Hazardous Materials Route Registry and Route Maps (updated periodically)	H	√							L	H	L	List and map formats; only PC and browser required
FHWA Highway Performance Monitoring System (updated annually)	H	√		√					L	L	M H	Dataset not readily available; online map viewer is available
U.S. Census Bureau Vehicle Inventory and Use Survey	H		√						N	L	L	Data summarized in Appendix H
FMCSA SAFER Company Snapshot	H					√	√		L	M	L	Online search for highway carrier incident, inspection, and safety statistics
PHMSA Company Registration Look-Up Tool	H						√		L	L	L	Online search for information on hazmat carriers
STB Carload Waybill Sample (updated annually)	R		√						S	H	M H	Issues: confidential file accessibility; high level of expertise required
FRA Rail Safety Data (updated annually)	R					√			L	M	L	Hazmat detail very limited
PHMSA National Pipeline Mapping System (updated periodically)	P	√	√				√		L	H	L	Gas or liquid pipeline map display by state, county, or zip code
PHMSA Significant Incident Data Access Web Page	P					√			L	H	L	Raw data and summary reports available for pipeline incidents
USACE Hazardous Commodity Code Cross-Reference File	W								All	H	H	Useful for evaluation of USACE waterway data for corresponding UN/NA placard ID

(continued on next page)

Table 4-1. (Continued).

Source	Mode(s)	Information Type: Networks	Commodity Movements	System Information	Population, Critical Facility Locations	Incidents	Point of Contact	Geographic and Environmental Data	Smallest Jurisdiction Size Applicability	Local Hazmat Relevance	Technical Expertise Level	Notes
USCG Marine Casualty and Pollution Database (latest incident year 2001)	W					√			L	H	H	Waterway hazmat incidents are the rarest; required level of expertise not justified in most cases
U.S. Census Bureau Census (updated every 10 years)	O (population)	√		√	√				L	H	L H	Useful for community profiles; spatial data requires GIS
USGS *National Map*	O (topography)							√	L	H	L H	Topography and land-cover data
USDA Web Soil Survey	O (soil, topography)							√	L	H	L	Soil type, topographic, and ecological data
NOAA National Climatic Data Center	O (climate)							√	L	H	L	Climate data charts and tables

Note: Letter designations for mode delineate highways (H), railways (R), pipelines (P), waterways (W), airways (A), and other (O); for smallest jurisdictional size applicability refer to local (L), regional/state (R/S), and national (N) scale levels; and for relevance to local hazmat transport and for required technical expertise use low (L), medium (M), and high (H) levels.

by low, medium, and high levels. Required technical expertise for using the information source also is indicated by low, medium, and high levels. Notes about using the information source are provided. These databases and reports are further described in Appendix G.1 and G.2. The tables are ordered by the modes and information types covered in the data sources. These sources of information include the following:

- Electronic database and mapping sources
  - HAZUS-MH software from DHS, FEMA;
  - Freight Analysis Framework (FAF) from U.S.DOT, FHWA, Office of Freight Management and Operations;
  - National Transportation Atlas Database (NTAD) from U.S.DOT, BTS, Research and Innovative Technology Administration;
  - Hazardous Materials Incidents Reports Database from U.S.DOT, PHMSA, Office of Hazardous Materials Safety;
  - National Hazardous Materials Route Registry and Route Maps from U.S.DOT, Federal Motor Carrier Safety Administration (FMCSA);
  - Highway Performance Monitoring System (HPMS) from U.S.DOT, FHWA;
  - Vehicle Inventory and Use Survey (VIUS) from U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau;
  - Safety and Fitness Electronic Records System (SAFER) Company Snapshot from U.S.DOT, FMCSA;
  - Company Registration Look-Up Tool from U.S.DOT, PHMSA, Office of Pipeline Safety;
  - Carload Waybill Sample from U.S.DOT, Surface Transportation Board (STB);
  - Rail safety data from U.S.DOT, FRA, Office of Safety;
  - National Pipeline Mapping System (NPMS) from U.S.DOT, PHMSA, Office of Pipeline Safety;

Table 4-2. HMCFS electronic reports and other data sources.

Source	Mode(s)	Information Type: Networks	Information Type: Commodity Movements	Information Type: System Information	Information Type: Population and Critical Facility Locations	Information Type: Incidents	Information Type: Point of Contact	Smallest Jurisdiction Size Applicability	Local Hazmat Relevance	Required Technical Expertise	Notes
FHWA National Statistics and Maps	H,R,W,P,A	√	√	√		√		S, N	M	L	Comprehensive source of information applicable to national and state levels
BTS & U.S. Census Bureau Commodity Flow Survey (updated every 5 years)	H,R,W,P,A		√					S, N (for hazmat)	M	L	Hazmat section only to national & state levels
BTS Freight Data and Statistics (updated annually)	H,R,W,P,A		√					S	M	L	Reports compiled from individual data sources (e.g., CFS)
NTSB Accident Reports	H,R,W,P,A					√		L	H	L	Reports summarizing initiating events and outcomes for significant accidents from all modes; includes accidents involving hazmat
FMCSA Crash Statistics (updated annually)	H					√		L, S	M	L	Hazmat detail limited to class
USACE Waterborne Commerce of the U.S. Reports (updated annually)	W	√	√	√				L	M	L	Commodity groups aggregated; most hazmat tonnage is in Petroleum and Chemicals categories
USACE Lock Performance Monitoring System (updated annually)	W	√	√	√			√	L	M	L	Commodity groups aggregated; most hazmat tonnage is in Petroleum and Chemicals categories
USACE *Waterborne Transportation Lines of the United States, Vessel Company Summary*	W						√	L	M	L	Lists type of vessels and commodity types carried by company for waterway segments
PHMSA Pipeline Incidents and Mileage Reports Web Page	P					√		L, S	H	L	Includes pipeline trends and information for serious and significant incidents, impacts, mileage by state, summary tables and charts, and access to raw data

Note: Letter designations for mode delineate highways (H), railways (R), pipelines (P), waterways (W), airways (A), and other (O); for smallest jurisdictional size applicability refer to local (L), regional/state (R/S), and national (N) scale levels; and for relevance to local hazmat transport and for required technical expertise use low (L), medium (M), and high (H) levels.

– Significant Incident Data Access Web page from U.S.DOT, PHMSA, Office of Pipeline Safety;
– Hazardous Commodity Code Cross-Reference File from USACE, Institute for Water Resources (IWR), Navigation Data Center;
– Marine Casualty and Pollution Database from DHS, United States Coast Guard (USCG);
– The Census from U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau;

  - *The National Map* from U.S. Department of Interior, U.S. Geological Survey (USGS);
  - Web Soil Survey from U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS); and
  - National Climatic Data Center from U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA).
- Electronic reports and other documents
  - National statistics and maps from U.S.DOT, FHWA, Office of Freight Management and Operations;
  - The Commodity Flow Survey (CFS) from U.S.DOT, BTS, Research and Innovative Technology Administration, and U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau;
  - Freight data and statistics from U.S.DOT, BTS, Research and Innovative Technology Administration;
  - Accident reports from NTSB;
  - Crash statistics from U.S.DOT, FMCSA;
  - *Waterborne Commerce of the United States* reports from USACE, IWR, Navigation Data Center;
  - Lock Performance Monitoring System reports from USACE, IWR, Navigation Data Center;
  - *Waterborne Transportation Lines of the United States, Vol. 2: Vessel Company Summary* from USACE, IWR, Navigation Data Center; and
  - Pipeline Incidents and Mileage Reports Web page from U.S.DOT, PHMSA, Office of Pipeline Safety.

4.3.1 Transportation Networks

Identifying the routes (i.e., railways, roadways, waterways, pipelines, and airways) in a jurisdiction that are capable of transporting hazardous materials is an important step in conducting an HMCFS. Because not all routes are equally likely to carry hazardous materials, determining which routes are most likely to carry hazmat transport establishes priorities for the HMCFS.

4.3.2 Commodity Movements

Commodity movement information covers what commodities are transported from location to location. The Bureau of Transportation Statistics (BTS) and U.S. Census Bureau's Commodity Flow Survey (CFS) is one of the most well known, comprehensive national sources of this data. The U.S. Census Bureau also conducted the 2002 Vehicle Inventory and Use Survey (VIUS), which includes information about hazardous material transport by different types of truck configurations. The 2002 VIUS national-level data were compiled and summarized for this guidebook (Appendix H). This information can be useful for a very general understanding of hazmat transport in a community. It also can be used in conjunction with new data for truck counts. Again, remember that much of the existing federal commodity movement information published in these sources is not directly applicable to many local transportation network segments. This is because the information is reported at the state level or higher, because the data are not appropriately sampled for application at the local or regional levels, and/or the aggregation of commodity groups limits identification of specific material hazards below class level.

4.3.3 System Information (Traffic)

Transportation system information covers performance of the transportation network (i.e., traffic levels on network segments). Although this information is not specific to commodity movements, it can help prioritize network components for consideration in an HMCFS. Some sources may be based on model estimates rather than observed traffic levels.

4.3.4 Facility, Population, and Infrastructure Locations

Fixed facilities, population centers, critical infrastructures, and future developments may be affected by, or alter patterns of, hazmat transport associated with such facilities. Special populations are comprised of anyone who requires special consideration to be appropriately protected. For example, congregate care facilities, such as hospitals, nursing homes, day care facilities, and schools may require special arrangements to overcome populations with physical handicaps or may have reduced capacity to fully comprehend warnings. Prisons, juvenile detention centers, and other institutions of confinement may require special security arrangements. Any facility where large numbers of people congregate en mass—stadiums, arenas, fair grounds, convention centers, auditoriums, and churches—may require special arrangements to accommodate the large numbers of potential exposures.

4.3.5 Incidents and Accidents

Information about incidents and accidents can help characterize hazmat transport risks in a community and identify risk hotspots (discussed further in Section 6.3.8). The number, location, and types of accidents occurring in the area can be identified by reviewing the historical record of local transportation accidents. Such an historical record is useful because carriers are often reluctant to change routing practices. To the extent that environmental conditions (e.g., traffic, infrastructural conditions, or weather) contribute to accidents, specific locations of prior accidents may be more likely to experience future accidents if those conditions are repeated or persist.

It should be noted that incidents are not limited to those that involve hazmat. For example, if a particular road or intersection is known to have a high rate of truck incidents, and the road has hazmat traffic, it may also have a high risk for hazmat incidents, even if a hazmat incident has not historically occurred there. Hence, high accident rates for trucks along a particular route may provide good reasons to limit hazardous materials along those routes. Further information about large truck incidents and accidents is provided in Appendix I.

4.3.6 Contact Information

Obtaining contact information for hazmat transportation carriers, shippers, and receivers can allow a jurisdiction to request information from these entities about their hazmat transport activities. These data sources may augment contact information that is locally available or maintained by trade associations.

4.3.7 Geographic and Environmental Data

The geographic and environmental characteristics of a community are another important component of risk and vulnerability analyses. Topographic features and climatic conditions affect dispersion of hazmat releases. Topographic information and climate data are important assumptions for release modeling and response assessments. Susceptibility of natural resources to hazmat releases may vary according to the type of flora and fauna that inhabit them. This is especially critical for environmentally sensitive areas that contain endangered/threatened species and delicate ecosystems.

4.4 Review Existing Data and New Data Needs

The project team reviews the existing HMCFS data during and after compiling it from various sources. The process for reviewing existing data sources is very similar to the review process for the baseline information, but more extensive. The project team reviews and evaluates hazmat transport and other HMCFS information to identify data gaps by mode of transport, routes or route segments, frequency and volume of hazardous materials, and other classifications. As with the baseline assessment, existing data may be sufficient to meet the data requirements (as driven by HMCFS objectives) and to document limited potential risks and exposures. In this case, no new data are required. If gaps remain in knowledge, or information is not current or relevant, then new data are required.

Note that in many cases, collection of new data may be performed concurrently with collection of existing data. This can be done because the HMCFS objectives have been defined along with associated data requirements (Promising Practices 1, 2, and 3 in Appendix D). In addition, the sampling and precision characteristics of existing data sources and their relevance to the local jurisdiction are known or easily determined (Tables 4-1 and 4-2). By comparing the data requirements with the existing data sources, the project team should be able to develop an idea, in advance, about the needs for new data and proceed with new data collection. As the existing data is collected, compiled, and reviewed, the collection of new data (previously scoped as discussed in Section 3.3) should be reviewed to ensure that gaps in existing data will be addressed, and that sufficient data collection methods and resources will be applied.

CHAPTER 5

Collect and Validate New Data

The project team collects new (original) HMCFS data based on the project scoping (see Chapter 3) and gaps in existing data (see Chapter 4). As discussed in Section 4.4, new data collection may be conducted concurrently with existing data collection, as warranted by the project's objectives and associated data requirements. It is likely that the project team will enlist the participation of volunteers or other project participants to assist with new data collection. Figure 5-1 shows a flow chart of the HMCFS process focusing on new data collection and validation. Collection of new data specifically for an HMCFS may include the following:

- Interviews with shippers and receivers, carriers, emergency managers and responders, and other key informants; and
- Traffic surveys ranging from very simple truck counts to much more complex examination of shipping manifests.

Considerations for New Data Collection

Collection of new data tends to be focused on roadway commercial and service truck transport because

- Locally relevant hazmat transport data for roadways are generally lacking or more difficult to obtain from existing data sources.
- Locally relevant hazmat transport data for non-roadway modes (railroad, waterway, and pipeline) are generally available from existing data sources.
- Roadways often serve as connectors to railroad, waterway, pipeline, and air terminals.

New data also may be collected for other modes, particularly railroads, when traffic variation by time of day, day of week, or season of the year are desired. Procedures for new data collection that are discussed in this guidebook for roadways are conceptually similar to new data collection procedures for other modes.

5.1 Conduct Interviews

Hazmat shippers, receivers, and carriers; emergency managers and responders; and other key informants can be interviewed by the project team about their knowledge of hazmat transport, including what is transported, to/from where, when, and how. This step goes beyond simply requesting existing information from these sources as described in Chapter 4. Interviews can be

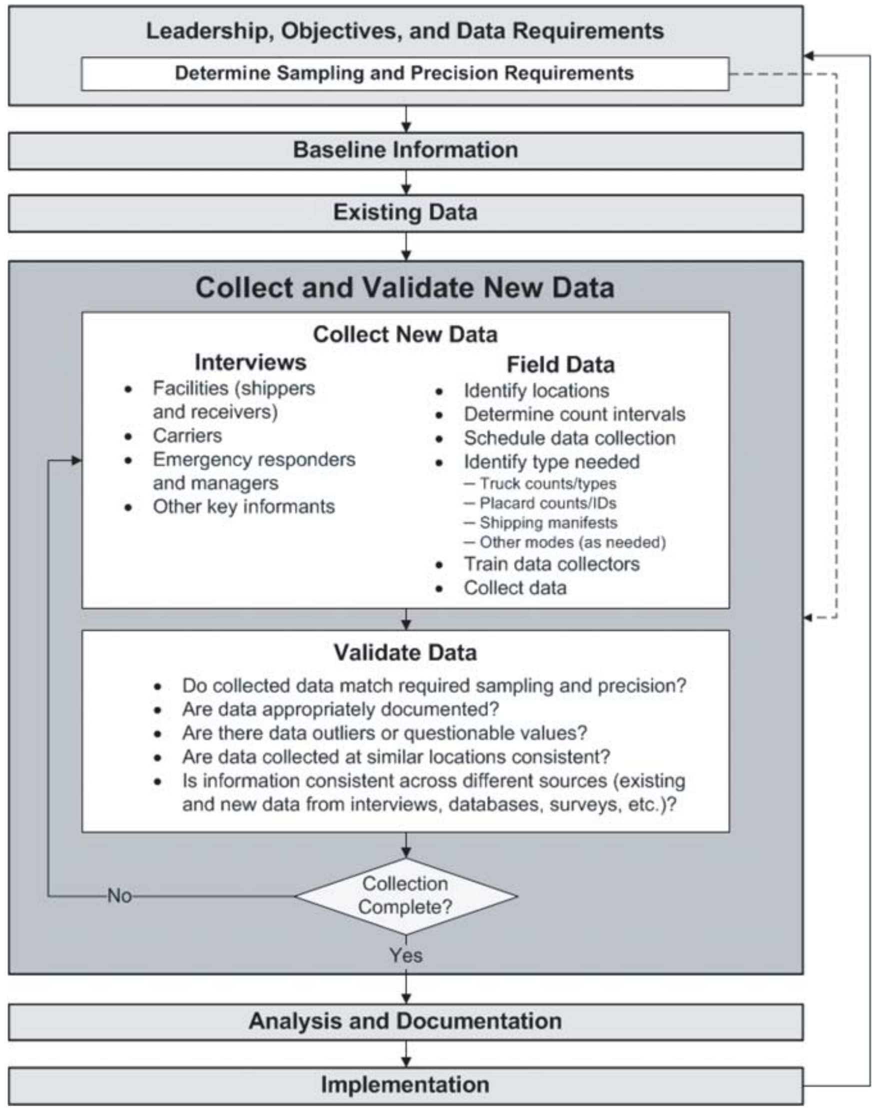

Figure 5-1. The HMCFS new data collection and validation process.

Things to Consider When Conducting Interviews

- The potential number of interviews is large and correspondingly time consuming, so a listing of contacts should be developed and prioritized.
- Interview information can be tabulated or written in list or paragraph form and summarized for each shipper, hazardous material, transport mode, etc.
- Although conducting interviews can be intimidating, the process becomes easier as interviewers become more experienced.
- The amount of information from interviews can seem initially overwhelming. Tasking a subcommittee with conducting and compiling interview data can yield a great deal of information over time, especially if interviews are conducted on an on-going basis (for example, each subcommittee member conducts one interview per week).

helpful for developing a general understanding of transport patterns within a jurisdiction or those originating and terminating in a jurisdiction. Extensive interviews are needed to develop an empirical understanding of hazmat transport over a network. Interview information also is important for guiding data collection, including verification of data collection locations and times.

5.1.1 Interviews with Hazmat Shippers, Receivers, and Carriers

For entities that are known to store hazmat (Tier II or locally required reports may be a source of this information), or entities that are located along or known to ship/receive/carry hazmat over transport corridors that are of key interest, suggested interview discussion points include the following:

- What hazardous materials are shipped/received/carried?
- What is the origin, destination, or both, of the hazardous materials?
- When are the hazardous materials shipped/received/carried by time of day, day of week, season of year, etc., and what is the frequency of shipment?
- How are the hazardous materials shipped/received/carried (modes)?
- Over what transport routes are the hazardous materials carried?
- How much (number of shipments, volumes, etc.) hazardous material is shipped/received/carried?

> Communicating with facilities and carriers is one way of obtaining commodity flow information. Cambria County LEPC in Pennsylvania talks with local industry plant managers to verify the types of hazmat shipments identified through vehicle and placard counts. They use information provided by railroads to verify railcar and placard counts.

5.1.2 Interviews with Emergency Responders and Managers, and Other Key Informants

Emergency responders deal with hazards on a daily basis and are a valuable source of real-life information. Ultimately, they are among the primary beneficiaries of the HMCFS, but they may be skeptical about the value of the effort if they are not familiar with the concept. Including emergency responders on the interview team can go a long way toward enhancing the quality of information provided and understood by interviewers. Keep in mind that local jurisdictional and "turf" issues may also affect the type and amount of information that can be obtained in interviews. Buy-in and approval from senior agency officials may help encourage staff participation. Suggested interview discussion points for emergency management and response personnel, or other key informants, include the following:

- With which areas of the jurisdiction are you experienced?
- What have you observed regarding locations, times, methods, frequency, and content of hazmat transport?
- Are there corridors or network segments that seem to be a higher priority for understanding hazmat transport? If so, do you have suggestions for data collection locations and times?
- Are there particular locations that are a higher risk for truck incidents and accidents than others?
- Do you know of other individuals who should be contacted about hazmat transport in the jurisdiction?

5.2 Considerations for Field Data Collection

The bulk of the effort for the project team and project participants for most HMCFS projects will be the collection of new data about hazmat transport by roadways. This is because obtaining locally specific information about hazmat transport by roadway usually requires some form of traffic survey through human observation. Existing data sources provide information at state or national levels, and although many large metropolitan areas and states have implemented monitoring systems on key transportation routes, typically, the systems are not very useful for describing hazmat-specific transportation information. Also, vehicle-mounted sensor systems (e.g., RFID tags) for public monitoring of truck traffic and hazmat cargos are not on the immediate horizon.

This does not mean that truck traffic information that was collected using automated systems is not useful for an HMCFS. Truck traffic volume data can be used to identify locations where hazmat data collection may be focused or be used to validate manual count information. Information about daily and seasonal variations in truck traffic patterns also can be identified from data collected by automated traffic counter systems, and weigh-in-motion (WIM) data can be used to estimate proportions of empty versus loaded trucks. General and truck traffic levels can be used to identify locations and times where the driving population may be at greater risk for hazmat incidents, or where roadway congestion will present response challenges. These data are typically maintained by state transportation agencies. However, trends for overall truck traffic may not directly apply to hazmat truck traffic, especially where seasonal variations in hazmat production, processing, or consumption apply.

Considerations for Selecting Traffic Survey Locations

- The safety of data collection personnel and the driving public is paramount. Consider Incident Command System principles in planning to collect new data, as applicable.
- Data collection personnel require a clear view of the roadway section(s) for which they are to collect information. Visibility requirements for placard counts may be more restrictive given placard sizes.
- Intersections allow data collectors to identify the turning movements of vehicles, including the road that the vehicle is turning from and the road onto which the vehicle is turning.
- Parking lots of fueling stations, shopping centers, abandoned buildings, highway maintenance, and material storage lots, roadway turnouts, or drives in the public right of way can make good data collection locations. License and weight stations (when open) also can be good data collection locations.
- Nighttime counts require sufficient lighting to allow identification, vehicle type, placards, or other factors. Lighting also should provide sufficient driver visibility to assure safety of data collectors and the driving public.
- Dry grass, weeds, or other debris under running (or hot) vehicles can ignite fires.
- Selecting locations that do not impede or endanger the driving public or inconvenience property owners is essential. Permission for collection of data on private property should be obtained when necessary. Objections are rare when property owners understand the purpose and nature of the data collection, provided that business and personal activities are not impeded.
- Coordination with local emergency management and law enforcement is important to provide pubic legitimacy, promote participation, and enhance use of the results. Passers-by may report traffic observers as engaging in suspicious activities, especially around industrial facilities or military installations. A letter about the data collection effort from the LEPC or other local agency may be useful to help answer questions from law enforcement or security personnel who are following up on such reports.

Traffic surveys for an HMCFS involve collecting vehicle, placard, or shipping manifest information, or combinations of these tasks. The traffic observations are recorded and analyzed to describe hazmat flows, as discussed in Chapter 6. It is important that traffic surveyors be able to collect data safely, efficiently, and effectively.

5.2.1 Determining Count Intervals

Many LEPCs and other local entities use volunteers for HMCFS data collection. Time and schedule availability may be limited for volunteers, and data collection may be conducted during times of extreme temperatures—very cold or very hot—requiring data collection to be performed from the inside of vehicles. Attention and accuracy of data collection are limited to a few hours at a time per individual, maximum. Thus, there needs to be a balance between traffic count intervals that are optimal and those that are practical. Following are some recommendations for determining count intervals.

- Using count intervals in even fractions of an hour simplifies the extrapolation of counting segments into 1-hour periods; 1-hour counts are preferred, and 30-minute or 15-minute counts are secondary options.
- Conducting at least 30-minute or 1-hour counts reduces the effects of traffic variation while providing sufficient timeframes for recording traffic counts.
- Longer count durations are possible, but they should be recorded in separate 30-minute or 1-hour segments.
- Starting count intervals on the half-hour or hour can ease data analysis for differences in traffic patterns by time of day.

5.2.2 Training Data Collectors

Maintaining consistency and accuracy of collected data directly affects the validity of HMCFS conclusions. This can be particularly challenging when using volunteers who have a variety of educational training and occupational backgrounds. Key members of the project team should practice and be familiar with all types of data collection methods that will be used for the project—for example, vehicle counts, placard counts, interviews—before providing training to other project participants. Not only will this help identify data collection pitfalls, needs, and procedures, but it also can help validate that the data collection locations, information, and sampling/precision requirements are appropriate to meeting the project's objectives. After the key members of the project team understand the data collection process and requirements, they can provide training to other team members. Training can include the following, as applicable:

- Safety procedures, notifications, and scheduling/coordination of data collection;
- Methods for identifying vehicles;
- Methods for identifying placards;
- Procedures for recording data;
- Recommended locations for data collection;
- Recommended interview questions; and
- Other information relevant to the HMCFS project.

Training can be performed through presentations at general meetings, specific training meetings, individually, or in small groups. It also will be helpful to include "real-time" data collection exercises at the end of training sessions to provide trainees with an opportunity to work through the "nuts and bolts" of vehicle or placard observations and data recording procedures. It is important to remember that conducting traffic surveys can seem intimidating at first for many volunteers, but the process soon becomes much easier for data collectors as they gain experience. This can be facilitated by having data collectors work in pairs, especially in the initial stages of a data collection effort.

5.2.3 Scheduling Data Collection (Sampling)

Keeping in mind the physical and practical limitations of traffic data collection, the goal for surveying trucks or other vehicles is to collect information that is sufficient to identify the following:

- General traffic patterns and
- Differences in traffic patterns for different days and times, as required by objectives.

The LEPC in Polk County, Texas, used a focused data collection effort on two major highway corridors for their commodity flow study. Overall project direction was handled by the county's emergency management office. Data collection on one corridor was scheduled and coordinated by a volunteer fire chief. Data collection on another corridor was scheduled and coordinated by a pipeline company employee. Volunteers from three local volunteer fire departments, a local amateur radio club, a county commissioner, and a city mayor all participated. Truck and placard counts for each corridor were collected over a 1-month period, and all days of the week and times of day were covered.

The sampling framework used for data collection should be driven by the HMCFS objectives (discussed in Section 2.2), the type and level of traffic that is observed, and the need to identify differences in traffic patterns for different times of the day, different days of the week, from week to week, or month or season of the year. Obviously, a greater amount of good quality, well sampled data increases the potential reliability of hazmat and traffic flow descriptions. However, more data requires more time for collecting, processing, analyzing, and validating.

As with any study that involves sampling, there is a trade-off between data collection feasibility, efficiency, and the ideal. In many cases, the goal of an HMCFS may be to develop a general understanding of the characteristics of hazmat flow patterns. This often can be accomplished using low-level sampling frameworks and limited data. As the critical nature of HMCFS objectives increases, high-level sampling frameworks and more data may be required. Table 5-1 provides a summary of traffic sampling framework examples, as well as the advantages and disadvantages of each. Appendix D.2, Let HMCFS Objectives Guide Sampling,

Table 5-1. Sampling frameworks, examples, advantages, and disadvantages.

Sampling Framework	Sampling Examples	Advantages	Disadvantages
Convenience	As available for data collectors	Easiest for data collectors; minimum scheduling management	Difficult to reliably identify traffic patterns at any one location or timeframe
Representative	One location per major roadway, at different times of day on any given weekday, during any season	Easy to conduct over time for data collectors; moderate scheduling management; moderate degree of information about traffic patterns for roadway; low–to-moderate level of data collection resources required	Cannot be used to reliably characterize traffic on different segments of same road or other roads, determine seasonal traffic patterns, or transport patterns throughout a network
Cluster	Multiple locations per major roadway, at different times of day, on multiple days of week, during multiple seasons	High degree of information about traffic patterns throughout a transportation network	High degree of scheduling management; may require high level of time commitment from data collectors or other data collection resources
Stratified or Proportional	Dependent on traffic characteristics on given network segment; less data are required for low traffic volumes, and more data for high traffic volumes	Very high degree of information about traffic patterns throughout a transportation network; focuses effort on high-priority segments	Requires statistical calculations to determine sampling requirements; extremely high degree of scheduling management; may require high level of data collection resources
Random	At random times of day, days of week, seasons of year, for a specific network segment	Very high degree of information about traffic patterns on sampled network segment	Requires statistical calculations to determine sampling requirements; extremely high degree of schedule management; requires high level of data collection resources
Census	All traffic data for all times of day, days of week, and seasons of year, for specific network segment or entire network	Complete information about traffic patterns at sample locations	Nearly impossible to attain with current systems; requires an extreme degree of data reduction

For More Information About Sampling

Local entities that are concerned about sampling requirements are encouraged to

- Review Appendix C.2 and Appendix H. If you still have questions, seek the advice of a transportation planner, consultant, university faculty member, or other individual with training in statistical sampling and traffic analysis.
- Review other sources of information about traffic data collection and sampling, including
  - *Traffic Monitoring Guide* (*TMG*), U.S.DOT, Federal Highway Administration, Office of Highway Policy Administration, 2001. Available online at http://www.fhwa.dot.gov/ohim/tmguide/. Oriented to traffic data collection by state DOTs, it includes discussions about sampling considerations and truck data collection using FHWA's vehicle classification system.
  - *Introduction to Traffic Engineering: A Manual for Data Collection and Analysis,* Thomas R. Currin, Thomson Learning, 2001. An easy-to-use overview of different data collection techniques for various traffic studies, including data collection at intersections.
  - *Traffic Engineering Handbook, 6th Edition,* edited by Walter H. Kraft, Institute of Transportation Engineers, 2009. The primary reference for transportation engineering professionals. It includes chapters on traffic characteristics, sampling, and analysis.

suggests guidelines for matching HMCFS objectives with sampling frameworks. Appendix E contains additional information about data collection using the different sampling frameworks.

5.2.4 Determining Precision of Traffic and Hazmat Data

The precision of traffic and hazmat characterization data also determine what can be identified about hazmat flows in a community. Traffic information may include the following:

- Number of vehicles observed (e.g., trucks), discussed in Section 5.3.1.1;
- Types and configurations of vehicles observed (e.g., van versus flatbed trucks, straight trucks versus tractor-trailer trucks, etc.), discussed in Section 5.3.1.2;
- Types of hazmat placards observed, discussed in Section 5.3.2;
- Combinations of vehicle and hazmat placard observations, discussed in Section 5.3.3;
- Vehicle and/or hazmat placard observations on both roadway directions or at intersections at the same time, discussed in Section 5.3.4; or
- Number of containers or packages in a shipment—this can be considerably difficult for most truck traffic surveys to determine, except for shipping manifest surveys, discussed in Section 5.3.5.

Hazmat characterization information may include the following:

- Whether a vehicle is carrying hazmat over placarding threshold levels (e.g., whether a truck does/does not have a placard);
- Hazmat class or division (e.g., as indicated by type of placard);
- UN/NA placard ID number (e.g., as indicated on a placard or on the side of a tank); or
- Specific material/chemical information, which can be considerably difficult for most truck traffic surveys to determine, except for shipping manifest surveys.

Table 5-2. Traffic and hazmat placard survey methods.

Survey Method	Description	What It Provides	What It Requires
Total Truck Surveys	A count of the total number of observed trucks	Information about overall truck traffic levels during sampled time periods	Assumptions about hazmat transported on observed trucks (e.g., that hazmat transport conforms to national averages); assumptions about types and configurations of trucks used to transport hazmat
Truck Type and Configuration Surveys	A count of observed trucks by truck type and configuration	Information about truck traffic levels, by type and configuration, during sampled time periods	Assumptions about hazmat transported on observed trucks by type and configuration (e.g., that hazmat transport conforms with national averages)
UN/NA Placard ID Surveys	ID and count of observed hazmat placards	Information about the number and types of hazmat placards present during sampled time periods	Assumptions about truck traffic patterns and the types and configurations of trucks used to transport hazmat
Total Truck Combined with UN/NA Placard ID Surveys	A count of the total number of observed trucks and ID and count of observed hazmat placards	Information about overall truck traffic levels and the number and types of hazmat placards present during sampled time periods	Assumptions about types and configurations of trucks used to transport hazmat; data collectors who can record truck count information and placard information
Truck Type and Configuration Combined with UN/NA Placard ID Surveys	A count of observed trucks by truck type and configuration and ID and count of observed hazmat placards	Information about truck traffic levels by type and configuration and the number and types of hazmat placards present during sampled time periods	Data collectors who can record truck type and configuration and placard information; may require more training of volunteers on data collection process and monitoring of collected data to ensure consistency
Directional and Intersection Surveys	Observation of trucks and/or placards on multiple road directions or at intersections at the same time	Information for more than one roadway lane collected at a single location; may reduce number of data collectors needed	Experienced data collectors; more training of volunteers on data collection process, and monitoring of collected data to ensure consistency
Manifest Surveys	Review of information found on shipping papers and interviews of truck drivers	Highly specific information about hazmat shipment content for both placarded and unplacarded loads	Coordination with local, state, or federal license and weigh stations or patrol units; potentially, a very intensive data collection process for high-traffic roadways

Together, information about traffic levels and hazmat content will be used to develop an understanding about when, where, and how much hazmat is being transported in a jurisdiction, as discussed in Chapter 6. Appendix D.3, Let HMCFS Objectives Guide Precision, contains further information about matching HMCFS objectives with data precision requirements. Table 5-2 provides a summary of various traffic and hazmat content survey methods that can be used to obtain different levels of data precision and identify the commodity flows—quantities and characterization of transported hazmat.

5.3 Collect Field Data

The project team members and other project participants collect field data after sampling and precision levels have been determined, the survey method has been selected, survey locations have been identified, and data collectors have been trained. As discussed in the previous section, collection of most new HMCFS data will be through manual surveys of commercial truck traffic. Focusing the surveys on certain sizes of commercial vehicles—for example, DOT Class 3 trucks and above (over 10,000 lbs. gross vehicle weight)—helps the project team focus data collection on vehicles most likely to be transporting hazmat.

Appendix J.1 contains sample images of truck types and configurations, as well as placard configurations. It can be used as a "cheat sheet" for data collectors. The truck types and configuration examples are grouped in eight different categories ("A" for standard gas and liquid tanks through

"H" for other trucks). The truck type and configuration categories are the same as the VIUS categories identified in Appendix H. These groupings are useful because they differentiate between truck types and configurations that are more and less likely to be carrying hazmat. The placard identification examples are taken from the *2008 ERG* (*5*). The cheat sheet only provides truck and placard examples, and is not exhaustive of all truck types and placards. See Appendix H and the *2008 ERG* for more information about the truck and placard types included in each category.

Several different truck or hazmat placard surveys are described in this section, ranging from simple truck counts to complex truck type and configuration and placard ID counts at intersections. The selection of a particular survey method will depend on the following:

- Level of information needed to support HMCFS objectives;
- Local conditions (e.g., visibility);
- Traffic levels;
- Available data collection resources (e.g., number of data collectors);
- Ability of data collectors; and
- Assumptions that the project team is willing to make about truck or hazmat traffic patterns.

Traffic survey information may be recorded using a variety of mechanisms, but a simple clipboard with tabulation sheets should work effectively for most applications. The tabulation sheets should include the following information:

- Location and direction of roadway,
- Date and day of week,
- Time period (start and end),
- Data collector name(s),
- Weather conditions,
- Page numbers (if multiple pages used for same location/date/time period),
- A location for notes or comments about data collection, and
- Vehicle count information.

Accurate documentation is key to data usability. Complete and accurate documentation may be highly variable when multiple data collectors participate in the project. The project team should be sure that each data collection record is properly completed and documented, especially for location and direction, date and day of week, and time period fields. This information also can be used to help track volunteer effort expended (remember that travel time and mileage to and from data collection locations can be additional when used for in-kind match). Data collection sheets are provided in Appendix J for each survey type, which are discussed in the following sections. Application of survey data for identifying hazmat flows is summarized in Table 5-2, and use of survey data for estimating hazmat flows is described in Appendix K. The project team should review these sections before selecting a commercial vehicle survey method for the HMCFS.

5.3.1 Commercial Vehicle Surveys

5.3.1.1 Total Truck Surveys

Surveys of the total number of commercial vehicles (trucks) are usually very easy for data collectors to conduct: they simply count the number of commercial vehicles that are observed at individual locations during a specified timeframe, and make a "tally mark" (in sets of five) on a data sheet for each count. A blank total truck count sheet and a completed example sheet are provided in Appendix J.2. The sheet provides for seven different truck count periods. If additional space is needed for each time period, simply continue on the next line or next page, making sure to note that the time periods are the same. Remember that using these data will require assumptions about the types and percentage of vehicles carrying hazardous materials—for example, that national-level percentages of hazmat transport by truck apply to the location. Use of these data for estimating commodity flows is discussed in Appendix K.4.

5.3.1.2 Truck Type and Configuration Surveys

Other information about types of commercial vehicles can be collected in addition to total vehicle counts. Most DOT vehicle classification counts by automated systems use FHWA's designation of vehicle class by tonnage and number of axles per vehicle. This type of information is not very useful for hazmat classifications. Rather, trucks can be classified according to cargo body types and configurations as discussed above. These counts will allow national averages for hazmat transportation, by hazmat class and division, to be applied for each truck type and configuration, rather than a national average for all trucks regardless of type and configuration. This also may serve as a basis for identifying future changes in truck traffic patterns in the jurisdiction, and may provide information useful for other local planning applications (i.e., transportation planning)—for example, some truck types are more frequently heavier or overloaded than others, which affects roadway infrastructure maintenance cycles.

Appendix H shows how the 2002 VIUS data were evaluated for truck cargo body types and configurations relative to hazmat transportation. A blank sample truck type and configuration count sheet corresponding to the VIUS categories and a completed example sheet are provided in Appendix J.3. A different sheet should be used for each count period. Remember that using these data will require assumptions about the percentage of vehicles that are carrying hazardous materials, for example, that national-level percentages of hazmat transport by truck type and configuration apply to the location. Use of these data for estimating commodity flows is discussed in Appendix K.5.

5.3.2 UN/NA Placard ID Surveys

A count of hazmat placards provides better information about the types of hazmat transported in an area than simply counting trucks and assuming that a certain percentage of them carries hazardous materials.

The goals of a placard count are as follows:

- To identify whether a vehicle is placarded or has a UN/NA placard ID;
- To identify the class/division of the transported material(s), which is indicated by color and pattern of placard (see Appendix A); and
- To identify information—words or numbers—written on the placard (see Appendix B). Additional markings may be present on the vehicle/vessel, for example, an orange UN number on ISO tanks and some tank trailers, or "Marine Pollutant." Some vehicles do not have a hazmat class/division or 4-digit placard ID, but use a "Dangerous" placard for when they are transporting combinations of hazardous materials above threshold quantities.

The data collection procedure for UN/NA placard ID counts is similar to the procedure for truck counts, except that instead of counting trucks, the placard information is recorded. Because placarded trucks only make up around 4 to 5 percent of commercial trucks, on average, this may result in relatively low placard counts for many locations and time intervals. A blank placard count sheet and a completed example sheet are provided in Appendix J.4. Multiple placards on the same truck should be circled to differentiate between all placards observed and the number of placarded trucks observed. The sample sheet provides for seven different truck count periods.

Remember that this type of data count will not provide information about the types and configurations of trucks carrying the hazardous materials or traffic levels, so it has limited applicability for some HMCFS objectives (for example, maximum scenario definitions). It is also important

Things to Keep in Mind for Conducting Placard Surveys

Placard surveys require observation of placarded vehicles as they pass by data collection locations. Good visibility of the observed traffic lanes is required, and an experienced data collector who is using binoculars is beneficial. Although this counting technique results in direct information about the hazmat transportation patterns in an area, it is more specific and difficult to conduct than truck type counts for the following reasons:

- Placards are less than 1 square foot in size, and placard numbers are 3.5 inches tall.
- Although vehicles are required to display placards on front, side, and back of the transported unit, the placement of the placards is not the same for each vehicle.
- High speeds and congested traffic can make it difficult for even experienced observers to identify every placard, especially when placards are obscured by other vehicles.

to remember that vehicles carrying less-than-placard-threshold levels can still be carrying hazardous materials, so a count of placarded vehicles will not yield a complete picture of hazmat transport. Use of placard count data combined with truck count data for estimating commodity flows is discussed in Appendix K.6. Use of placard ID data for estimating commodity flows is discussed in Appendix K.7.

5.3.3 Combined Commercial Vehicle and UN/NA Placard ID Surveys

5.3.3.1 Total Truck and UN/NA Placard ID Surveys

A more intensive data collection technique is to combine truck counts with UN/NA placard ID counts. Observations of placards and trucks are recorded for the same locations and times. This allows for both identification of the percentage of placarded trucks for the time period, and identification of the hazmat placards. A blank sample truck and placard ID count sheet and a completed example sheet are provided in Appendix J.5. Multiple placards on the same truck should be circled to differentiate between all placards observed and the number of placarded trucks observed. The sample sheet provides for four different truck/placard count periods.

Remember that this type of data count will not provide information about the types and configurations of trucks carrying the hazardous materials or traffic levels, so it has limited applicability for some HMCFS objectives (for example, maximum scenario definitions). It is also important to remember that vehicles carrying less-than-placard-threshold levels can still be carrying hazardous materials, so a count of placarded vehicles will not yield a complete picture of hazmat transport. Use of these data for estimating commodity flows is discussed in Appendix K.8.

5.3.3.2 Truck Type and Configuration and UN/NA Placard ID Surveys

A combined count of truck type and configuration and hazmat placard IDs increases the complexity of the data count. These counts can be used to identify overall truck traffic levels, proportions of truck traffic by type and configuration and the percentages of placarded trucks for each category, and identification of the hazmat placards. This information also can be used for rough estimates of relative quantities (small, medium, or large amounts) of transported hazardous materials—for example, depending on their configurations, a straight tank truck may have a capacity of around 3,000 gallons while a tractor-trailer tank truck may have a capacity of around

9,000 gallons. Also keep in mind that many tank trailers with placards on them are empty and either cleaned or—more likely—contain residual product.

A blank truck type and configuration and placard ID count sheet and a completed example sheet are provided in Appendix J.6. Multiple placards on the same truck should be circled to differentiate between all placards observed and the number of placarded trucks observed. Separate count sheets should be used for each period. The spacing provided in rows for different truck type/configurations should accommodate either the number of tally marks for trucks or identification of hazmat placards for most roadways for a 30-minute count. Multiple sheets may be used if needed during the same time period, noting the multiple page numbers for the same time period.

Use of these data for estimating commodity flows is discussed in Appendix K.9. As with other counts of placard ID information, it is important to remember that vehicles carrying less-than-placard-threshold levels still can be carrying hazardous materials, so a count of placarded vehicles will not yield a complete picture of hazmat transport. Although collection of combined truck and placard data is manageable for a single data collector for roads with low traffic volumes, it can be particularly challenging for high-traffic-volume locations. For these locations, it is almost essential to have data collectors working in pairs.

5.3.4 Directional and Intersection Surveys

The truck and placard ID traffic survey examples provided in Sections 5.3.2 and 5.3.3 assume that data are collected for only one direction of a single roadway per time period. Another level of complexity is for recording traffic data for both roadway directions, and/or at a three-way or four-way roadway intersection. For example, rather than having eight data collection locations for a four-way intersection (one for each direction of each roadway segment), the information can be collected at a single location. Potentially, this can reduce the number of data collectors needed, but it also can be a very intensive effort for busy roadways or intersections, and is best accomplished using experienced data collectors.

A blank sample data sheet is provided in Appendix J.7 that can be used for collecting truck type and configuration (corresponding to the VIUS categories) and placard ID information for both directions of a roadway, or at an intersection. Each data sheet provides for recording information for up to 25 trucks. For each truck, the truck type, configuration, placard ID, and directional information (as applicable) are recorded by circling the corresponding categories. Each truck type category is listed for groups “A” through “H” as shown on the example sheet provided in Appendix J.1. Truck configurations are shown for straight trucks (ST), tractor-trailers or straight trucks with a trailer (TT), and tractor with multi-trailer (MT) configurations. Placard categories are provided for the nine hazmat classes along with a tenth category for other placards, e.g., “Dangerous,” “Marine Pollutant,” etc., and there is space for recording more specific placard information such as numbers or words. “Un” is used to identify “unknown” or “uncertain” information for all categories.

The sheet also allows for identification of directional movements for both directions of a roadway or for turning movements at intersections. If recording both directions of a single roadway (and not at an intersection), the data collector can indicate the direction of travel for each truck (e.g., “NB” for northbound trucks, or “SB” for southbound trucks). This can be done using either the “Approaching On” or “Departing On” columns—although both columns are marked in the example sheet, using both columns is not absolutely necessary for single-direction truck traffic surveys since the directions are the same for an individual truck. (That is, in single-direction surveys, all northbound trucks continue northbound. In this case it would be possible to use only one column to indicate direction.)

If recording data at intersections, the data collector indicates the direction that the truck was travelling when it approached the intersection and the direction a truck was travelling after it turned (departed the intersection). For example, a truck approaching northbound toward an intersection would be indicated as NB in the Approaching On column, and if it turns eastbound at the intersection would be indicated as EB in the Departing On column. For roads and intersections that do not correspond directly to north, south, east, and west, the data collector may have to adopt these directions as frames of reference, and be sure to note which direction corresponds to which roadway segment, etc.

Since each count sheet provides for collection of data from only 25 trucks, it is likely that many data sheets will be needed for a single count period on a busy roadway or intersection. This type of data collection effort, data processing (tabulation), and analysis can be intensive. For additional information about collecting, processing, and analysis of intersection data, see the sources provided earlier in this chapter in the example titled "For More Information about Sampling," or seek assistance from a transportation engineering or planning professional. These sources may also provide examples of alternate directional or intersection traffic survey data collection sheet configurations. Analysis of these data will be similar to data analyzed in Appendix K.4 through K.9, depending on the type of data that were collected.

5.3.5 Shipping Manifest Surveys

Shipping manifest surveys can fill an important information gap for hazmat traffic flows since they can be used to identify hazmat shipments in both placarded and unplacarded vehicles, shipment sizes and packing methods, specific materials, and shipment origin and destination (which can yield information about how the vehicle will travel through a jurisdiction). Unfortunately, shipping manifest surveys also can be the most labor-intensive manual hazmat traffic survey to conduct.

In this method, access to trucking shipping manifests is obtained by working with license and weight bureaus of authorized local and state police services, or similar vehicle inspection authorities. Shipping manifests are reviewed as part of the inspection process, and truck drivers may be interviewed regarding their most likely route. Shipping paper information of interest from the *2008 ERG* (*5*) is shown in Appendix B, but it should be noted that information formatting and location on shipping papers is widely variable.

DOE has conducted shipping manifest studies for 24-hour continuous counts at license and weigh stations in cooperation with state enforcement agencies. Information collected includes the following:

- Time of day,
- Shipment origin/destination,
- Truck type,
- Placard class/division and UN/NA ID,
- Material description, and
- Shipment weight.

Additional information from driver interviews also may be recorded. Depending on the information desired, a table or chart can be used for multiple truck manifests, or a single page or a notebook may be used for each truck or manifest record.

5.4 Validate New Data

The new data are validated as they are collected and compiled by the project team. Validation helps ensure that the collected new data meet the data requirements of the HMCFS objectives. This can be done in advance of the actual data analysis. For example, users might ask themselves, does precision of collected data match data requirements? What other information might help meet the HMCFS objective data requirements? Addressing the following additional concerns helps the project team underscore the validity of the HMCFS data:

- Are data appropriately documented?
- Are there data outliers or questionable values?
- Are data collected at similar locations consistent?
- Is information consistent across different sources (existing and new data from interviews, databases, surveys, etc.)?

Hopefully, an HMCFS project has many different participants. However, a commonly contributing factor to data validity problems is the fact that the data are collected by people. This is an inherent source of error in every project using human data collectors, and it is impossible to avoid. Data validity concerns identified by the project team early in the data collection phase can be addressed much more easily than at the end of data collection. The project team may wish to review the data collection procedures with volunteers, make sure that new data collection locations enable accurate and efficient data collection, and review the data collection sampling and precision frameworks versus the data requirements. Remember that at least some variation in traffic should be expected and may be substantial for certain locations. Further validation of the data will take place as data are analyzed. Analysis of HMCFS data is described in Chapter 6.

CHAPTER 6

Analyze and Document Data

After the project team collects existing and new HMCFS data, it analyzes the data and documents the commodity flows. A flow chart of the HMCFS process focusing on data analysis and documentation is shown in Figure 6-1. Analyses of HMCFS commodity flow data can be straightforward or complex, depending on the existing or new data sources used and the amount of manipulation or cross-referencing required.

1. The simplest analyses will involve reviewing existing local, state, or national estimates for commodity flows (assuming those apply to the location of interest) and developing a listing of hazardous materials expected in a community by class, division, UN/NA placard ID number, or specific commodity.
2. Analysis complexity increases as more locally relevant data are used (e.g., vehicle and/or placard counts).
3. For most local entities, the most complex HMCFS data analyses will identify differences in commodity flows spatially (e.g., different network segments, intersections, etc.), temporally (time of day, day of week, season of year, etc.), or some type of spatial–temporal combination (e.g., "hotspots").
4. For most LEPCs, shipping manifest data would be used on a limited basis to provide an indication of where hazardous material is going on major roadway networks, as well as amounts and types of non-placarded hazardous material being transported. Modeling of network flows using shipment origin–destination (O/D) data from shipping manifests is typically performed by transportation specialists in large metropolitan planning offices, state agencies, universities, or consulting firms. This type of analysis is much more specialized than most local entities are equipped to handle.

Although analyses of some existing data might not require any data manipulation, a more complex analysis involving other existing or new data sources will require computing resources and personnel that are skilled in data management and validation, spreadsheet creation and charting, mapping, and even statistical analysis.

6.1 Railway, Pipeline, Waterway, and Airway Data Analysis

Generally, analyzing HMCFS information for railways, pipelines, and waterways is straightforward.

- Most data come from existing, previously compiled data sources.
- The existing flow information is based on a census of all hazmat traffic in the case of railways and waterways, and assumed to be continuous in the case of pipelines.

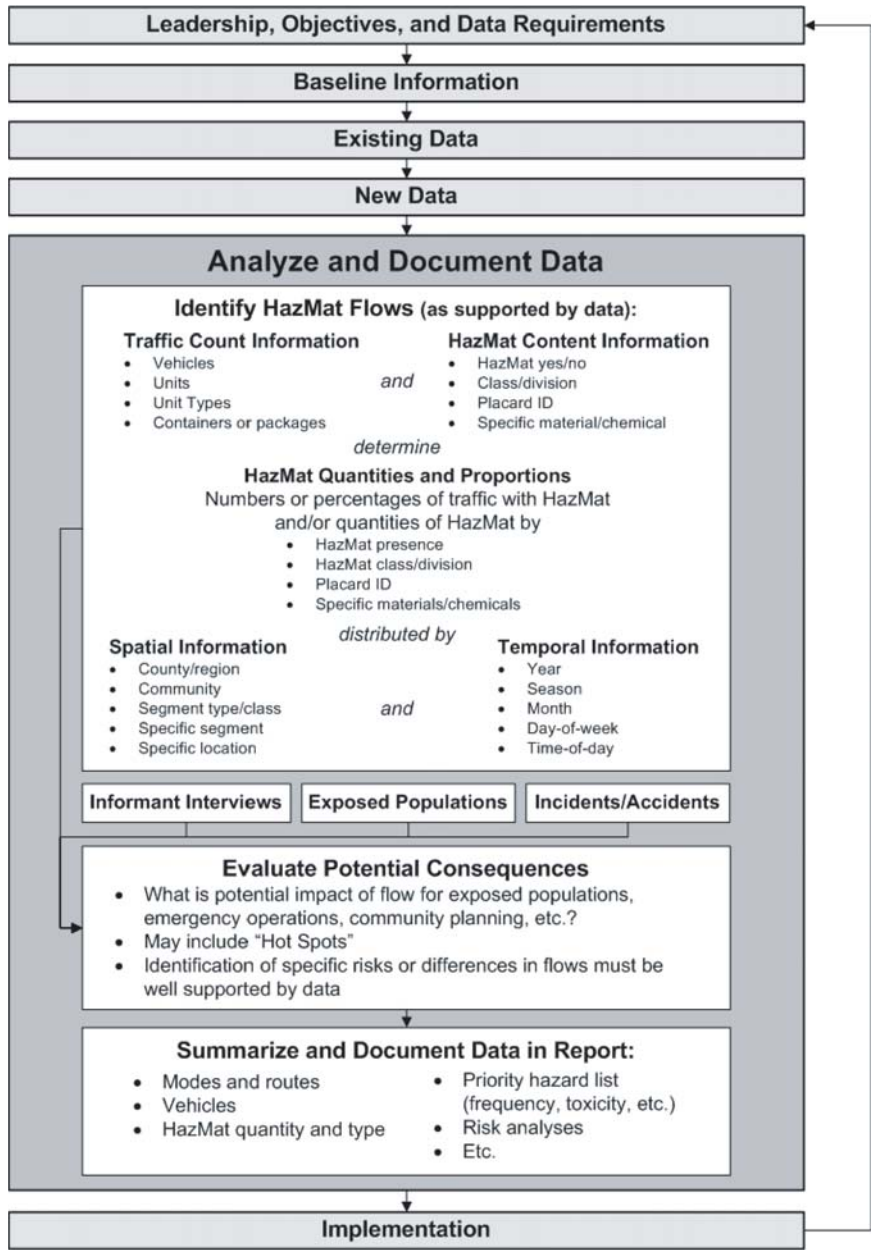

Figure 6-1. The HMCFS analysis and documentation process.

- Typically, there is no need to deal with sampling limitations, except, for example, if the STB Railway Sample Data are used, existing information is provided by shippers, receivers, and carriers, or new data are collected using some type of sampling to identify daily, weekly, or seasonal patterns in rail traffic.

It is likely that locally relevant existing flow information for airways will be unavailable if it is not provided by air carriers serving the jurisdiction, and the BTS Commodity Flow Survey represents the only other major source of publicly available data on hazmat transport by air.

Table 6-1 lists hazmat flow data characteristics for railway, pipeline, waterway, and airway modes. Table 6-2 lists hazmat flow data analysis output characteristics by data source for these modes, the maximum level of HMCFS objective for which they are typically applicable, their general relevance to a local HMCFS, and a rating indicating the expected effort required for analysis.

Table 6-1. Hazmat flow data characteristics, by source, for railway, pipeline, waterway, and airway transport modes.

Trans. Mode	Hazmat Commodity Flow Data Source	Hazmat Commodity Flow Data Characteristics				
		Spatial Applicability	Temporal Framework	Metrics/ Units	Material Description	Sampling Framework
Railway, Pipeline, Waterway, Airway	BTS Commodity Flow Survey	State/national	Annual, every 5 years	Value, tons, and ton-miles	Variable, includes overall hazmat, class/division, and UN/NA ID	Stratified (national)
Railway, Pipeline, Waterway, Airway	FHWA Freight Analysis Framework	State/national	Annual	Value and tons	SCTG	Variable
Railway	STB Carload Waybill Sample data	Regional/state (assume routes)	Shipment date	No. of tons or carloads	Specific commodity	Stratified (national)
Railway	Railroad carrier information	Local network	As provided (annual)	No. of carloads	As provided (class, specific commodity?)	Census (for hazmat)
Pipeline	PHMSA National Pipeline Mapping System	Local network	Assumed continuous	Assumed continuous	Crude, nat'l. gas, petrol. prods., etc.	Assumed continuous
Waterway	USACE reports	Local network	Annual	No. of tons	Commodity groups	Census
Waterway	USACE reports with commodity code/ placard ID cross reference	Local network	Annual	No. of tons	Commodity groups w/assoc. UN/NA IDs	Census
Waterway	USACE reports with carrier, facility info	Local network	As provided (seasonal or monthly?)	No. of tons or shipments	As provided (spec. commod.?)	Census

6.2 Truck/Roadway Data Analysis

The project team has many approaches for analysis of existing and new roadway data, depending on the type of information collected. Examples of these approaches are summarized in Tables 6-3 and 6-4. Table 6-3 lists hazmat flow characteristics and Table 6-4 lists hazmat flow data analysis output characteristics for these examples. Table 6-4 also lists the level of HMCFS objective to which these approaches correspond. Analysis of hazmat flows corresponding to many of the examples listed in Tables 6-3 and 6-4 are discussed in Appendix K. Note that specific applications, relevance, and effort required may not conform to these example summaries. They are not exhaustive of all potential analysis possibilities using the existing or new data sources discussed in Chapters 4 and 5.

6.3 Document the Data

After analyzing the existing and new HMCFS data, the project team prepares, summarizes, and documents the HMCFS data for presentation to the core team. Remember that the purpose of the HMCFS process is to enhance a local jurisdiction's ability to estimate or quantify the risks

Table 6-2. Hazmat flow data output, applicability, relevance, and analysis effort required, by source, for railway, pipeline, waterway, and airway transport modes.

Trans. Mode	Hazmat Commodity Flow Data Source	Hazmat Commodity Flow Data Analysis Output Characteristics	Max. Appl. Level	Local HMCFS Relevance	Required Analysis Effort
Railway, Pipeline, Waterway, Airway	BTS Commodity Flow Survey	Lists, tables, or spreadsheets of flow information, may be displayed using charts; source of data for other federal freight data publications	Minimum Scenario	Low	Low
Railway, Pipeline, Waterway, Airway	FHWA Freight Analysis Framework	Lists, tables, spreadsheets, or maps of flow information, may be displayed using charts; data sourced from other federal freight data publications	Minimum Scenario	Low	High
Railway	STB Carload Waybill Sample data	Lists, tables, or spreadsheets of estimated commodity flows over rail lines in region	Equipment Needs	Low–Medium	High
Railway	Railroad carrier information	Lists, tables, spreadsheets, or maps of commodity flows over rail lines, as available	Comprehensive Planning	Medium–High	Medium
Pipeline	NPMS data	Tables or maps of pipeline types and locations	Comprehensive Planning	Medium	Low
Waterway	USACE reports	Tables or spreadsheets of commodity group flows	Maximum Scenario	Low	Low
Waterway	USACE reports with commod. code/placard ID cross reference	Tables or spreadsheets of commodity group flows with associated placard IDs	Emerg. Planning	Medium	Medium
Waterway	USACE reports with carrier, facility info	Tables, spreadsheets, or maps of specific commodity or commodity group flows in waterways, along with associated placard IDs, as available	Comprehensive Planning	Low–High	Medium–High

that are present associated with the flow of hazardous material into, out of, within, and through an area. This ability depends on the following three critical components:

1. Identifying where, when, and how hazardous material is transported;
2. Identifying what is transported (type of hazardous material and associated characteristics); and
3. Determining the consequences associated with incident occurrence (incident likelihood and who may be impacted).

6.3.1 Identifying Hazmat Flows

With a wide range of data sources and HMCFS objectives, the project team's potential options for identifying hazmat flows range considerably. Generally, the flow information is used to assess risks, and provides context for the decisions associated with the HMCFS project's objectives and emergency planning and response. Flow estimates might use only existing data, a mix of existing and new data, or all new data. The sampling and precision of the source data determines the specificity of information that can be concluded about hazmat transport. Examples of how hazmat flows can be analyzed and documented are provided in Appendix K.

6.3.2 Risk Estimation

Procedures for conducting risk assessment calculations are well established and depend on specific characteristics of the local setting, commodities that are transported, and modes of trans-

Table 6-3. Hazmat flow data characteristics, by source, for truck/roadway transport mode.

Hazmat Commodity Flow Data Source	Hazmat Flow Data Characteristics				
	Spatial Applicability	Temporal Framework	Metrics/ Units	Material Description	Sampling Framework
CFS	State/national	Every 5 years	Value, tons, and ton-miles	Includes overall hazmat, class/division, and UN/NA ID	Stratified (national)
FAF	Entire county or state	Annual	Estimated value and tons	Commodity groups	Stratified (national)
HPMS data w/VIUS data	Local network	Annual	Estimated total and hazmat trucks	Must apply VIUS data for hazmat classes	Unknown
Truck count w/VIUS data	Local network, as collected	As collected	Total trucks, estimated hazmat trucks	Must apply VIUS data for hazmat classes	Stratified (national)
Truck type count w/VIUS data	Local network, as collected	As collected	Total trucks, trucks by type/configuration, estimated hazmat trucks	Must apply VIUS data for hazmat classes, by truck type	Stratified (national)
Placard count w/truck count	Local network, as collected	As collected	Total trucks, percent trucks with placard	None	As sampled
Placard ID count	Local network, as collected	As collected	Number and type of placards	Specific placard ID	As sampled
Truck count w/ placard ID count	Local network, as collected	As collected	Total trucks, percent trucks with and without placard, number and type of placards	Specific placard ID	As sampled
Truck type and configuration count w/placard ID count	Local network, as collected	As collected	Total trucks, trucks by type/configuration, percent trucks with placard by type and configuration, number and type of placards	Specific placard ID	As sampled
Truck/ Roadway	Interviews with carriers, shippers, receivers	As provided	As provided (seasonal or monthly?)	As provided	As provided
Truck/ Roadway	Manifest surveys	As collected	Shipment volume/weight	Specific commodity name	As sampled

port. Risk estimation is especially applicable for designation of hazmat route analysis but can also be useful for other HMCFS objectives.

When based on sufficient existing or new data, hazmat flows can be characterized by commodity movements (e.g., tons, carloads, or number of vehicle/placard observations) on a spatial (e.g., each route or route segment) and temporal (e.g., daily, monthly, annually, etc.) basis. Risk is identified by combining the commodity flow information with historical incident/accident information to identify potential impacts on populations or environmentally sensitive areas. It is important to remember that such estimates can be highly inaccurate when low-level sampling techniques or small sample sizes are used, or the data are imprecise. Some suggested sources for further information on hazmat transport risk analysis are as follows:

- *Highway Routing of Hazardous Materials: Guidelines for Applying Criteria* (13).
- *Guidelines for Chemical Transportation Risk Analysis* (26).

6.3.3 Spatial Elements of Risk Estimation

A focus on the routes or segments with hazmat flows that contribute most significantly to the overall risk in the study area can provide insight into better management techniques and even risk mitigation. Considerations for spatial analyses of hazmat transport and risk estimation include the following:

- Routes or route segments contribute significantly to risk when they are characterized by high frequency of hazmat flows.

EPA's ALOHA software and the *Emergency Response Guidebook* (available from PHMSA) were used to determine potential hazmat incident impact radii and identify high risk areas along major transport corridors in Arizona. High risk and environmentally sensitive hotspots were identified on maps.

Table 6-4. Hazmat flow data output, applicability, relevance, and analysis effort required, by source, for truck/roadway transport mode.

Hazmat Commodity Flow Data Source	Hazmat Commodity Flow Data Analysis Output Characteristics	Maximum Objective Level	Local HMCFS Relevance	Required Effort
CFS	Lists, tables, or spreadsheets of flow information, may be displayed using charts; source of data for other federal freight data publications	Minimum Scenario	Low	Low
FAF	Lists or tables of commodity groups for county	Minimum Scenario	Low	High
HPMS data with VIUS data	Lists or tables of commodity classes expected to be present in community; chart of truck traffic patterns as supported by data	Minimum Scenario	Low	Low
Truck count with VIUS data	Lists or tables of commodity classes expected to be present in community; chart of truck traffic patterns as supported by data	Minimum Scenario	Low	Low–Medium
Truck type count with VIUS data	Lists or tables of commodity classes expected to be present in community; chart of truck traffic patterns as supported by data	Minimum Scenario	Low–Medium	Medium
Placard count with truck count	Lists or tables of hazmat presence or absence at surveyed locations (percent trucks with hazmat placard); chart of truck traffic patterns as supported by data	Minimum Scenario	Low–Medium	Low–Medium
Placard ID count	Lists, tables, or charts of placard IDs observed by road network segment and/or time	Resource Scheduling	Medium–High	Medium–High
Truck count with placard ID count	Lists, tables, charts, or maps of placard IDs observed by road network segment and/or time; proportion of truck traffic with placard; chart of truck traffic patterns as supported by data	Route Designation	High	Medium–High
Truck type and configuration count with placard ID count	Lists, tables, charts, or maps of placard IDs observed by road network segment and/or time; proportion of truck traffic with placard, by truck type; chart of truck traffic patterns as supported by data	Route Designation	High	High
Interviews with carriers, shippers, receivers	Lists, tables, charts, or maps of specific commodity carried, by road network, as supported by data	Legal Takings	High	High
Manifest surveys	Lists, tables, charts, or maps of specific commodity carried, including quantity, road network, and truck type, as supported by data	Legal Takings	High	High

- Routes or route segments that frequently exceed capacity, are narrow or winding, are frequently under construction, have (draw) bridges, tunnels, or other bottlenecks are often characterized by high accident rates and become priorities for more extensive analysis.
- Routes or route segments with special populations located nearby—such as schools, hospitals or nursing homes—also receive high priority.
- Routes or route segments with truck stops, weigh stations, rest stops, and siding-tracks may receive attention because of the associated delays along the route, increasing the duration that transported hazardous materials are present.

6.3.4 Temporal Elements of Risk Estimation

As supported by the data, the HMCFS should consider the temporal patterns of hazmat transport by time of day, day of the week, or season of the year. Considerations for temporal analyses of hazmat transport and risk estimation include the following:

- Metropolitan and large urban areas usually exhibit daily traffic patterns that can have a significant impact on hazmat flows and thus need to be considered.

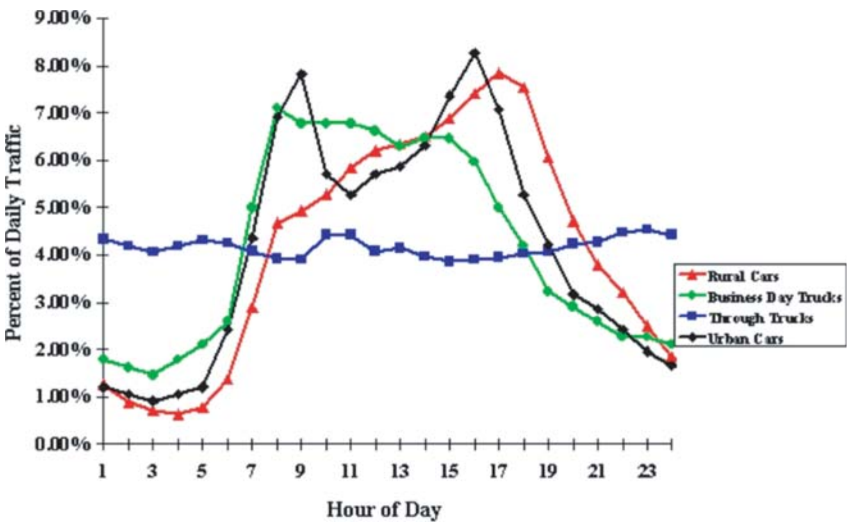

Figure 6-2. Variation in traffic patterns by time of day.
Source: FHWA *Traffic Monitoring Guide* (*14*), Figure 2-2-1.

- Daily variations in overall traffic patterns and flows may arise due to shift changes, commutes to work, and school hours.
- Communities that lack major through-routes will typically have substantially less traffic during the dead-of-night hours than during daylight hours.
- When compared with daylight-hour traffic, communities with major through-routes may see only a moderate reduction in traffic on these routes during the dead-of-night hours.
- Nearly all communities in the United States exhibit weekly traffic patterns, with weekdays and weekends exhibiting marked differences.
- Many areas experience seasonal variations in traffic associated with the economic activity of the area (e.g., agricultural areas have planting and harvesting seasons, petroleum refining areas have seasonal production patterns, etc.).

Figure 6-2 illustrates variations in traffic patterns as a percentage of daily traffic by time of day, taken from FHWA's *Traffic Monitoring Guide* (*14*). This figure illustrates differences between rural and urban cars, business day trucks, and through trucks on an example highway where each curve represents 100 percent of traffic for each vehicle category (i.e., just over 4 percent of through truck traffic per time period times 24 hours equals 100 percent). A jurisdiction's traffic flows may show very different patterns, especially across roadway types (highways, arterials, secondary roads, etc.)

6.3.5 Hazmat Incident/Accident Likelihoods

Careful examination of local incident/accident history can help inform emergency response staffing, scheduling, and resource allocation decisions. If incident or accident data and traffic volume data are available, the likelihood of a hazmat accident is determined by multiplying the accident rate by the volume of hazmat traffic. Areas that have not experienced prior incidents can estimate incident likelihood based on state, regional, or national averages.

Figure 6-3 provides an example of how incident or accident data may be analyzed, applied to hourly frequencies of serious in-transit hazmat highway incidents reported to PHMSA between 2002 and 2008 across the United States. Two patterns are readily apparent in these data. First, the weekend–weekday difference indicates that weekends have lower accident rates—beginning around 4 A.M. on Saturday morning and continuing through to Monday morning rush hour at around 5 A.M. Secondly, the weekday pattern is relatively stable across days of the week—characterized by a

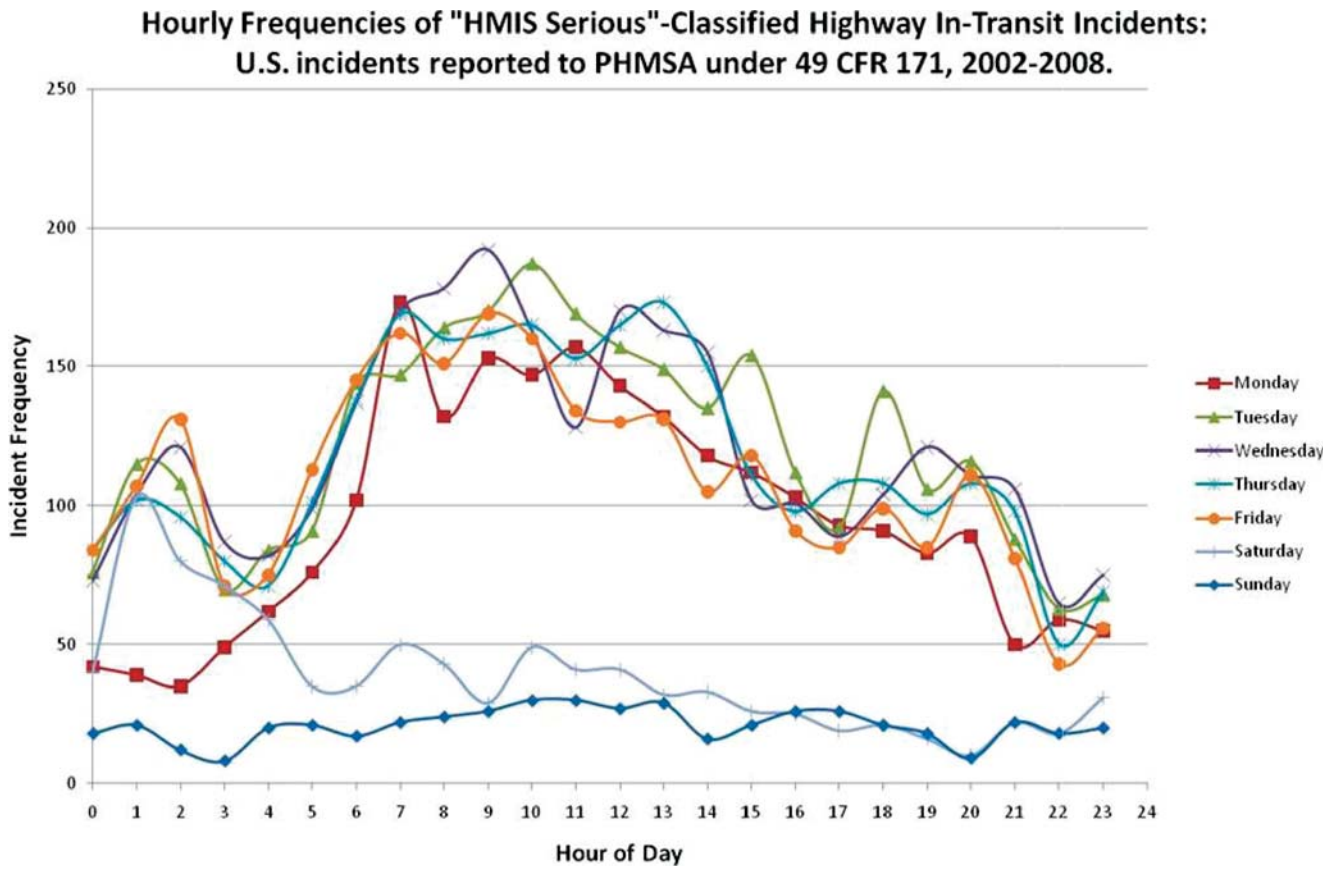

Figure 6-3. Hourly frequencies of highway in-transit incidents classified as "HMIS Serious."
Source: Texas Transportation Institute (using HMIS microdata).

slight increase in the early morning hours (i.e., right after midnight and declining after 3 or 4 A.M.), then increasing into the early hours of the workday (i.e., reaching a peak around 8 to 10 A.M.), and declining throughout the rest of the day (i.e., reaching low levels again around 10 or 11 P.M.).

Local patterns may differ from these national trends, and apparent differences should be understood in light of local conditions. Jurisdictions with access to local accident information may be able to develop similar charts, whether for incidents involving hazardous materials, all truck accidents, or traffic accidents in the entire driving population. Note that patterns of truck traffic accidents may not directly compare with those of general traffic accidents, with truck accidents tending to be higher in the early daytime hours, and general traffic accidents higher later in the day. Unique spikes or dips that are not related to specific local conditions may require further validation. Interviews with key informants, such as emergency managers and responders, will be useful to the validation process.

6.3.6 Properties of Hazardous Materials

Identifying every single hazardous material likely to be transported through an area is extremely difficult—especially when the nature of the hazmat flows in the area are complex and variable. Some jurisdictions find it advisable to concentrate on general classes of materials (e.g., flammables, corrosives) being transported. When detailed data (i.e., UN/NA placard IDs) are available, they can be used to identify implications of various types of incidents in terms of their potential consequences.

Identifying Hazards and Initial Response Guidelines

Commodity information may be used to identify potential hazard zones around routes or route segments in the study area. For example

1) Nearly all communities have flows of fuels, including UN/NA placard ID number 1203 (i.e., gasohol, gasoline, or motor spirits) among others.
   - The *2008 ERG* indicates that this material is highly flammable and will ignite easily by heat, sparks, or flames, and may form explosive vapors when mixed with air.
   - The potential for irritation of the skin and eyes if inhaled or contacted are included among the health impacts.
   - Procedures outlined in the *2008 ERG* (Guide Number 128) indicate immediate isolation of the spill or leak to a distance of 50 meters, with downwind evacuation for large spills of at least 300 meters, and up to 800 meters in all directions if the tank (car or truck) is involved in fire.
2) Many communities have flows of anhydrous ammonia (UN/NA placard ID 1005, *ERG* Guide Number 125) and chlorine (UN/NA placard ID 1017, *ERG* Guide Number 124).
   - The *2008 ERG* suggests initial isolation of 30 and 60 meters for small spills of ammonia and chlorine, respectively, with daytime downwind evacuations of 0.1 and 0.2 km, respectively. Small nighttime spills increase the recommended evacuation distances to 0.2 and 1.6 km, respectively.
   - The *2008 ERG* suggests isolation of 150 and 600 meters for large spills of ammonia and chlorine, respectively, and downwind daytime evacuation zones of 0.8 and 3.5 km, respectively. Nighttime distances expand to 2.3 and 8.0 km for large spills of ammonia and chlorine, respectively.

Considerations for Identifying At-Risk Populations

- The residential population in the potential hazard zone is of critical importance, especially during certain times (e.g., evenings, late nights, and weekends).
- Retail and commercial areas are of particular interest during peak use periods (e.g., shopping malls during the holiday season, office buildings during typical work hours).
- Special populations require special attention, especially those located in (or near) the potential hazard zone. Planners may wish to focus on special-population facilities that reside in a confluence of potential hazard zones associated with various routes or route segments.
- Congregations of people for special gatherings (e.g., large sporting or entertainment events, fairs, religious or political events) also may require focused attention. Event planners may wish to consider relocating some events to venues outside the potential hazard zones.

6.3.7 Potential Consequences of Hazmat Releases

The negative consequences of potential hazmat incidents are most often expressed in terms of the potential for human exposure. Consequences associated with potential incidents are most likely to occur among general populations, special populations, and mass congregations located in the hazard zone at the time of the incident. Consequences of hazmat exposures also can have great negative impacts for environmentally sensitive habitats or other areas (e.g., locations with historical or cultural significance). Software programs available from the U.S. EPA's CAMEO suite (including CAMEO, MARPLOT, or ALOHA) can be used to model consequences of potential hazmat releases. Further information about this software suite may be found at http://www.epa.gov/oem/content/cameo/index.htm.

6.3.8 Hotspots Analysis

Spatial–temporal analysis, commonly called *hotspots analysis*, identifies times and places where the co-location of people and hazardous materials needs special attention. With at least four critical components of hazmat risk analysis (i.e., time, space, hazardous materials, and people/fauna/flora) and virtually infinite possibilities of each, the possible outcomes can seem both complex and somewhat overwhelming. Appendix D.9, Use Hotspots Analysis, is provided as a resource to assist the project team with conducting a hotspots analysis.

6.4 Summarize Information

It is essential that HMCFS information prepared by the project team is useful for emergency planning. HMCFS users must understand the HMCFS, be comfortable with it, and able to extract needed information. The HMCFS information will be used by the core team to make decisions. Information for the HMCFS core team should be summarized to identify the critical points that will be needed for decision making. Lists, tables, charts, and maps may be used by the project team to present the information.

CPG 101 (*2*) suggests organizing hazard information in a matrix. A matrix provides a format by which risks can be compared and prioritized. This concept can be adapted for compiling

Tips for Summarizing HMCFS Information

FEMA's *CPG 101* (*2,* p 3-18) suggests some basic rules for writing plans and procedures. Some of these rules can be applied to summaries of HMCFS information, including the following:

- Keep the language simple and clear by writing in plain English. Summarize important information with checklists and visual aids, such as maps and flowcharts.
- Avoid using jargon and minimize the use of acronyms.
- Use short sentences and active voice. Qualifiers and vague words only add confusion.
- Provide enough detail. . . . The amount of detail a plan should provide depends on the target audience and the amount of certainty about the situation. Plans written for a jurisdiction or organization with high staff turnover might require more detail.

HMCFS information according to the hazard analysis process dimensions listed in *CPG 101,* as follows:

1. Probability or frequency of occurrence (e.g., what are the frequencies of hazmat transport over different network segments? What are the incident rates?).
2. Magnitude—the physical force associated with the hazard or threat (e.g., how much hazmat might be released in a hazmat transport incident?).
3. Intensity/severity—the impact or damage expected (e.g., what are explosive or toxic impacts associated with potential hazmat releases?).
4. Duration—how long the hazard or threat will be active (e.g., do hazmat releases disperse/neutralize on their own or require neutralization?).
5. Speed of onset—how fast the hazard or threat can impact the public (e.g., hazmat incidents are typically immediately acute, with incident timeframes of minutes to several hours).
6. Time available to warn (e.g., warning time for a hazmat release may depend on distance to populations, environmental conditions, topography, etc.).
7. Location of the event—an area of interest or a specific or indeterminate site or facility (e.g., ability to define individual locations or segments of interest may depend on network specificity covered in the HMCFS).
8. Potential size of affected area—(e.g., initial isolation zones) affected by hazmat characteristics, environmental conditions, and topography.

See the *Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances* (*27*) for examples of matrices used to summarize hazmat release information, worked examples, and information about chemical hazards.

Considerations for Summarizing HMCFS Information

FEMA's *CPG 101* suggests validation steps for emergency plans. Some of these steps can be adapted as considerations for summarizing HMCFS information as follows:

- Is the HMCFS information sufficient to inform and accomplish emergency prevention, preparedness, response, and recovery planning?
- Is the information consistent with the HMCFS objectives? Does it adequately address them?
- Does the HMCFS information comply with assignments and guidance from leadership and management?
- Are the assumptions valid?
- Is the HMCFS structured in a way that lends consideration to homeland security and political supportability for emergency planning?

6.5 HMCFS Content

The HMCFS report is prepared by the project team and should be a stand-alone document that can be readily integrated into a community's emergency plans. Remember that an HMCFS is not an emergency plan by itself, but it forms a knowledge basis for many different aspects of emergency planning. Based on recommendations in *CPG 101* for emergency plan content (with some additions), the following should be included in an HMCFS:

- Front matter
  - Cover page, including title, data, jurisdictions covered, and authorship;
  - Approval page with appropriate senior officials' signatures;

  - Record of corrections, changes, or modifications (as applicable to individual documents, subsequent HMCFS efforts may focus on different locations, hazards, timeframes, etc. and might not be considered as a change);
  - Record of distribution;
  - List of entities involved the in HMCFS project, including HMCFS core team, HMCFS project team, key personnel, volunteers/data collectors, contractors, etc.;
  - Table of contents and lists of figures and tables; and
  - Situation overview (e.g., an executive summary of HMCFS information).
- Main document
  - Purpose (HMCFS objectives);
  - Scope (jurisdiction, modes, and network segments that are included);
  - Background information (e.g., previous or adjacent jurisdiction HMCFS information, geographical and environmental information about jurisdiction and communities; critical facility locations, etc.);
  - Methodology (overview of data collection methods, sampling, and precision);
  - HMCFS outcomes (the "meat" of the document—text, matrices, lists, tables, charts, graphs, maps, etc.—for different materials classifications, modes, and network segments, as applicable);
  - Assumptions and limitations (e.g., an HMCFS is a snapshot of hazmat commodity flows in a community at specific times and locations—does the hazard analysis assume that observations are consistent with other times and/or locations?);
  - Conclusions and recommendations, including identification of most frequent or greatest threats, needs for additional intelligence, etc.; and
  - References, including all existing data sources, reports, statistics, and documents that were used—references should include author, performing agency, title, report or series volume and number, publication date, publisher, and other information as applicable.

Additional information may be included in appendices including hazmat transportation regulations and requirements, images, and other information (such as sampling forms or schedules) not included in main body of the HMCFS document.

CHAPTER 7

Implement Information

The HMCFS information that was prepared by the project team is reviewed by the core team in the final step of the HMCFS process. The core team then takes actions that are necessary to implement the information. Closing the HMCFS life cycle by using it to make objectives a reality is critical in making the HMCFS worthwhile. Also critical to HMCFS implementation is a recognition and complete appreciation of the limitations of the study. A review of the choices made in conducting the HMCFS will help decision makers recognize what additional information might be required to make high-level decisions. A flow chart of the HMCFS process focusing on implementation is shown in Figure 7-1.

7.1 Review Objectives and Limitations

Before the results of the HMCFS are implemented, the core team reviews the objectives that were set for the HMCFS and the project's limitations. This helps decision makers interpret and apply the results appropriately. Reviewing the objectives and limitations of the HMCFS involves the following:

- Listing specific objectives,
- Listing the HMCFS results that bear on each outcome, and
- Identifying the limitations associated with each result.

Decision makers should determine the extent to which HMCFS results merit actions to mitigate, avoid, or prepare for the risk. Table 7-1 illustrates how specific objectives, results to support them, and the basis of information can be placed side by side.

7.2 Disseminate and Communicate Information

HMCFS dissemination consists of the one-way communication of the results of the study to various audiences, while HMCFS communication is a two-way interaction about the results of the study with these stakeholders. The core team is responsible for both disseminating and communicating HMCFS information.

7.2.1 Dissemination

Dissemination of HMCFS results is a simple, three-step process, as follows:

1. Decide which critical results can be distributed in a one-way communication without clarification or elaboration;

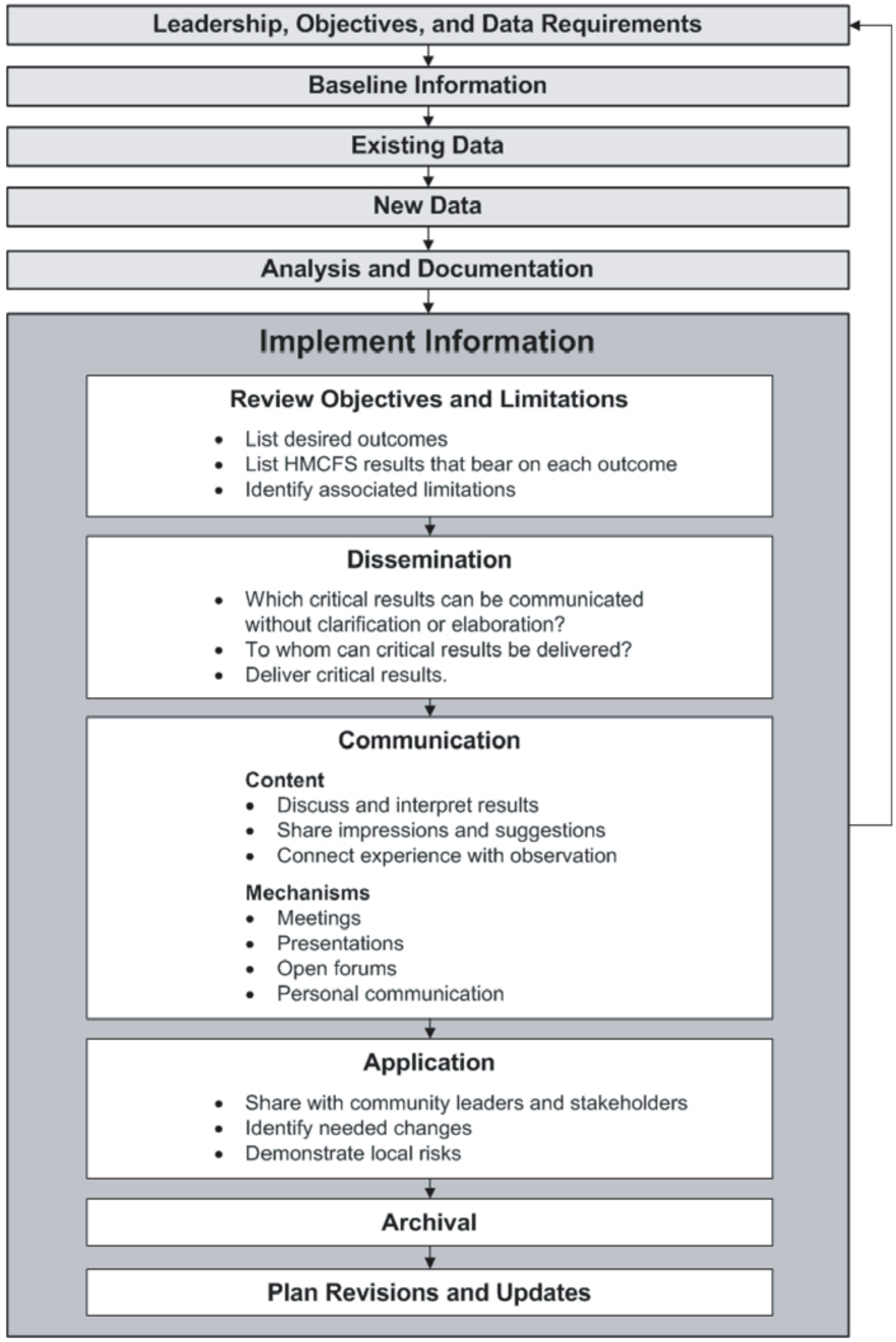

Figure 7-1. The HMCFS implementation process.

2. Decide to whom these critical results should be delivered, and collect contact information; and
3. Deliver the documents, videos, or presentations to the contacts listed in Step 2.

Deciding what HMCFS objectives and results to disseminate may prove challenging. Information disseminated is typically limited to the simplest, most direct, and generic results stemming from a well-conducted HMCFS. Results at this level require little or no explanation—they are self evident. This does not mean they have no value! For example, discoveries of hazmat flows where they were previously not known to exist have clear, self-evident implications.

Table 7-1. Example of objectives, results, basis, and recommendations.

Specific Objective	HMCFS Results	Limitation	Possible Recommendation
Routing hazmat around business district of town	Estimates of risk on route segment around business district	National traffic data and VIUS hazmat data results in "national average" risk, not local	Collect more local data
		Local traffic data and VIUS data result in "local estimates" of risk	Begin to develop plans for potential route designation
		Local traffic and hazmat data results in locally observed risk estimates	Take action to implement route designation

7.2.2 Communication

Communication of HMCFS results to critical stakeholders is more intense and time-consuming than dissemination but also provides feedback about the validity of the study results. Communicating HMCFS results can involve the following:

- Scheduling and holding meetings,
- Making presentations,
- Holding open forums, and
- Engaging in personal communication with critical stakeholders.

Communication of the HMCFS information focuses on both the critical and more subtle aspects of the project that are important to critical stakeholders. Tailoring the message to the interests of each critical stakeholder will help engage them in the implementation process. Risk communication allows for the following:

- Discussion and interpretation of results;
- Sharing of more subtle information (e.g., impressions, suggestions); and
- High-order interpretations, such as the connection between stakeholder experience and expertise and what was observed directly.

Tips for Encouraging Participation

FEMA's *CPG 101* (*2,* p 3-8) lists some tips for getting active participation from planning team members. Some of these tips may be useful for HMCFS projects, including the following:

- Plan ahead. Provide plenty of notice about where and when the meeting will be held. If time permits, ask team members to identify the time(s) and place(s) that will work for the group.
- Provide information about team expectations. Explain why participating is important to the participants' agencies and to the community itself.
- Ask the senior elected or appointed official or designee to sign the meeting announcement. A directive from the executive office carries the authority of the senior official and sends a clear signal that the participants are expected to attend.

Multi-way communication of HMCFS results often involves discussion of the findings and their underlying meaning for the project's objectives. This multi-way discussion also can help explain the complexities of the HMCFS objectives and data collection efforts to help assure that the HMCFS is not interpreted beyond its information capacity—decisions based on too little information are usually risky. Appendix D.10, Use Risk Communication Checklist, contains a checklist of entities to which HMCFS communication can be considered.

7.3 Apply Results

The HMCFS is a living document in that it contributes to ongoing planning processes including emergency planning, transportation planning, comprehensive planning, equipment procurement, and hazmat route planning. Presenting the results in a document is only a momentary snapshot of an ongoing process. Simply stopping at this point and putting the document on the shelf fails to stimulate discussion, decision making, or proactive response to impending situations. Applying the results of the HMCFS project to emergency planning and other community concerns is the responsibility of the core team and community stakeholders.

The HMCFS can provide evidence of potential concern for public and local authorities. Using the results of the study to inform the public, public officials, and community leadership in this regard is one very useful outcome of the HMCFS process. The critical question for implementation is what will be done differently now that the HMCFS information is available? What adjustments are needed to accommodate what is now known about the transport of hazmat into, out of, within, and through the community?

Appendix D.11, Demonstrate Local Risk, encourages users to employ the HMCFS results to help obtain support for emergency planning. Implementation involves actively engaging various groups of interested parties, stakeholders, community leaders, industry, and other end users. As with formation of the HMCFS core team, communication of HMCFS results is another opportunity to involve major hazmat transportation, responder, and community stakeholders. To begin, sponsors of the HMCFS should be engaged to meet either implied or explicit contractual agreements. Other participants were engaged in the HMCFS process because they have some vested interest. This interest, together with their active participation, makes them some of the most likely people to use the HMCFS for its intended purposes.

- *CPG 101* notes that "elected leaders are legally responsible for ensuring that necessary and appropriate actions are taken to protect people and property from the consequences of emergencies or disasters" (*2,* p 1-1). This includes consequences resulting from hazmat transportation incidents. Community leaders such as the county judge and commissioners, the mayor(s) and council(s), fire and police chiefs, and county sheriff have an interest in using these data to provide for community well-being and safety.
- Personnel engaged in emergency planning and response, at all levels public and private, will find the results of the HMCFS directly relevant to their missions.
- Hospital administrators are likely to find the results useful to validate emergency operations plans. In addition, because hospitals are often located near major transportation corridors to allow access (i.e., locations most likely to be impacted by releases along those corridors), they also must be concerned about response plans to assure the safety and well-being of patients and staff.
- Although nursing and convalescent care facilities are less likely than most other types of facilities to have access problems, they may find themselves located in potentially impacted corridors and in need of emergency response plans to accommodate hazmat concerns.
- Public school officials are likely to have similar concerns about their locations and student well-being and safety.

Implementing HMCFS information in emergency planning and training is key to making it worthwhile. Some real-world examples include the following:

- Lewis and Upshur Counties LEPC in West Virginia developed a risk and vulnerability analysis for transportation routes and fixed facilities.
- Victoria County LEPC in Texas plans to use their HMCFS for siting of local facilities, evaluation of hazmat routes, and guiding training needs.
- Pennsylvania's Cambria County LEPC uses their HMCFS information to guide training and equipment needs, and distributes the information to police and fire departments to promote hazmat transport awareness.
- HMCFS results were used by the Arizona SERC and LEPCs to identify worst-case incident scenarios and inform officials of the need for critical response teams.
- Iowa's Region V LEPC purchased and stocked two hazmat incident response trailers and planned responder training. Taylor County LEPC in Wisconsin used their information to establish the need for a Level B hazmat team. Colorado's Jefferson County LEPC and Johnson County LEPC in Missouri identified personal protective equipment needs for their hazmat teams.
- Sullivan County LEPC in Pennsylvania used their HMCFS information as justification for reducing speed limits in municipal areas to prevent future incidents from occurring.
- LEPCs in Canyon County, Idaho and Lycoming County, Pennsylvania, confirmed local knowledge of hazmat transport activities, while Illinois' Effingham County LEPC learned they had less hazmat transport than they had previously thought.
- Pueblo County LEPC in Colorado used their HMCFS information as a public and carrier education tool about risks of shortcuts between transport routes.
- Hidalgo County LEPC in Texas was able to identify the source and ownership of a crude oil pipeline rupture with their hazmat CFS information.

Sharing these data with community leaders provides a validation of the data, engenders buy-in, and increases the likelihood of the study being used for its intended purpose(s). These community leaders should be engaged to inform, protect, and serve the community's best interests.

Each of these critical people and the offices they represent should be

- Briefed on the results of the HMCFS,
- Asked to provide any conflicting data or information,
- Asked to provide any data that may confirm the results, and
- Asked to document any adjustments they are likely to consider based on the HMCFS.

The briefings should include discussions about implications of the findings. Decisions or changes that need to be made can be identified, as well as who has authority to take action. Recommendations regarding needed changes or actions should be made. Conflicts may need to be resolved, but will ultimately strengthen the project's outcomes. Confirmation of HMCFS results further validates the study.

7.4 Archiving the HMCFS

Once the HMCFS dissemination and communication processes are complete at the local level, the issue becomes how the HMCFS and associated data can be preserved for the future in a way that encourages its use in ongoing processes. Clearly, the results of the study should be preserved. In addition, all materials disseminated to interested parties should be preserved as different materials may focus on different aspects of the HMCFS. Identifying the sources of existing data and locations and procedures for collected data are useful both for documenting what was done, and as a template of where to begin next time. Presentations also can be archived for future use in documenting changes or stable patterns.

Documents should be archived in a variety of locations so that focused catastrophes cannot wipe out all records. For example, they can be stored in county records, municipal records, sent to federal and state authorities, as well as put on Web sites and stored at the public library. This will help make it nearly impossible for one failure to wipe out all the documentation of the HMCFS. To the extent that electronic records allow for information management, searching, retrieval, and distribution from decentralized locations, electronic archival is preferred. This further underscores the need to archive in several locations to avoid future loss of critical information.

7.5 Revisions and Updates

An HMCFS is a static picture of an ongoing, changing process. Thus, local entities need to consider when an HMCFS should be revised or updated. Continuous updating and revisions would be difficult to manage for many jurisdictions. Critical incidents or accidents in the study area, nearby, or in similar communities elsewhere should trigger the re-examination of relevant HMCFS data. In a similar manner, significant changes in resident populations, industrial or transport facilities, or route or route segments should trigger the re-examination of relevant HMCFS data. The re-examination may demonstrate that transport on nearby parallel routes accounted for new flows, or identify a need for conducting a new HMCFS to account for significant changes in the community.

Keep in mind that many of the hazards associated with hazmat transportation may be considered to be stable compared with adaptive hazards or threats such as terrorism. Ongoing planning for hazards due to hazmat transportation will require changes as the community's characteristics change. As noted in *CPG 101,* other updates to an HMCFS may be considered "in association with changes in operational resources, formal emergency planning updates, changes in elected officials, major exercises or activation events, or enactment of new or amended laws and ordinances" (*2,* p 3-23). The faster significant changes occur in a community (e.g., populated areas or locations) or its hazmat flows, the greater the need for more frequent updates and revisions to the HMCFS. Large metropolitan areas with complex flows are likely to opt for more frequent revisions and updates to successfully manage HMCFS efforts. Even small communities with complex flows (especially through-traffic) may find it necessary to revise and update the HMCFS frequently, while those with less complex flows may find that a well-done HMCFS can last for years.

> Cambria County LEPC in Pennsylvania has kept their HMCFS current and relevant by doing a little bit each year for 12 years in a row. In addition to scheduled traffic counts, LEPC members collect data at different highway locations when they are "out and about." The LEPC can easily keep track of their top five hazardous materials moved by truck.

CHAPTER 8

Conclusions and Recommendations

There is no clear-cut way of describing what an HMCFS project requires based solely on community size, economic base, or transportation network characteristics. The requirements of an HMCFS can be highly variable depending on local needs and conditions. The complexity of conducting an HMCFS project generally increases as

- Size of community increases, resulting in more diverse goods consumption;
- Proximity to major hazmat producers, processors, and consumers increases;
- Complexity of the local and regional economy increases, resulting in greater seasonal variations in hazmat transport for different economic sectors;
- Levels of sampling and precision required to support HMCFS objectives increase;
- Need for locally relevant, specific hazmat transport data increases;
- Number of different modes included in the HMCFS increases;
- Number of major roadway transport corridors included in the HMCFS increases; or
- Availability of locally relevant existing data decreases, increasing the requirement for collection of new data.

The following two general HMCFS practices can be recommended for all entities who conduct a local HMCFS:

1. Follow the HMCFS process. The HMCFS process identified in this guidebook is based on the previous U.S.DOT *Guidance* (*1*), supported by previous practice and literature, and is validated in real-world experience.
2. Use the Promising Practices. The Promising Practices presented in Appendix D are based on feedback from LEPCs and direct experience with conducting HMCFS about what works and does not work for an HMCFS project. Many of these practices are keys to the successful planning, conducting, evaluation, and implementation of an HMCFS project.

A number of recommendations-based common threads found in the case studies presented in Appendix C and other research conducted for this guidebook include the following:

- Funding and staffing the HMCFS project
  - Utilize available funding resources for conducting the study, such as HMEP or EPA grants. Be sure to understand grant requirements, including tracking and reporting of volunteer effort.
  - Consider multi-jurisdictional efforts to help distribute the workload and increase the relevance of project outcomes to multiple communities.
  - Consider the use of contractors for data analysis and reporting. If contractors are used, involve the LEPC in major aspects of the project.
  - Utilize volunteer participation from community stakeholders, including emergency response, industry, and health professions; military personnel; business groups; and volunteer groups such as community emergency response teams or citizen corps councils. Often, volunteers

who participate in collecting HMCFS data will identify linkages of hazmat transport with their professions of which they were not previously aware.
- Maximize volunteer participation through training, scheduling, and providing data count supplies, facilities, or equipment.

- Planning the HMCFS project
  - Identify desired outcomes of the study in advance (e.g., confirming types of hazmat transported, evaluating hazmat transport in specific risk areas, etc.).
  - Be realistic—an HMCFS requires time and planning, which makes conducting one in short timeframes less likely to be successful. Coordinating the project, especially volunteer data collection, requires advance planning and may involve delays due to weather, conflicting schedules, etc.
- Using existing data sources
  - Use existing local, state, and national information sources as much as possible. Although CFS from jurisdictions that do not share common corridors may provide examples of how to conduct a study, those project results may have little relevance to hazmat transport in your community.
- Collecting data
  - Begin data collection as early in the project as possible, and do it often, especially when volunteer effort is being used as in-kind grant matching funds. LEPCs that wait too long to begin data collection can easily find themselves "behind the 8 ball" for completing the project within given time limits or having a good set of reliable data.
  - Use multi-person teams for data collection on busy traffic corridors. Volunteer personnel time availability and attention for data collection may be limited.
  - Collect data at locations where traffic is either slowed or stopped, such as truck stops, rest areas, license and weigh facilities, or signaled intersections.
  - Use the data collection effort as an opportunity to enhance emergency response training, such as responders' familiarity with the *ERG*.
- Validating data
  - Validate results across different data sources, including regional/state traffic data, incident reports, and prior CFS conducted for the jurisdiction or surrounding areas.
  - Consider CFS information in terms of how reliable the data are and how they were collected (sampling and precision). Recognize limitations of the CFS.
  - Be aware that information is typically a snapshot of hazmat transportation for specific times and locations. Transport patterns may vary widely by time of day, day of week, and season of year.
- Presenting HMCFS results
  - Present project results using various formats, including tables, charts, graphs, and maps. Cross-referencing of hazmat transport information with spatial and temporal data of sensitive areas can be used to identify risk hotspots.
- Implementing the HMCFS
  - Distribute the CFS to appropriate community stakeholders.
  - *Use it.* CFS information does little good if it just "sits on the shelf." CFS information may be applicable to a wide range of applications. Consider potential applications for CFS information in addition to the project's original goals and groups other than emergency management and response agencies.
  - Conduct an after-action analysis to identify lessons learned and potential modifications to future efforts.
  - Plan for follow-on efforts to evaluate hazmat transportation in the community. Jurisdictions were able to identify changes in hazmat transportation patterns by referencing previous studies. Do not wait too long to conduct subsequent studies.

References

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Key Terms & Acronyms

Key Terms

Confidence Interval: statistics that define the lower and upper boundaries of the expected 'true mean' or average values with a specified degree of confidence, based on supporting data.

Core Team: a group of individuals responsible for oversight, objectives setting, review, and implementation of a hazardous materials commodity flow study.

Emergency Plan: a document that identifies what a community will do to protect itself from its unique hazards and threats with the unique resources it has or can obtain (*CPG 101*).

Emergency Planners: those responsible for, or involved in, conducting emergency planning and developing emergency plans.

Emergency Planning: a systematic or methodological way to think through the lifecycle of a potential crisis, determine required capabilities, and help stakeholders learn and practice their roles. It directs how a community envisions and shares a desired outcome, selects effective ways to achieve it, and communicates expected results (*CPG 101*).

Hazardous Materials (hazmat): any substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce (49 CFR. Part 171.8).

Hazmat Commodity Flow Study: a special kind of transportation analysis project intended to identify the types and amounts of hazardous materials transported through a specified geographic area.

Hazmat Class and Division: classifications of hazardous materials as defined in Hazardous Materials Regulations under 49 CFR, Part 173.

Hazmat Placard: a sign or indicator that is attached to a vehicle, vessel, tank, or other container that indicates the type of hazardous materials contained therein.

Incident: an occurrence or event, natural or manmade, that requires a response to protect life or property (National Response Framework).

Objectives: categories of HMCFS applications that help summarize the intended use of HMCFS information and guide the conduct of the project.

Project Team: a group of individuals responsible for conducting the HMCFS, including scoping, coordinating, compiling, analyzing, documenting, and presenting project information.

Sample: a group of data or information.

Sampling: a systematic method or procedure for collecting a sample.

List of Acronyms

AADT: Annual Average Daily Traffic

AAR: Association of American Railroads

BTS: Bureau of Transportation Statistics

CEMP: Comprehensive Emergency Management Plan

CFS: BTS' Commodity Flow Survey

CPG 101: FEMA's *Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining State, Territorial, Tribal, and Local Government Emergency Plans*

EOP: Emergency Operations Plan

EPCRA: Emergency Planning and Community Right to Know Act

ERG: PHMSA's *Emergency Response Guidebook*

FAF: FHWA's Freight Analysis Framework

FEMA: Federal Emergency Management Agency

GIS: Geographic Information Systems

HAZUS-MH: FEMA's Hazards U.S. Multi-Hazards software

HMEP: PHMSA's Hazardous Materials Emergency Preparedness Grant Program

HMCFS: Hazardous Materials Commodity Flow Study

HMIR: PHMSA's Hazardous Materials Incidents Reports database

HMR: Hazardous Materials Regulations

HPMS: FHWA's Highway Performance Monitoring System

ICS: Incident Command System

IWR: USACE's Institute for Water Resources

LEPC: Local Emergency Planning Committee

MPO: Metropolitan Planning Organization

NIMS: National Incident Management System

NGO: Non-Governmental Organization

NPMS: PHMSA's National Pipeline Mapping System

NOAA: National Oceanic and Atmospheric Administration

NRF: National Response Framework

NRHM: Non-Radioactive Hazardous Materials

NTAD: National Transportation Atlas Database

SAFER: FMCSA's Safety and Fitness Electronic Records System

SERC: State Emergency Response Commission

SSI: Sensitive Security Information

STB: Surface Transportation Board

TERC: Tribal Emergency Response Commission

TIH: Toxic Inhalation Hazard

TRANSCAER: Chemical Manufacturer's Association Transportation Community Awareness and Emergency Response Program

UN/NA: United Nations/North American

USACE: U.S. Army Corps of Engineers

VIUS: BTS' Vehicle Inventory and Use Survey

APPENDIX A

Hazardous Materials Placards

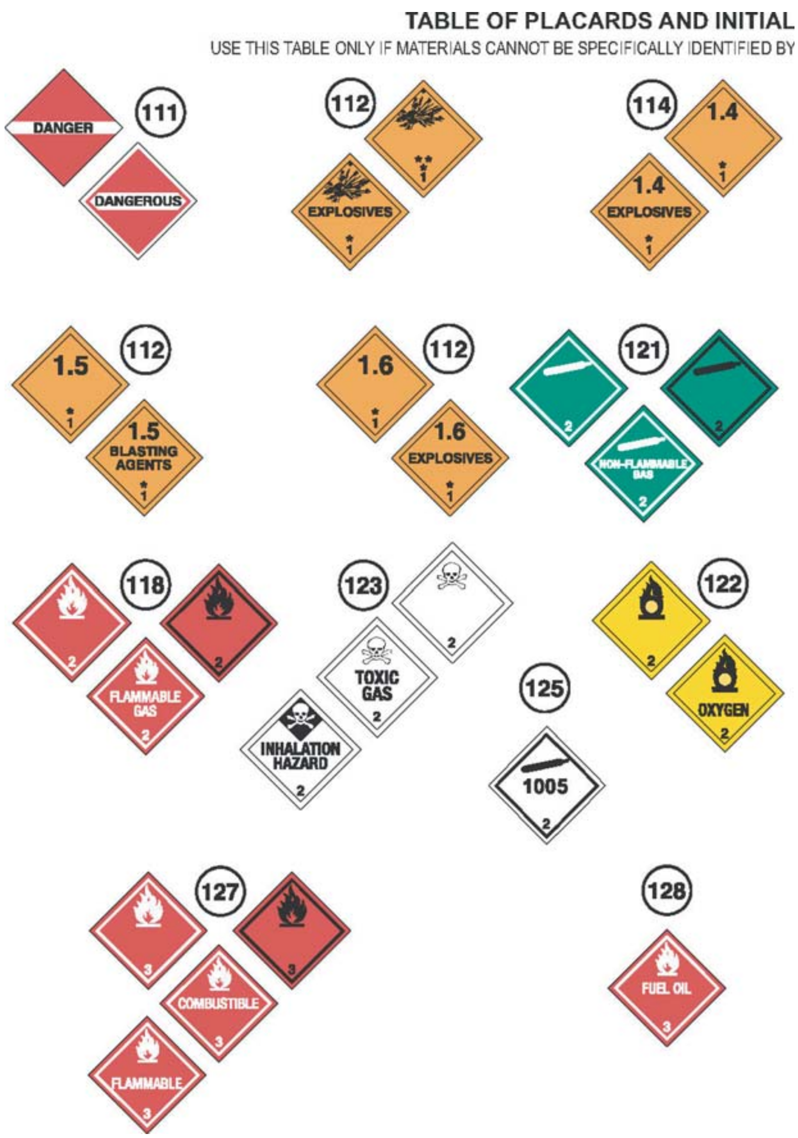


Figure A-1. 2008 ERG example placards for HazMat classes 1 through 3 (5, p 16).

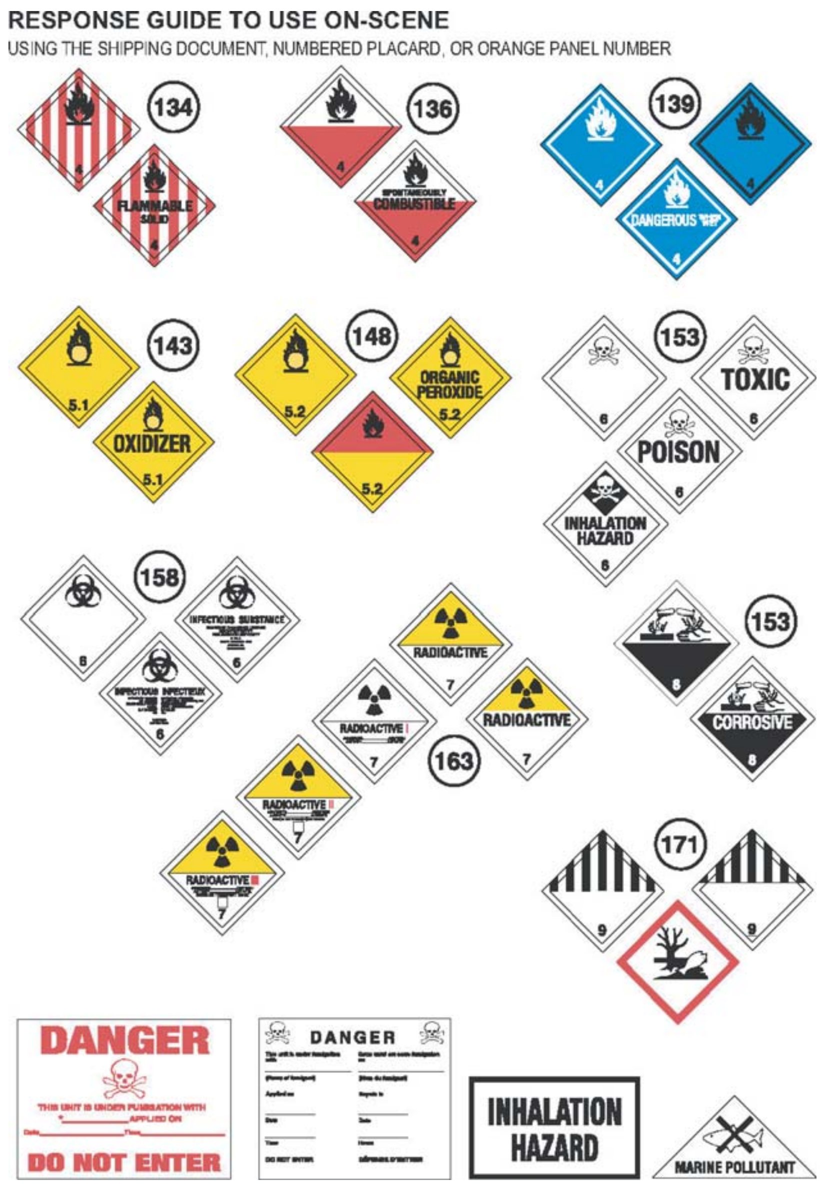


Figure A-2. 2008 ERG example placards for HazMat classes 4 through 9 and other placards (5, p 17).

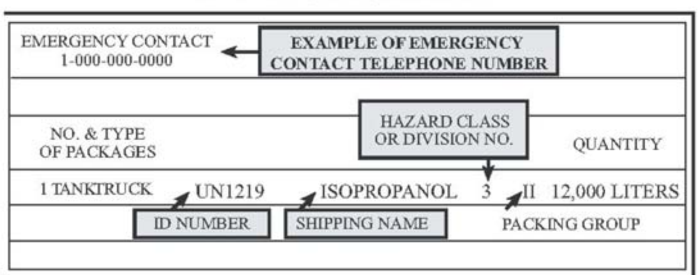
APPENDIX B

Shipping Documents and Placard Numbers from *2008 ERG*

SHIPPING DOCUMENTS (PAPERS)*

The shipping document provides vital information when responding to a hazardous materials/dangerous goods** incident. The shipping document contains information needed to identify the materials involved. Use this information to initiate protective actions for your own safety and the safety of the public. The shipping document contains the 4-digit ID number (see yellow-bordered pages) preceded by the letters UN or NA, the proper shipping name (see blue-bordered pages), the hazard class or division of the material(s), and, where appropriate, the Packing Group. The shipping document will also display a 24-hour emergency response telephone number. In addition, there must be information available that describes the hazards of the material which can be used in the mitigation of an incident. The information must be entered on or be with the shipping document. This requirement may be satisfied by attaching a guide from the ERG2008 to the shipping document, or by having the entire guidebook available for ready reference. Shipping documents are required for most dangerous goods in transportation. Shipping documents are kept in

- the cab of the motor vehicle,
- the possession of the train crew member,
- a holder on the bridge of a vessel, or
- an aircraft pilot's possession.



EXAMPLE OF PLACARD AND PANEL WITH ID NUMBER

The 4-digit ID Number may be shown on the diamond-shaped placard or on an adjacent orange panel displayed on the ends and sides of a cargo tank, vehicle or rail car.

A Numbered Placard or A Placard and an Orange Panel

* For the purposes of this guidebook, the terms shipping document/shipping paper are synonymous.
** For the purposes of this guidebook, the terms hazardous materials/dangerous goods are synonymous.

Figure B-1. 2008 ERG shipping document information and placard number identification. (5, p 18)

APPENDIX C

HMCFS Case Studies

Seven case studies are provided to describe how HMCFS have been conducted for local jurisdictions. The case studies cover a range of jurisdiction sizes (very small to very large) and regions (East Coast to West Coast) and are listed by year conducted (oldest to newest). These case studies were selected based on a review of HMCFS conducted by LEPCs from across the United States. The selected case studies include those that were most comprehensive and reflect principles outlined in this guidebook. HMCFS recommendations based on analysis of the case studies are included in Chapter 8.

C.1 Case Study 1: LEPC in the Midwestern United States

This LEPC is located in southern Indiana on the banks of the Ohio River. It has a population of less than 100,000 people and is traversed by an Interstate highway and several U.S. and state routes. Several railroads, including Class I railroads, pass through the study area.

The LEPC worked jointly with another LEPC in 2000 as part of a continuing effort to update and improve emergency plans, as well as develop a relative risk assessment for major highways in the area.

Resources for the study consisted of U.S. EPA grant money through the Indiana Department of Environmental Management. A consultant was hired to help conduct the project.

The HMCFS was based on similar prior studies conducted in five neighboring Indiana counties. Their results, along with the results of the CFS conducted in 1994 in Tulsa County, Oklahoma, were included and presented in the same format in the project report in order to compare findings. The Tulsa County CFS had compared findings with prior HMCFS from Oregon, Nevada, Utah, and Florida. It also had utilized TRANSCAER®'s guide and the U.S.DOT's *Guidance* for conducting HMCFS.

Hazmat trucks were counted by consultant staff at 11 sites on major highways in the county, one of which was at a weigh station because high traffic volume inhibited clear view and reading of placards from the roadside. Data collection was conducted by one person, in two periods of 2-hour shifts over 2 days and in both traffic directions, except at the weigh station where two 8-hour shifts took place, one at the northbound and one at the southbound scale. The process was similar to that followed by the five neighboring counties and Tulsa County. All of their results were included in the same format for purposes of clear comparison.

Collected data included the number of total and hazmat trucks, placard numbers, and UN/NA numbers. A listing of railroad hazmat data was requested and supplied by CSXT and other railroad companies. Marine data consisted of commodity tonnage, number of barges, and description through the two Ohio River locks in the area by direction.

It was found that roughly 5 percent of all commercial truck traffic carried hazardous materials. Almost 60 percent of the placards involved Class 3 Flammable Liquids, and almost 13 percent were Class 8 Corrosives, with the remaining classes complementing the total. The results are displayed in tables and bar graphs showing the total number of trucks and placarded trucks by site, the percentage of placarded trucks, and numbers and percentages of hazmat placards observed by class and UN/NA placard IDs.

The Tulsa HMCFS is included in the HMCFS report, apparently in its entirety, to the point that trends are likely to be similar between the two. A sophisticated risk assessment was performed in the Tulsa HMCFS. Census tract maps were overlaid on highway maps and the at-risk population within a 1-mile radius from each highway (i.e., people per square mile) were estimated—"hotspots analysis". PHMSA's HMIS incident data were examined and enabled calculation of the probability of an incident per million miles. The two were multiplied and a relative risk index for each highway segment was calculated. Additional data consisted of hazardous materials and extremely hazardous substances (EHS) rail shipments, as well as PHMSA HMIS incidents for rail.

C.2 Case Study 2: Peninsula LEPC, Virginia

The Peninsula LEPC region comprises a largely urban area (York County and Cities of James City, Hampton, Newport News, and Poquoson), with a population of nearly 400,000 people. It has two major highway routes traversing it (I-64 and US 17) and one main rail line, owned by CSXT.

The purpose for conducting the HMCFS (2002) was to identify which hazardous materials (focusing on EHSs) were frequently shipped in large quantities to, through, and within the jurisdictions by air, rail, road, waterway, and pipeline, and the main routes used, where applicable. The objective was to facilitate emergency planning by the local governments.

Funding for the HMCFS was provided by a U.S.DOT Research and Special Programs Administration (RSPA) grant, coordinated by the Virginia Department of Emergency Management, and managed by the Peninsula LEPC. A university was hired to help conduct the project.

A questionnaire was developed in an attempt to collect data on the amounts and frequency of hazardous materials shipped, as well as the routes used, and sent to authorities (e.g., Virginia DOT, Department of Environmental Quality [DEQ]), and fixed facilities/hazmat shippers. This method worked for obtaining information from pipeline companies, but not for other modes because of data unavailability (inexistence) or inaccessibility (proprietary). New data were not physically collected; rather, already existing data were obtained, compiled, and analyzed.

Hazmat truck inspection data for four inspection stations located at two tunnels (two for each tunnel by direction) were obtained from VDOT. Distributions were developed to show transport of hazardous materials by class for each site, by week and weekday. For railroads, hazmat information was requested from CSXT, but it only consisted of hazmat names, and no quantities, frequencies, or origins–destinations. The potential risks associated with each hazardous material transported by rail are elaborated upon in the text. For marine, the only available data were a list of hazardous materials stored in the terminal on a single day, provided by terminal management, as hazmat data were deemed either proprietary or unavailable by the Virginia Port Authority and Coast Guard. Distributions were developed for the terminal hazardous materials showing percentages of materials by characteristic (e.g., flammability, toxicity, gaseous, etc.). For pipelines, it was assumed that incidents only occur if pipelines are ruptured by excavation. Pipeline companies identified the hazardous materials flowing through their pipelines and the ranges of flows and pressures. It was found that there was no hazmat cargo transported through the local airport.

The project report included a discussion on the data limitations (proprietary or unavailable) associated with military installations, railroad, and marine, as well as the limited time period for which highway data were available. Recommendations included better overall tracking of hazmat movement data through logistical or technological means, and subsequent data entry into corresponding databases, in order to facilitate future analyses. The appendix to the project report includes a sample questionnaire, and maps of the area showing the main hazmat routes by mode, as well as the bridges, tunnels, etc. used in the study.

C.3 Case Study 3: LEPC #3, Vermont

Vermont's LEPC #3 (Southern Windsor County/Southern Windsor County Regional Planning Commission) comprises 478 square miles and 13 towns with a total population of around 40,000 people. The region is largely undeveloped or sparsely developed. Major highway routes in the area include I-91, I-89, and several state routes. Three rail lines traverse the area as well.

The LEPC was concerned about traffic disruptions and threats to public safety due to highway HazMat vehicle accidents and spills, as well as contamination of the local watershed—the source of drinking water. This concern was due to a train derailment in 2001, which dumped thousands of gallons of diesel fuel into the Connecticut River.

The LEPC's objective for conducting the HMCFS (2006) was to verify their beliefs—that most of the hazardous materials transported through their area were motor vehicle fuels (diesel and gas) and heating fuels (oil and gas)—or to alert them to those hazardous materials being transported of which they were not aware in order to identify major concerns for emergency responders and planners.

Resources consisted of grant money through the SERC from the HMEP Grants Program, along with in-kind matching through community volunteer labor hours and costs for travel to and from the data collection sites. The LEPC did not include fixed Tier II facilities in the HMCFS, although it possessed the information. It instead focused on hazardous materials on highways and railways.

The HMCFS was conducted from April–May 2006 and included over 167 total hours by 10 volunteers. The volunteers included members of the LEPC and a Community Emergency Response Team (CERT). Rail traffic and motor vehicle (truck) traffic were observed on selected railways, highways, and intersections within the region. Points of observation were chosen carefully in an effort to optimize data collection with regard to personal safety. Rail observation points consisted of rail yards, depots, and track sidings. Highway observation points consisted of interstate rest areas, truck stops, parking areas, and highway intersections. Pertinent information recorded included rail car or trailer body type and placard number.

Data collectors were trained beforehand to use the *Emergency Response Guidebook* for identifying hazmat placards, rail car types, and truck body types, and to note the corresponding placard IDs on the data collection forms. U.S. EPA's *Hazard Analysis on the Move* was used for guidance. The BTS 2002 *CFS* data for Vermont was used after the study was completed to verify that the local data were consistent with the state data. In addition, high crash location data for the region were obtained from readily available state DOT reports, and 4 years of hazmat incident history listings were supplied by Vermont Emergency Management.

The LEPC had a good understanding of their effort's constraints and limitations. They made a point to evaluate and list the primary and secondary impacts due to a hazmat incident with respect to people, property/environment, and the economy. Once the flow study was completed, it was distributed to all of the emergency management personnel in the various towns that are covered by the LEPC. The commodity flow study also was used as a reference in drafting emergency plans.

The HMCFS report included several relevant appendices (i.e., the BTS 2002 *CFS* data for Vermont, typed data sheets, *ERG* figures showing hazmat placards, railcar and truck body types and codes, and an area map with rail and highway routes). The report also included conclusions and recommendations on several possible/future uses of findings, including local disaster mitigation planning (especially for worst-case scenarios, around schools and other high-risk areas), evacuation plans, shelters, public building and infrastructure planning, and hazmat incident containment. The latter specifically called for a refresher of *ERG*-recommended procedures for the identified hazardous material, and emergency response training, planning, exercising, equipment, and personnel.

C.4 Case Study 4: Lewis/Upshur Counties LEPC, West Virginia

The Lewis/Upshur Counties LEPC, located in north central West Virginia, covers two counties with a total land area of 737 square miles and a population of 40,911. The region is characterized by steep topography in a rural setting. Two major highway routes traverse the area, I-79 in a north–south direction, and US 33 in an east–west direction.

The HMCFS (2006) was conducted in the context of various hazard analyses and risk assessments, which are part of comprehensive emergency response plans established by the West Virginia Code in implementation of the EPCRA. The study findings were intended for use in hazmat incident prevention and mitigation efforts.

Resources consisted of grant money through the SERC from the HMEP Grants Program along with community volunteer labor hours; volunteers were members of both counties' CERTs. A consultant was hired to help conduct the project.

Prior to the HMCFS, a uniform questionnaire was developed to solicit information on hazardous materials at fixed facilities in both counties. Despite the low response rate, responses were comparable to those received during the previous HMCFS conducted by the LEPC in 1999. Each responding facility in the 2006 HMCFS also was described in the project report.

The LEPC consulted their 1999 HMCFS, which made clear that local railroad freight consisted of practically 100 percent coal; hence the railroad mode was excluded from the 2006 HMCFS, as were waterways (there are no navigable waterways in the area). The area does contain natural gas pipelines that were considered outside the scope of the HMCFS. The steep topography of the area was recognized as a factor that inhibited heavy truck movements. National data on hazmat incidents readily available from PHMSA were examined by mode, cause, hazmat class, and consequence. The national incident data were compared with state hazmat truck incident data posted by WVDOT and the two were found to be largely in agreement. State crash data previously prepared by WVDOT were analyzed by route and county, as well as for deaths, injuries, and damages. The national 2002 Commodity Flow Survey for commodity shipments originating in West Virginia was reviewed to validate information about modal split and was found to largely agree with local experience.

Data collection was methodical. Five sites were chosen on the two major routes in both directions and ranged from exits to rest stops to intersections. Five daytime and nighttime shifts were scheduled (each day–night shift took place on the same day) along I-79 and US 33. Each shift consisted of multiple continuous hours of data collection and was manned by two-person crews (an observer and a recorder).

Recorded data included UN/NA placard ID, truck body type, and total traffic volume. The latter was recorded in order to compare it to total hazmat traffic and determine the probability of crashes with the aid of the state crash data. Special attention was paid to reporting the observed Extremely Hazardous Substances (EHS) and the percentages of EHS trucks versus non-EHS trucks.

The discussion of findings included confirmation and/or deviation of study findings with respect to national trends. Similarities/differences between hazardous materials transported on a highway and hazardous materials in fixed facilities were noted in the conclusions. Recommendations for the future were thoughtful, valuable, and detailed (i.e., what to do better or different next time around, how to use the results of the study further). They included updating the study on a regular basis, comparing it to studies conducted by neighboring counties, expanding the number of data collection sites, including rail and pipeline modes, conducting in-depth vulnerability and risk assessment, enhancing emergency response, developing a database of fixed facilities, standardizing data collection methods, and expanding the number of industries surveyed. In fact, subsequent to the effort, the LEPC used information from the study to develop a risk and vulnerability analysis for their transportation routes and fixed facilities.

The data collected by the volunteers were provided to the consultant for final analysis and assimilation into a report. Appendices included lists of hazardous materials and EHSs observed in transportation and present in fixed facilities, reportable and threshold planning quantities for EHSs, photos of the data collection sites, and typed data sheets from site observations and facility surveys.

C.5 Case Study 5: Arizona SERC and Five Arizona LEPCs

The study area included portions of five counties (Apache, Gila, Graham, Greenlee, and Navaho) in central/eastern Arizona, a largely rural area with a population of less than 100,000 people. A large percentage of the total land area considered is Indian Reservation land. The study focused on the US 60 and US 70 corridors, along which several large communities were located, and the rail lines that run parallel or across them. US 60 is the major corridor between the Phoenix metropolitan area and New Mexico, carrying a significant volume of commercial trucks, especially those related to mining activity in the LEPC's area. US 70 also leads to New Mexico and serves private vehicles enroute to state parks.

This HMCFS (2008) was conducted to provide accurate information to federal, state, and local officials, to make informed decisions about resource allocation, and better manage the flow of hazardous materials in the study area. The HMCFS also was conducted to provide insight to appropriate entities (e.g., fire departments) in order to enhance emergency response and disaster preparedness for incidents.

The study was completed in two phases and covered hazmat transportation by truck and rail—the two primary modes of goods movement in the area. The study focused on the US 60 and US 70 corridors (including arterial highways) and rail lines running parallel or across them (i.e., Arizona Eastern Railway and Union Pacific Railroad).

Resources consisted of grants from the PHMSA's HMEP Grants Program and the U.S. DHS to the Arizona SERC. A consultant was hired to help conduct the project. The LEPCs considered the involvement of all stakeholders in all stages of the study crucial to ensure the study's goals were met and assure quality control of the contractor's work. As a result, a kick-off meeting was held prior to commencing the study to obtain feedback from stakeholders, including SERC, County Emergency Management, Department of Public Safety (DPS), EPA, fire department, and industry. An interim stakeholder meeting also was held to discuss the status of the placarded truck surveys (e.g., revise data collection sites and proposed modeling methodologies).

Tier II information previously requested by AZSERC from fixed facilities was reviewed. It consisted of the facility name and description, hazmat name and chemical description, physical/health hazards, number of days on-site, maximum and average material quantities stored on-site, etc.

The highway hazmat truck analysis reviewed AZDOT traffic counts and automatic traffic recorder data for all traffic and truck traffic levels along the corridors over various durations. Incident data from the National Response Center and the state DEQ were reviewed. The railroad analysis reviewed the FRA Office of Safety Analysis' accident databases for railroad accidents that resulted in a hazmat release. Between 1999 and 2007 there were 13 highway incidents and 2 rail incidents that resulted in a hazmat release.

Data collection on highways consisted of hazmat placarded truck surveys in March 2008, at a total of 13 sites, for 1–2 days per site, over 12-hour shifts, including 3 night shifts. Data were recorded in 30-minute intervals and included the total number of trucks passing the survey points, number of placarded trucks, placard type and number, and placarded truck type.

Two railroads parallel and/or cross the US 60/70 study corridors: the Arizona Eastern Railway (AZER) and the Union Pacific Railroad (UPRR). They provided hazmat type, quantity, and frequency information on hazardous materials transported along the corridors.

The results were illustrated in the project report in the form of bar graphs and pie charts showing number and percent by direction of total trucks versus placarded trucks, class and division of placards, and placarded truck type. It was found that percentages of placarded trucks varied greatly by corridor. Also, 13 different hazardous materials were recorded with variations by corridor. Almost all trucks in both surveyed corridors were 5-axle tank tractor-trailers.

Computer modeling using EPA's Area Locations of Hazardous Atmospheres (ALOHA) Model, along with the 2004 *Emergency Response Guidebook,* was used to determine impact radii (evacuation distances) in the event of a spill or release of any of the typical hazardous materials observed along the corridors. The results were used to delineate areas of concern along the corridors and overlay them with identified high-risk areas.

The risks and consequences of a hazmat spill in the proximity of high-risk areas (e.g., schools, hospitals, environmentally sensitive areas, waterways, and habitats of endangered species) were evaluated and described in the report. Maps based on the Census 2000 Tiger/Line files identified high risk/environmentally sensitive areas and transportation networks ("hotspots").

Future development/industries in the area that had the potential to increase hazmat flows were briefly discussed. Recommendations on areas of improvement for conducting future HMCFS included more attention to statistical significance through increasing consecutive data collection periods and durations, number of sites, and seasonal repetition. A recommendation to improve the general understanding of hazardous materials moving along the transportation corridors in the area was periodic and comprehensive inspections of trucks to include paperwork and loads at various locations and of adequate duration in order to yield a statistically significant sample of hazardous materials moving through the area.

Several appendices contained detailed data and results stemming from all sources examined (e.g., site maps, Tier II facilities and information list, number and percent of all-trucks and placarded trucks by site and direction, placarded truck types by site, etc.).

C.6 Case Study 6: Cambria County, Pennsylvania

Cambria County has a population of more than 100,000, is located in the southwest–central section of Pennsylvania and is approximately equally rural and urban. It consists of 703 square miles and 63 municipalities and is of semi-mountainous terrain. Major highway routes include

U.S. and state routes, running east–west and north–south. The major rail route belongs to Norfolk Southern (NS). The area's waterways do not support commercial marine transportation.

This LEPC has been conducting an HMCFS on an annual basis for the last 12 years (most recently in 2008). The purpose stated in the most recent HMCFS document was the emergency preparedness plan annual update for the 12th consecutive year (i.e., identify response needs and concerns, and enhance education and awareness). Resources consisted of an HMEP grant and community volunteers, whose labor and other related expenses constituted the local match value. The LEPC received a small amount of funding reimbursement from the grant.

Historic data for all of the LEPC's previous HMCFS are included in the 2008 HMCFS report. For example, the top five hazardous materials transported by highway and the top 15 hazardous materials transported by rail are listed. A good county profile is presented, describing demographics, economics, special populations, parks, etc.

For highway counts, the LEPC performs truck counts on highways around 40 times per year. Local emergency management employees also record hazmat observations when they are "out and about." Although the LEPC recognizes that this method is not as consistent to obtaining specific counts per hour, they feel that this method helps them get a good idea of what is going up and down the roads in their jurisdiction. The participation it promotes has positive benefits as well.

For rail data, the local emergency management office is located near train tracks, and since the trains have to slow down there, it is an easy place to conduct counts. Emergency management staff perform railcar counts 3 to 4 hours per day approximately eight times a month during the busy season of June–August and 3 to 4 times per month in April–May and Sept–October. In 2008, they counted 144 trains. The staff take laptop computers and other work they can do in a vehicle and locate the vehicle at the railroad locations for these field operations. When a train comes, they perform the count.

The LEPC also surveys the Superfund Amendments and Reauthorization Act (SARA) facilities in conjunction with annual emergency plan updates. By talking with plant managers, the LEPC verifies shipment types that are coming and going to and from facilities, as well as hazmat vehicle/placard counts made during previous years. The most common hazardous materials stored by facilities also were identified in the HMCFS. All SARA facilities in the county receive hazmat shipments via highway. Pipelines and the hazardous materials flowing through them also were listed by a pipeline company. The highest volume commodity was natural gas, and the number one cause of pipeline incidents was excavation.

No particular hotspot analysis or map overlay was indicated in the HMCFS document. At-risk populations (e.g., schools, prisons, hospitals) are described in the county profile. The HMCFS are used to make sure training is relevant and to verify that proper equipment is purchased (in some instances, the HMCFS is used as justification). The HMCFS also is distributed to county police and fire departments so they have an idea of what is being transported on roads and rail within their jurisdiction. In the most recent year, the LEPC added a chemical profile sheet for the "top" hazardous materials in their jurisdiction by combining information for rail, highway, and fixed facilities.

C.7 Case Study 7: Victoria County, Texas

Victoria County is located in the south-central portion of Texas and is approximately equally rural and urban. It consists of nearly 900 square miles and 20 communities. The topography is gently sloping plains. Major highway routes include U.S. and state highway routes, running east–west and north–south. The primary community of 60,000 people is in the middle of the county and is the intersection for three U.S. highways, two of which (US 59 and US 77) serve as major coastal corridors between Houston, Texas, and the Texas–Mexico border area. The major rail route belongs to Union Pacific (UP), with the BNSF Railway and Kansas City & Southern Railway Company (KCS) operating by trackage rights over UP lines. The community has numerous pipelines and a waterway that supports commercial marine transportation.

Victoria County LEPC conducted an HMCFS in 2009. The purpose of conducting the study was to develop a better understanding of hazmat transport in the county, identify changes to transport patterns since the LEPC's previous HMCFS (1996), and consider hazmat routing designations. A university-based state agency was contracted to help conduct the project. Funding sources included an HMEP grant, in-kind match by the university-based state agency which assisted with the project, and in-kind match provided by the LEPC through volunteer hours. The Texas Division of Emergency Management administered the HMEP grant funds and monitored project performance.

A county profile is presented in the project report, describing demographics, transportation and critical facility infrastructures, climate and weather, soil and terrain, and water resources. Transportation network maps for all surface modes and pipelines are included.

Most of the volunteer effort was for collecting information about roadway hazmat transport. The project focused on the two major U.S. highways that transect the county and also included major arterials. Overall, over 330 hours of truck traffic observations were recorded for over 24,000 trucks at 16 different locations in the county (travel time and mileage to and from count locations were additional). The volunteer effort was coordinated by local (city and county) emergency management. The LEPC was able to obtain a high level of involvement from community members, including staff from a regional hospital, industry, and emergency response agencies. The LEPC facilitated volunteer participation by providing data collection facilities (including a mobile command unit) for protection from summer heat, and scheduling volunteer participation for different times and locations to ensure a broad coverage of data sampling.

The data were collected using representative sampling for some roadways, and cluster sampling for priority roadways. Traffic count periods ranged between 15 minutes and several hours. Trucks were counted by configuration (straight and tractor-trailer) and type (box van, refrigerated van, bulk aggregate tank, liquid tank, utility, flatbed, etc.). Placards were identified by the most specific information identifiable by data recorders, up to specific UN/NA placard IDs.

The traffic data were evaluated by the university-based state agency and presented to the LEPC in a project report. The percentage of placarded trucks was summarized for different roadways, by truck type and configuration, hazmat class/division, the most frequent placards observed, and higher hazard materials placards observed including toxic inhalation hazard (TIH), violent polymerization, and water reactive placards. In addition, the percentage of corresponding 2008 *ERG* numbers based on observed placards also was presented. Initial response guidelines from the *ERG* were summarized for higher hazard UN/NA placard IDs that were observed.

The most frequent UN/NA placard IDs observed in the county were identified. Overall, over 2,250 placards were observed; there were 180 different 4-digit UN/NA placard IDs observed, along with other placards with less-specific information (e.g., "Flammable," etc.)

In addition, daily truck traffic patterns were identified for major roadways where data supported development of that information. The project results were validated by comparison with hazardous material and truck traffic observations from an adjacent LEPC's HMCFS, and with TxDOT truck traffic survey estimates. Because of different sampling locations and procedures, information that could be compared directly with the LEPC's 1996 study and the TxDOT data were limited (the 1996 study counted only placarded trucks, not all trucks, and at different locations; the TxDOT study classified vehicles by weight and number of axles, not truck configuration or hazardous materials content). However, comparisons for some commodities were able to be made, and it also was determined that overall placarded truck traffic increased substantially. Truck incidents locations resulting in hazmat releases were identified and mapped based on information contained in a Texas Commission on Environmental Quality incident database and PHMSA's HMIS database.

Data for transport of hazardous materials by rail were provided by the Class I rail carriers operating over UP trackage in the county and rail summarized by hazmat class and division for major trackage segments, by annual number of carloads. Information also was summarized for TIH, violent polymerization, and water reactive hazardous materials, including number of carloads per segment and initial response guidelines.

Waterborne transport of hazardous materials were estimated from the USACE *Waterborne Commerce of the United States, Calendar Year 2007, Part 2—Waterways and Harbors, Gulf Coast, Mississippi River System and Antilles* report. Materials transportation quantities are limited compared with those transported along coastal counties in the state. Pipeline maps were developed using PHMSA NPMS data for different commodity types, and pipelines were assumed to be full and operating (throughput was not evaluated).

Project results were distributed to emergency response and emergency management agencies, and the local metropolitan planning organization. The project results raised attention about vehicle placarding requirements relative to license and weight enforcement activities. The information will be used to identify whether modifications to local hazmat route designations may be needed. The project results also will be used to identify and document equipment and training needs for emergency response agencies, particularly those of smaller communities in the area.

APPENDIX D

Promising Practices for Conducting an HMCFS

Best practices reported by LEPCs in the survey conducted for this project, case studies, and interviews were overlaid on some of the most important concerns expressed by LEPCs for conducting HMCFS. "Promising practices" were compiled from direct reports of best practices by LEPCs in meeting critical HMCFS needs as well as logical progressions to fill identified gaps in the process. The 11 promising practices are:

1. **Use HMCFS Objectives Checklist**—Consists of an initial checklist of objectives that local entities have reported for their HMCFS.
2. **Let HMCFS Objectives Guide Sampling**—Identifies the appropriate balance between the desire for extensive data collection, the project's objectives, and the realities of limited resources.
3. **Let HMCFS Objectives Guide Precision**—Matches the HMCFS project's objectives with the level of precision of HMCFS data collection efforts.
4. **Match Protection Level with HMCFS Objectives**—Evaluates the extent of match between desired risk level (goals) for a community and the HMCFS project's objective(s). This helps ensure consistency of project results with their ultimate purpose: ensuring public protection.
5. **Stretch Limited Time and Resources**—Suggests ways for funding an HMCFS using in-kind funding, volunteer participants, industry contributions, and sequenced HMCFS activities.
6. **Consider Consecutive Year Studies**—Deals with time constraints that can be associated with funding cycles. Shows how a more comprehensive and complete HMCFS can be conducted over several years.
7. **Use Volunteers to Conduct HMCFS**—Identifies key HMCFS project activities for LEPC members regardless of whether the HMCFS is done by the LEPC or by a contractor.
8. **Use Existing Data Sources**—Provides a list of potential existing data sources to help those conducting an HMCFS (especially first-timers) start the process.
9. **Use Hotspots Analysis**—Examines collocation of hazardous materials and human populations in time and space.
10. **Use Risk Communication Checklist**—Includes a list of locations, people, or offices to consider for the communication of HMCFS results.
11. **Demonstrate Local Risk**—Suggests ways that risks associated with hazmat transportation through an area can be communicated to help local leaders understand the importance of taking preemptive actions, reducing risk, and mitigating consequences.

D.1 Use HMCFS Objectives Checklist

Why is the HMCFS being conducted? There are many reasons local jurisdictions choose to conduct an HMCFS, ranging from very general, such as enhancing awareness about whether hazmat transport is present in a community, to very specific, such as designating a hazmat transportation route. Many LEPCs use HMCFS results to learn about hazmat transport, conduct planning, or guide training exercises. Many other LEPCs also use HMCFS results to inform equipment needs. Some LEPCs use their HMCFS to conduct risk analysis for hazardous materials route designations or other applications.

Understanding the objectives of the HMCFS corresponds with the types of decisions users hope to make based on the information. Too little information results in decisions based on insufficient information, may lead to poor decision making and increases community risk. Too much information can result in misallocation of resources (i.e., time, money, and personnel effort) in the process of collecting the supporting data. Lack of clarity about objectives increases the likelihood that the HMCFS will fail to satisfy user needs. Promising Practice 1: Use HMCFS Objectives Checklist helps focus the effort on stated objectives given the realities of limited resources.

Promising Practice 1: HMCFS Objectives Checklist

The HMCFS objectives checklist is comprised of an initial checklist of some of the objectives that local entities have reported for their HMCFS. Local entities simply review the components associated with the different outcomes and check those desired for their hazmat CFS. If a variety of objectives are identified, they may be applied independently to different corridors, routes, or route segments. At a minimum, discussion among participants about project objectives helps clarify the purpose of the HMCFS. The following advantages and disadvantages of using the checklist are provided.

Objective Category	Objective Component
Awareness/Minimum Scenario Definition	☐ Increase awareness of hazmat transport for local officials, community groups, or general public. ☐ Confirm or document existing knowledge about hazmat transport in jurisdiction.
Maximum Scenario Definition	☐ Guide hazmat response training, preplan incident response.
Emergency Planning	☐ Plan for hazmat incident prevention, response, and mitigation. ☐ Assess risks for hazmat incidents in jurisdiction. ☐ Develop and locate emergency notification, shelter, and evacuation warning and communication systems.
Comprehensive Planning	☐ Community planning and zoning and infrastructure planning.
Equipment Needs	☐ Identify hazmat response equipment deficiencies/needs. ☐ Provide grant funding justification.

Objective Category	Objective Component
Resource Scheduling	☐ Establish or increase hazmat response teams. ☐ Schedule personnel, equipment, other resources.
Route Designation	☐ Locate new public/high-occupancy facilities. ☐ Designate hazmat routes or transport corridors.
Legal Takings	☐ Relocate public, high-occupancy, or industrial facilities. ☐ Restrict access, operations, development, or other usage of high-risk locations.

What other objectives might your community have for conducting an HMCFS? How do they relate to the objectives listed above?

The Objectives Checklist has Advantages (A) and Disadvantages (D)	
A Focuses available resources on information required for objectives. Lowest data collection requirements mean reduced resource requirements. A Explicit delineation of the outcomes desired from the hazmat CFS. A Captures the goals and outcomes of the hazmat CFS implementation team.	D Potentially misses objectives that may arise but remain hidden during the early phase of the work. Can be overcome by periodic reflection on goals throughout the HMCFS process. D Explicit delineation of objectives may stifle creativity and innovation. Can be overcome by keeping communication lines open and providing opportunities for innovative thinking. D May inadvertently encourage ignoring data inconsistent with objectives. Can be overcome by specific search for, and listing of, inconsistent data. D Conclusions made based on information may be more focused than actual operating conditions. Can be overcome by incorporating focused CFS goals into "operational conditions" during exercises and drills.

D.2 Let HMCFS Objectives Guide Sampling

Some data, such as national-level estimates, should only be used to develop very general ideas about the nature and patterns of what might be travelling through a jurisdiction such as a city or county. Other data provide enough information to understand the local nature and patterns of hazmat transport in a jurisdiction, but not for specific times, locations, or individual hazmat commodities. At the highest level, data are very locally detailed and can be used to identify the particular nature and patterns of what has been observed in a jurisdiction, even for a specific network location, time of day, or hazmat commodity. Promising Practice 2: Let HMCFS Objectives Guide Sampling suggests some guidelines for how hazmat transport data should be sampled (that is, where, when, and how often data should be collected) in order to match the HMCFS project's objectives.

Promising Practice 2: Let HMCFS Objectives Guide Sampling

Problem

Understanding the objectives of the hazmat CFS helps identify the information required and the precision needed to make these types of decisions. Too little information results in decisions based on insufficient information; too much information may result in misallocated resources (i.e., time, money, and personnel effort).

Promising Practice

This promising practice helps identify the appropriate balance between the desire for extensive data and the realities of limited resources by providing a matrix for matching HMCFS objectives with sampling frameworks. See Appendix H for further information about sampling frameworks.

Convenience sampling involves selecting observational units (network segments, locations, times, and frequencies of data collection) because of the ease associated with making observations. Convenience sampling can effectively be used to establish the existence of, but not the extent or distribution of, hazardous material in a community.

Representative sampling involves selecting observational units to represent major groups of hazmat flows in a community. Representative samples are slightly stronger than convenience samples and can be used to reflect types of hazmat in a community, but cannot establish magnitude of flow or the empirical likelihood of hazardous materials across a network.

Cluster sampling involves selecting multiple representatives from major groups of observational units. Clusters can be used to estimate the existence and magnitude of hazmat flows in a community. Observations may have limited generalizability beyond the empirical sample.

Stratified and proportional samples involve selecting observational units in numbers proportional to those in the overall population. Hence, stratified and proportional samples are only possible when sufficient prior data exist to establish the proportions of various types of observational units. Stratified and proportional samples can be used to estimate the existence and magnitude of HazMat flows. Since the sampling is based on existing data, stratified samples encounter some limitations in tracking new types or quantities of hazmat transport patterns. Most HMCFS objectives can be accomplished with low levels of data sampling.

Random samples are the "gold standard" of sampling but are also generally impractical for most HMCFS applications. They involve selecting observational units in a truly random manner. Hence, no information is required on the type or quantities of flow and no limitations are encountered. When randomly selected data are distributed in time and space, random samples can prove quite ineffective use of data collection resources—due to travel between units and waiting for the next temporal unit to occur.

A complete census involves observing all units in the universe as a whole. It is usually not logistically possible in most survey applications. However, in rare instances, a census of information is available or relatively easy to attain. For example, when hazmat flows are small or limited, it may be possible to observe all flows in a community. When available, a census meets all decision objectives but it is not usually recommended due to its constraints.

The vertical axis of the following figure lists HMCFS objectives in terms of increasing complexity. Trace along the row of the highest HMCFS project objective until it is matched with the appropriate sampling framework. This helps identify data requirements and avoid misallocation of data collection resources.

Objectives	Sampling Framework					
	Convenience	Representative	Cluster	Stratified/ Proportional	Random	Census
Legal Takings and Route Designation	<	<	<	=	=	>
Resource Scheduling, Equipment Needs, and Comprehensive Planning	<	<	=	=	>	>
Emergency Planning	<	<	=	>	>	>
Maximum Scenario Definition	<	=	=	>	>	>
Awareness/Minimum Scenario Definition	=	=	>	>	>	>

<	Information collected using sampling framework is insufficient for objective(s)
=	Information collected using sampling framework matches objective(s)
>	Information collected using sampling framework exceeds requirements for objective(s)

The Objectives-Sampling Matrix has Advantages (A) and Disadvantages (D)

A It matches the project's objectives with the sampling procedure capable of producing information sufficient to achieve these outcomes.

A It reduces chances of misallocating resources by collecting data that are not needed to achieve objective(s).

A It reduces the likelihood of making decisions based on insufficient information.

D It inhibits mid-stream adjustments, especially when objectives are broadened to include greater information requirements. This can be overcome by recognizing when data are critical to achieve objectives and remaining flexible enough to change sampling frameworks for particular locations when warranted.

D When little is initially known about hazmat flows in a community, it may be difficult to foresee how an HMCFS may be used, making identification of sampling frameworks more difficult. It can be overcome by recognizing that as more HMCFS information becomes available, the picture becomes clearer and objectives and sampling frameworks can become more defined.

D.3 Let HMCFS Objectives Guide Precision

The higher the level of precision used to collecting HMCFS data, the more effort is required. Promising Practice 3: Let HMCFS Objectives Guide Precision suggests a classification system that helps determine when the additional usefulness is warranted. It can be used to define data collection requirements for hazmat quantity (e.g., hazmat presence, relative hazmat quantity such as "small," "medium," and "large" quantities, or specific hazmat quantity such as number of gallons or pounds transported) and hazmat classification (e.g., whether or not it is hazmat, chemical/material class/division, UN/NA placard ID, or specific chemical/material name).

Promising Practice 3: Let HMCFS Objectives Guide Precision

Problem

Having extra data available can be nice when other needs arise. However, data collection can be expensive, and scarce resources can sometimes be misallocated if outcomes are based on more information than is needed. When decision outcomes use insufficient data, they are often challenged or fail to meet the objectives. The problem becomes, how to efficiently choose appropriate levels of precision (hazmat quantity and characterization) so that data can support the project's objectives?

Promising Practice

This promising practice lets the objectives of the HMCFS guide the precision of hazmat transport data collection. This helps save resources while maximizing utility.

When highly precise data are collected for low-level decision outcomes, the information content is overmatched with the desired outcome. Collecting less precise data can be sufficient for low-level outcomes but should not be "over-extended" to high-level decision outcomes. As the level of HMCFS objective increases, more precision is often required.

The Objectives-Precision Matrix has Advantages (A) and Disadvantages (D)	
A It allows local entities to provide detailed information in focus areas. A It promotes efficient use of available resources in the conduct of HMCFS.	D It has the potential to misallocate resources to areas not requiring attention or distract local entities from most serious hazmat flow issues in the area. This can be overcome by open, inclusive communication among local leaders, especially early in the HMCFS process.

The vertical axis of the following figure lists HMCFS objectives in terms of increasing complexity. Trace along the row of the highest HMCFS project objective until it is matched with the appropriate precision levels for hazmat quantity and characterization. This helps identify data requirements and avoid misallocation of data collection resources.

	Hazmat Quantity			Hazmat Characterization			
Objectives	Hazmat Presence	Relative Quantity (e.g., # trucks, placards, or small, medium, and large quantities)	Specific Quantity	Hazmat Yes/No	Class/Division	UN/NA Placard ID	Specific Material/Chemical
Legal Takings and Route Designation	<	=	=	<	<	=	=
Resource Scheduling, Equipment Needs, Comprehensive Planning, Emergency Planning, and Maximum Scenario Definition	<	=	>	<	=	=	>
Awareness/Minimum Scenario Definition	=	=	>	=	=	>	>

<	Information collected at precision level is insufficient for objective(s)
=	Information collected at precision level matches objective(s)
>	Information collected at precision level exceeds requirements for objective(s)

D.4 Match Protection Level with HMCFS Objectives

Planning for everything can often result in planning for nothing! When resources are limited, trying to plan for every possible outcome may result in the limited utility of what is accomplished. Too little information results in decisions based on insufficient information; too much information may result in misallocation of resources (i.e., time, money, and personnel effort). Four levels of public protection (risk) goals are considered: complete protection (all risks), maximum protection (possible risks), reasonable protection (probable risks), and general protection (most likely risk).

D.4.1 Complete Protection

The goal at this level is to protect the public from all risk. The standard of protection is zero risk tolerance. This standard was implemented under the Delaney Clause of the 1958 amendment to the Food, Drug and Cosmetic Act of 1938. Named after the Congressman Delaney of New York, the language of the bill called on the FDA to prohibit the use of chemical food additive(s) that induce cancer in humans or animals (*15*). This criterion was applied to herbicides and pesticides in processed foods until 1996, when the Delaney Clause was removed. Emergency responders are often caught up in the desire to provide complete protection from all potential harm, including environmental harm. This is especially prone to occur when minimal information is known about a jurisdiction's hazmat flows. Fundamentally, the zero-tolerance policy fails to recognize human mortality, vulnerability, and that bad things happen.

D.4.2 Maximum Protection

This goal seeks to protect the public from all possible risk(s) and does not spend resources on the impossible or unforeseeable. This protection standard was originally cast from the congressional mandate for maximum public protection in the disposal of the unitary chemical stockpile (*16*). This risk was eventually standardized in the magnitude of 10^{-8}, or greater than one chance per hundred million. Protection at this level is often characterized in the selection of protective actions for the public, including large-scale or general evacuations.

D.4.3 Reasonable Protection

This goal seeks to protect the public from all probable risk(s), eliminating risks with very low potential from consideration. This standard of public protection was originally cast in the Nuclear Regulatory Commission (*17*) language pertaining to the licensing of nuclear waste disposal for which applicants must assure that the proposed site, design, facility, closure, and institutional controls are adequate to provide reasonable assurance of protection to the general public. This risk was operationally defined as in the magnitude of 10^{-6} or greater than one per million. Providing reasonable protection might involve matching protective actions for various populations in a position to be directly harmed near the incident, including shelter-in-place protection for institutional populations and limited evacuation for mobile populations.

D.4.4 General Protection

This goal seeks to protect the public from risks that are most likely to occur under normal operations. This standard of protection of the public is often used as the legal standard of negligence. Operators that fail to plan for these relatively common accidents with magnitudes of 10^{-4} or greater than one in a hundred thousand in routine operations would certainly be held accountable. In the railroad, computing, and chemical industries, this is often referred to as "five–nines" reliability. There are many such incidents, and routine tank-car or tank-truck incidents where flammable fluids are involved would be among them. Protection for these accidents is typically confined to the protection of emergency responders.

Promising Practice 4: Match Protection Level with HMCFS Objectives describes how local entities can match desired level of risk with HMCFS objectives.

Promising Practice 4: Match Protection Level with HMCFS Objectives

Problem

Once a jurisdiction's desired level of protection and HMCFS project objectives have been defined, evaluating whether they are matched to each other can help ensure consistency of project results with their ultimate purpose: ensuring public protection.

Promising Practice

The objectives provide a focus for the HMCFS process but they also have direct implications for the results of the study and the hazard management in the area. The desire of precise and exhaustive data is seldom realistic. A balance is achieved by matching the objectives with the protection levels of interest in the study area.

Emergency planning often uses accident scenarios for a given area to test preparedness across a distribution of accidents. Less specific outcomes require very little, mostly generic scenarios, but more precise detailed data are required for more specific outcomes. Awareness requires very little occurrence information, while route adjustments and takings have intense data requirements. This guidebook considers four levels of planning scenarios: complete protection from all risks, maximum protection from possible risks, reasonable protection from probable risks, and general protection from most likely risks.

Identify Boundary Conditions

The vertical axis of the figure below illustrates HMCFS objectives in terms of increasing complexity. Trace along the row of the highest objective used for your HMCFS until it is matched with the desired level of protection. Matching the HMCFS objective(s) with the desired protection level helps the core team recognize the limits of the study.

Objectives	Protection Level Considered			
	Complete	Maximum	Reasonable	General
Legal Takings and Route Designation	<	<	<	=
Resource Scheduling, Equipment Needs, and Comprehensive Planning	<	<	=	=
Emergency Planning	<	=	=	=
Maximum Scenario Definition	<	=	=	>
Awareness/Minimum Scenario Definition	=	>	>	>

<	Too conservative—more decision weight is given to low-likelihood events than is warranted.
=	Matched—objectives are matched with protection level and corresponding risk.
>	Over-generalized—there is more information than needed for objectives.

The Objectives-Protection Matrix has Advantages (A) and Disadvantages (D)

A It matches the goals and objectives with the planning standard appropriate for these types of decisions.

A It reduces chances of wasting resources to collect data that are not needed to reach decisions objective(s).

A It reduces the likelihood of making decisions on insufficient information.

D It inhibits mid-stream adjustments, especially when decision outcome(s) are broadened to include greater information requirements. This can be overcome for special circumstances through focused, more in-depth investigations where needed, but are appropriately adhered to overall.

D.5 Stretch Limited Time and Resources

Depending on the level and type of information needed, as well as the effort required to obtain that information, an HMCFS can range from a simple, low-cost effort to one that is very complex, involving the expenditure of a large amount of monetary or personnel resources. After identifying what needs to be done, the next step is to identify how it is going to be done, and who is going to do it. Promising Practice 5: Stretch Limited Time and Resources discusses options for funding an HMCFS.

Promising Practice 5: Stretch Limited Time and Resources

Problem

Limited time and resources are often critical, especially for medium-to-large local entities where resources are limited, but hazmat flows are often large and complex. Such local entities may experience the funding "squeeze" from both ends.

Resources to conduct HMCFS are often limited but at the same time critical to completing and implementing results. Grant mechanisms for the conduct of HMCFS—such as federal grant funding through the Hazardous Materials Emergency Preparedness (HMEP) Program (via SERCs)—may require matching funds. Local entities often lack experience using match funding mechanisms. They may not know that such funds are available, or do not understand mechanisms by which matching funds can be obtained and implemented. Improving local understanding about the use of matching funds through hard and/or soft matches (e.g., volunteer participation) is an important promising practice.

Promising Practice

LEPCs were established under EPCRA to implement the planning and recordkeeping aspects of the Act. Most LEPCs are voluntary in nature, and funding for their activities tends to be sparse and difficult to come by. The most common funding sources for LEPC activities include: volunteers, donated services, local government funding, grants, supplemental environmental projects, and industry donations.

The U.S.DOT's HMEP grants are one way to fund an HMCFS. These grants carry a match requirement. The non-federal match requirement for HMEP grant funds is 25% of the grant value (this equals 20% of the total project cost). This match may be either a hard match (e.g., cash) or a soft match (e.g., in-kind contribution). OMB Circular A-87, *Cost Principles for State, Local, and Indian Tribal Governments* (*18*), defines match funding requirements for local entities that use federal grant funds, including HMEP grants. Most LEPCs rely heavily on volunteers and members for in-kind match contributions, such as volunteer hours.

In-kind funding is not limited to hours that volunteers spend counting vehicles. An example of the activity categories, personnel, and rate calculation is shown below. Note that the activities, number of personnel, effort, and rates are hypothetical and provided as a summary spreadsheet example only. They may not reflect the activities, effort, or rates at any particular LEPC.

Volunteer participants—Community volunteers for an HMCFS may include members of the Community Emergency Response Ream (CERT) or Citizen Corps Councils (CCCs), first responders, scout groups, college students, as well as members of the general public. Smaller and rural LEPCs often have the advantage in community support for this type of

Activity	Personnel	No.	Effort	Rate*	In-Kind Value	Notes
Kickoff Meeting	Supervisors	6	2 hrs	$50/hr	$600	Does not include mileage to/from meeting or meals
	Line Staff	4	2 hrs	$30/hr	$240	
	Clerical Staff	1	4 hrs	$20/hr	$80	
Training and Data Collection	Supervisor	1	8 hrs	$50/hr	$400	
	Line Staff	8	20 hrs	$30/hr	$4800	
	Clerical Staff	2	5 hrs	$20/hr	$200	
	Mileage		340 mi	$0.50/mi	$170	
Analysis, Application, Presentation	Supervisors	6	2 hrs	$50/hr	$600	Example: review project results and ID equipment needs. Does not include mileage or meals.
	Line Staff	4	2 hrs	$30/hr	$240	
	Line Staff	4	2 hrs	$30/hr	$240	
	Clerical Staff	2	2 hrs	$20/hr	$80	
Total					**$7650**	Matches $30,600 grant at 25% match requirement

* Hypothetical rates. May reflect fully loaded rates with benefits, administrative costs, and overhead, not just base salaries. **Matching funds must be documented according to OMB Circular A-87.**

volunteer contribution. Residents of these types of jurisdictions tend to be "vested" in the community and, as a result, are more apt to participate. Many LEPCs undertake an HMCFS due to third-party interest. These third parties also make good sources for in-kind matching resources (e.g., if a school district has a vested interest, they may be willing to pay bus drivers a few extra hours to become observers along their routes).

Industry contributions—Some LEPCs receive industry donations (e.g., in the form of membership dues) to augment local government contributions and to meet matching requirements for grants. Industries may also make personnel available for participation in the HMCFS project.

The following table is a potential, but not exhaustive, checklist of in-kind match, hard match, and other match sources. Match sources must document how they supported the HMCFS. Specific matching requirements can be found in OMB Circular A-87.

In-Kind Match Sources (Volunteer Time)		Hard Match Sources	Other
☐ Municipal Admin.	☐ County Admin.	☐ State (Emerg. Mgt., Environ., Trans., Hwy. Patrol, Other Agencies)	☐ Mileage
☐ Planning Staff	☐ Zoning Commission	☐ County	☐ Postage
☐ Fire Department	☐ Emergency Mgt.	☐ Municipal	☐ Phone
☐ Police Department	☐ Sheriff's Department	☐ Industry	☐ Facilities
☐ Health Department	☐ Industry Personnel	☐ Private	☐ Meals
☐ Hospital	☐ HazMat Carriers		☐ Mat'ls. & Supplies
☐ Comm. Advocates	☐ CERTs		

Sequenced HMCFS—Local entities experiencing the funding "squeeze" could consider sequenced efforts that are individually more limited in scope in any given funding year but accomplish the comprehensive HMCFS over a several-year period. This is particularly pertinent for LEPCs with staff limitations, local entities that rely on grant funding, or LEPCs that are conducting more extensive HMCFS efforts (e.g., either with broader, more interrelated jurisdictional coverage or level of detail). For example, a 2-year project might see an LEPC review and evaluate existing information and identify target areas for collection of new data in the first year, and then collect and analyze the new data in the second year. Other possibilities might focus on one mode of transportation in one funding year and another mode in subsequent years, or focus on one corridor in one year and another thereafter.

Using Matching Resources has Advantages (A) and Disadvantages (D)	
A Donations from industry help fund HazMat CFS effort and provide incentive for industry participation and commitment.	D Because donations from industry are often voluntary and rely on the generosity and ability of the local industry to contribute, they can vary from year to year and project to project. This can be overcome by actively engaging donors in the process.
A In-kind contributions used in lieu of hard matches provide matching funds and assure participation of interested parties.	D In-kind contributions can be very difficult to track and coordinate. This can be overcome by setting up effort tracking systems and careful record keeping.
A Even small in-kind contributions can contribute to the overall commitment and promote buy-in to the process.	D Volunteer workforces may prove difficult to coordinate and supervise, particularly in large, complex metropolitan areas. This can be offset by the added buy-in from the workforce for the project and the goals of the LEPC.
A Volunteers and in-kind contributions are often easier to coordinate in rural jurisdictions.	D Volunteer data collection has limited quality control. This is best overcome by training, including stressing the importance of accuracy and care required in making hazardous materials observations.

D.6 Consider Consecutive-Year Studies

Many locations have seasonal traffic variations associated with industrial, agricultural, or other economic bases. As identified in FHWA's *Traffic Monitoring Guide*, it is important to keep the following in mind:

> Truck traffic patterns are governed by a combination of local freight movements and through-truck movements. Extensive through-truck movements are likely to result in higher nighttime truck travel and higher weekend truck travel. Through-traffic can "flatten" the seasonal fluctuations present on some roads, while creating seasonal peaks on other roads that have nothing to do with economic activity associated with the land abutting that roadway section. . . . Local truck traffic can be generated by a single facility such as a factory, or by a wider activity such as agriculture or commercial and industrial centers. These "point" or "area" truck trip generators create specific seasonal and day-of-week patterns much like recreational activity creates specific passenger car patterns. Truck trips produced by these generators can be highly seasonal (such as from many agricultural areas) or fairly constant (such as flow patterns produced by many types of major industrial plants) (*14,* Section 4, Chapter 3, Permanent/Continuous Classifiers section, Create Initial Factor Groups subsection, paragraphs 1 and 3).

The annual grant funding cycle through the HMEP Grant Program creates challenges for collecting HMCFS data for more than one or two seasons, unless multi-year efforts are specifically programmed through a state's SERC (and then funding is contingent on appropriation of HMEP funds and approval of funding administrators) or conducted using other funding sources. However funded, partitioning a complex HMCFS over several years can provide an incremental approach to a more complete outcome using resources available and it can allow for collecting seasonal data. Promising Practice 6: Consider Consecutive-Year Studies covers how an HMCFS can be scaled over several years to address scheduling and resource limitations, which may be particularly applicable in large jurisdictions.

Promising Practice 6: Consider Consecutive-Year Studies

Problem

Limited timeframes often create artificial temporal boundaries for conducting an HMCFS. Local entities apply for grants to conduct the study, receive funding in the early months of the fiscal year, collect data during the late spring/early summer, and report results in the fall, leaving out seasonal traffic variations.

Promising practice

One way to deal with these time constraints is to plan a more comprehensive and complete HMCFS over several years. Through these project phases, the HMCFS produces additional information each year and also considers the need for seasonal adjustments, more detailed work along certain corridors, or investigating specific concerns raised by third parties in interviews. Several examples of activities are shown in the following table.

Example Activities

I	II	III
Year 1		
Study of primary corridor(s): spring–summer	Study of primary corridor(s): existing data only	Study of primary corridor(s): spring–summer
• Interview key informants about other areas of concern • Identify key concerns not addressed by baseline • Present results from baseline study • Plan Year 2 activities		
Year 2		
Study of primary corridor(s): fall–winter	Study of primary corridor(s): collect new data	Study of secondary corridor(s): spring–summer
• Conduct focused investigations to address critical concerns • Update baseline study with expanded information • Brief critical CFS stakeholders • Plan Year 3 activities		
Year 3		
Study of secondary corridor(s): spring–summer	Study of primary corridor(s): fall–winter	Investigate potential for seasonal variation: fall–winter (key corridors)
• Focus on overall analysis • Plan response(s) in terms of adjustments to: hazmat routes, comprehensive planning, emergency equipment needs, and emergency plans/operations		

Consecutive-Year Studies have Advantages (A) and Disadvantages (D)	
A They allow local entities to collect more detailed information over time. A They promote efficient use of available resources. A They allow for local feedback and two-way communication among key stakeholders. A They can focus on the most serious hazmat flow issues raised in the area over time. A They identify new and unknown issues through feedback with stakeholders.	D Data for any given place may be less current as they are not collected every year. This is offset because more detailed data are obtained in the long-run, especially in places where there is little year-to-year variation in hazmat transport. D They require long-term commitments from participants or participant organizations and can be challenging to coordinate and supervise, particularly in large, complex metropolitan areas. This can be offset by the buy-in that committed organizations provide to the effort and the LEPC's ongoing activities.

D.7 Use Volunteers to Conduct HMCFS

Coordinating volunteers and keeping them engaged through a complex HMCFS can be a challenge. Promising Practice 7: Use Volunteers to Conduct HMCFS presents issues particularly relevant to LEPCs for conducting an HMCFS using volunteer participation.

Promising Practice 7: Use Volunteers to Conduct HMCFS

Problem

The LEPC is a focal point for hazmat emergency management and preparedness in local jurisdictions. An LEPC is made up of volunteers from the community it serves. LEPC membership includes representatives selected by the local governmental entities and is approved by the SERC. The LEPC membership must include local officials, police, fire, civil defense, public health, transportation, and environmental professionals, as well as representatives of facilities subject to the emergency planning requirements, community groups, and the media. Keeping this critical group of community leaders involved in the HMCFS is essential to a well-informed study that is able to meet the project's objectives.

Promising Practice

The voluntary composition of, and participation in, the LEPC are both the greatest strength and weakness of the committee. In an active LEPC, each member brings unique perspectives to the committee, and the diverse public and private views of the community being represented. The equal representation of views and knowledge is the committee's greatest strength. Additionally, the diversity of the committee provides increased resources and allows the committee to become a mechanism for collaboration between various industry and the community interests.

Some LEPCs suffer from passive participation. This lack of participation is often the result of members or potential members—or the entities that they represent—not understanding the importance of the committee's functions. The consequence of this lack of participation is a weak or inactive LEPC that struggles to fulfill its responsibilities to the community. Hence, participation by the LEPC in the HMCFS is important to the success of the study.

Demands on LEPC volunteers can be time consuming, and without the cooperation and support of local government and industry, finding qualified volunteers and members can be a daunting task. Because an LEPC is voluntary in nature, LEPCs are often unmanned and under-funded as noted in the 2001 National Institute of Chemical Studies report to the EPA regarding LEPCs and risk management plans (*19*). This study examined how LEPCs could use risk management plans to improve community safety and promote hazard reductions. The study found that encouraging hazard reductions was recognized as a logical role of many LEPCs, and there were a number of challenges and concerns that hindered them from implementing that role. Among the concerns were: lack of mandate under EPCRA, lack of resources, lack of technical expertise, unclear responsibilities, public apathy, and lack of support. The study team recommended a number of ways that the EPA could address LEPC concerns and strengthen their role in hazard reduction.

LEPC-conducted HMCFS—When an LEPC conducts its own HMCFS it fosters the active participation of its members in the emergency planning process. Participation of committee members in a commodity flow study is achieved especially through member participation in project planning, data collection, analysis, and other HMCFS activities.

Contractor-conducted HMCFS—Some LEPCs may also choose to hire an outside entity to conduct the study. If an outside contractor is used to collect the data and conduct the study, the LEPC still needs to be actively involved in the study. Involvement by the committee in the process increases the understanding of the process and can also be used as part of the match that may be required by grants.

LEPC Participation Checklist

There are various activities in which LEPC members can be involved throughout the HMCFS process. The following checklist is not intended to be comprehensive or exhaustive, but rather suggests the kind of activities that may assure LEPC participation in the process. LEPC members may be asked to

- ☐ Provide HazMat transport data;
- ☐ Provide or augment planning support;
- ☐ Provide or augment logistic support;
- ☐ Provide facilities for planning meetings, training, and analysis;
- ☐ Recruit and/or coordinate volunteers;
- ☐ Volunteer for data collection efforts;
- ☐ Provide expertise in consultant roles throughout the process;
- ☐ Provide input to the contractor about the purpose and use of the study;
- ☐ Provide input about historical events or special local situations that may not be readily known;
- ☐ Provide assistance to the contractor in acquiring data (e.g., LEPCs are able to more readily access data from Tier II companies and some transporters such as rail and barge companies);
- ☐ Provide input on whether site locations for data collection sites meet the needs of the jurisdiction;

- ☐ Serve as a study liaison to media outlets;
- ☐ Review results to assure broadest possible appropriate application;
- ☐ Present to, and discuss results with, local entities;
- ☐ Serve as critical informants; and
- ☐ Lead/coordinate data collection effort(s) at specific locations, or at some particular time period.

Volunteer HMCFS Participation has Advantages (A) and Disadvantages (D)

A It provides understanding and insight into types of hazardous material traversing the jurisdiction and patterns of flow.

A Volunteer involvement increases the understanding of the process by the LEPC.

A Participation can also be used as part of the match that may be required by grants.

A Participation in the HMCFS is likely to increase interest by members in the functions of the committee, which promotes a more active LEPC.

A Contact by LEPC members with industry during the study can be used as a mechanism for recruiting new members to the committee.

A Participation in an HMCFS can demonstrate utility and thereby help retain existing LEPC members.

D Commodity flow studies conducted internally may compromise objectivity as local entities and leaders inject concerns. This may be overcome by assigning roles in HMCFS that are independent of on-going political or agency roles.

D Commodity flow studies conducted by an outside source may discourage participation. This is best overcome by using contractors with a record of encouraging participation and specifically asking local officials to participate in the process.

D Participation in the study process may burden already overworked and overcommitted volunteers. This is overcome by allowing volunteers to limit participation, lead others, and supervise others in the completion of assigned tasks. This takes advantage of special skills and knowledge sets and reduces overall burden.

D.8 Use Existing Data Sources

Even for the experienced, remembering the numerous sources of data can be onerous. Promising Practice 8: Use Existing Data Sources presents a summary of existing data sources that allow users to tabulate the availability and relevance of different data sources and can help to determine where focus needs to be placed for collection and evaluation of existing data. The checklist is not exhaustive of all the information sources included in this guidebook.

Promising Practice 8: Use Existing Data Sources

Problem

The task of identifying relevant existing data sources can seem daunting. Local leaders report "not knowing where to start" in the early phases of an HMCFS.

Promising Practice

A list of potential sources can help those conducting an HMCFS (especially first-timers) to start the process. Review each source on the list to identify whether it has data applicable to your jurisdiction, HMCFS objective, and data requirements. There are many sources of data and any list (including this one) cannot pretend to be complete. Federal sources of data are the most comprehensive in terms of the types of data available. State data sources vary but can be nearly as comprehensive and more relevant to local concerns. Local sources are often unique to each locality. They include data provided by good corporate neighbors, but efficiently obtaining these data can depend on personal relationships and contacts.

Federal sources of data include data on transportation and accidents, hazardous materials, mapping, emergency preparedness, and population exposure. Hence, data archived by U.S.DOT agencies (PHMSA, FHWA, FMCSA, BTS, STB, and FRA), the U.S. Department of Homeland Security (FEMA and USCG), U.S. Census Bureau, NTSB, U.S. Geological Survey, U.S. Department of Agriculture, and National Oceanic and Atmospheric Administration are often found to be useful.

State sources of data often include many of the same types of data as the federal sources, on transportation and accidents, hazardous materials spill/incidents, and emergency response and preparedness. Data are often archived in state departments of transportation, the highway patrol agencies, environmental quality or natural resources agencies, and emergency management agencies.

Local sources of data include county and municipal offices, as well as local private corporations. The county judge's office, local mayor's office, and even the chamber of commerce can often provide data about growth/decline and geo-location of local populations. Local sheriffs' departments, police departments, fire departments, and emergency managers can often provide information about recent (and sometimes historical) accidents and events. Local industry participants are often active in the LEPC and can be engaged to provide relevant data. Many of these people can provide insight into potential issues of concern through key informant interviews.

The Existing Data Source Checklist has Advantages (A) and Disadvantages (D)

Advantages	Disadvantages
A It provides a starting place for data acquisition efforts. A It helps avoid some important sources being overlooked.	D It is not to be interpreted as exhaustive—the HMCFS will develop other data or data sources as shown to be relevant. This can be overcome by thinking of the checklist as a place to begin the search for existing information rather than an exhaustive list of data sources. Remember that no list can be exhaustive in this ever-changing information age. D Data from some sources may require validation and "cleaning" to accurately reflect the local situation—data cannot always be taken at face value, and these are no exception. This is overcome by examining data for apparent inconsistencies and making appropriate corrections based on other relevant information.

Existing Data Sources	Applicability to Local HMCFS: Not Avail.	Not Appl.	Low Appl.	High Appl.
Prior CFS	☐	☐	☐	☐
Adjacent Jurisdiction CFS	☐	☐	☐	☐
Electronic Sources				
FEMA HAZUS-MH	☐	☐	☐	☐
FHWA Freight Analysis Framework	☐	☐	☐	☐
BTS National Transportation Atlas Database	☐	☐	☐	☐
PHMSA Incidents Reports Database	☐	☐	☐	☐
FMCSA Nat'l Hazmat Route Registry/Maps	☐	☐	☐	☐
FHWA Highway Performance Monitoring System	☐	☐	☐	☐
Census Bureau Vehicle Inventory and Use Survey	☐	☐	☐	☐
FMCSA SAFER Company Snapshot	☐	☐	☐	☐
PHMSA Company Registration Look-Up Tool	☐	☐	☐	☐
STB Carload Waybill Sample	☐	☐	☐	☐
FRA Rail Safety Data	☐	☐	☐	☐
PHMSA National Pipeline Mapping System	☐	☐	☐	☐
USCG Marine Casualty and Pollution Database	☐	☐	☐	☐
Census Bureau Census	☐	☐	☐	☐
USGS National Map	☐	☐	☐	☐
USDA Web Soil Survey	☐	☐	☐	☐
NOAA National Climatic Data Center	☐	☐	☐	☐
BTS Commodity Flow Survey	☐	☐	☐	☐
FHWA National Statistics and Maps	☐	☐	☐	☐
BTS Freight Data/Statistics	☐	☐	☐	☐
NTSB Accident Reports	☐	☐	☐	☐
FMCSA Crash Statistics	☐	☐	☐	☐
USACE Reports (various)	☐	☐	☐	☐
Shippers and Receivers				
Facility A: ____________________________	☐	☐	☐	☐
Facility B: ____________________________	☐	☐	☐	☐
Etc.				

Existing Data Sources	Applicability to Local HMCFS			
	Not Avail.	Not Appl.	Low Appl.	High Appl.
Carriers				
Class I RRs: BNSF, CN, CP, CSX, KCS, NS, UP	☐	☐	☐	☐
Class II RRs: Regional: ______________________	☐	☐	☐	☐
Class III RRs: Shortline, Port & Terminal, etc.	☐	☐	☐	☐
Pipelines	☐	☐	☐	☐
Waterways	☐	☐	☐	☐
Airlines	☐	☐	☐	☐
Other Local, State, Tribal, or Federal Agencies				
Emergency Management/Response	☐	☐	☐	☐
Environmental Protection	☐	☐	☐	☐
Homeland Security	☐	☐	☐	☐
Transportation and Public Works	☐	☐	☐	☐

D.9 Use Hotspots Analysis

A hotspots analysis is a way to relate four critical components of hazmat risk analysis: time, space, hazardous materials, and people (or the environment). The analysis can help identify times and places where the co-location needs special attention. Hotspots, which are discussed in Promising Practice 9: Use Hotspots Analysis should be easily understood and self evident in that little interpretation is required.

Promising Practice 9: Use Hotspots Analysis

Problem

Using the HMCFS to identify unique areas of concern in the local area provides insight into critical issues in emergency management, including hazmat route designation, resource allocations, and potential consequences. Yet, local entities may not know how to interpret data to identify associated hotspots—specific areas of concern or unique risks.

Promising Practice

Areas of potential concern are identified by an overview of risks associated with the transport of hazmat over the transportation network. Determining specific areas of concern is done by a hotspots analysis.

Possible Hotspot Analyses

Planning for emergency response capabilities: This analysis determines the existing coverage of hazmat response equipment and facilities and determines where current and future gaps exist.

Hazards identification: This analysis determines locations where hazmat incidents occur at elevated levels. This may result in finding locations along the transportation network or locations at, or near, fixed facilities.

Land use compatibility: This analysis determines locations where hazmat-related land uses and adjacent land uses are not compatible. This is important when considering redevelopment or new development of land uses adjacent to hazmat routes, industrial areas or facilities where hazardous material is prevalent, and high-risk areas.

Data and Resource Needs

The data required for this type of analysis come from various sources and are largely a factor of the complexity of the desired analysis. Most, if not all, of the hazmat-related data, such as fixed facility locations and commodity flows, come from the data collection portion of the commodity flow study. Hotspots analysis goes beyond the hazmat-specific data, and requires additional data integration to supplement already acquired data.

Hotspots analysis data are spatial in nature; that is, they represent something geographically identified, such as transportation networks or streams. In addition to spatial data, there are also temporal data, such as hourly traffic flows on targeted roadways, hours of operation of certain fixed facilities, or seasonal traffic patterns. The following table provides an inventory of data items that may be useful in a hotspots analysis.

The simplest way to identify relationships between data sources is to examine existing printed maps. This task may be more easily accomplished by using resources available on the Internet, such as online maps. Many online maps have multiple data items identified, such as schools or rivers, in addition to transportation networks.

Types of Data: Geographic

- Transportation
  - Road and intersection locations and characteristics
  - Infrastructure (bridges, drainage, etc.)
  - Traffic volumes and mixes
  - Truck counts
  - Rail lines, sidings, and yards
  - Truck stops
  - Port or intermodal facilities
  - Traffic accident locations
  - Highway-rail grade crossings
- Hazmat/Emergency Response
  - Spill and/or release locations
  - Hazmat incidents
  - Designated hazmat routes
  - Fixed facilities
  - Hazmat commodity flows
  - Fire stations/emerg. response teams
  - Military installations
  - Other emergency response facilities/resources
- Human
  - Population locations
  - Schools
  - Parks and recreation locations
  - Hospitals
  - Colleges/universities
  - Employment centers
  - Future growth/development areas
  - Tourist/cultural points of interest
  - Land use/zoning
  - Special needs populations
- Business
  - Business locations where hazmat is produced, shipped, and/or received
  - Business parks or clusters
  - Local/regional development locations
- Environmental
  - Drinking water sources
  - Habitat: oceans, lakes, rivers, wetlands, etc.
  - Land coverage, topography and soils

Types of Data: Temporal	

• Hourly traffic flow distribution
  ○ By roadway and/or roadway type
  ○ Truck volumes
• Hourly/seasonal LOS, congestion
	• Hours of operation
	  ○ Facilities, businesses, etc.
	  ○ Schools, employment centers, etc.

Types of Data: Other	

• Interviews
  ○ Fire, police, and emergency response
  ○ Industry and business representatives
  ○ Transportation providers
  ○ General public
	• Weather conditions
	  ○ Daily/seasonal temperatures
	  ○ Daily/seasonal wind conditions
	  ○ Daily/seasonal precipitation

It is also important to investigate the online resources that are available from local and regional planning entities. Many now have online thematic maps and online GIS maps that are available at no charge. On a national level, the USGS maintains "The National Map," which is an online GIS map viewer capable of displaying a wide variety of spatial data for use in a spatial analysis. Electronic geographic features and locations may require "ground-truthing" or confirmation with local observations.

For-purchase professional GIS software is also a valuable resource for hotspots analysis. These packages are capable of displaying the data layers in a single output and also have powerful built-in functions that perform complex spatial analyses.

Hotspots Analysis Procedures

Clarify analysis needs: Current Internet and GIS software allows for complex analysis to be performed; however, the project's data analysis needs may warrant a simpler solution using existing printed maps, databases, and charts.

Data coordination: The data requirements largely correlate to the hotspots analysis complexity. Users can identify both required and desired data sources for the analysis from the data source inventory above. Local, regional, or state planning organizations may already have data available in formats easily incorporated into the hotspots analysis.

Perform analysis: Hotspots analyses are largely spatial in nature. Displaying the data layers in relation to each other is the critical initial component of the analysis. Using the mapping or software resources allows for evaluation of many data elements to identify the hotspots within a focused study area.

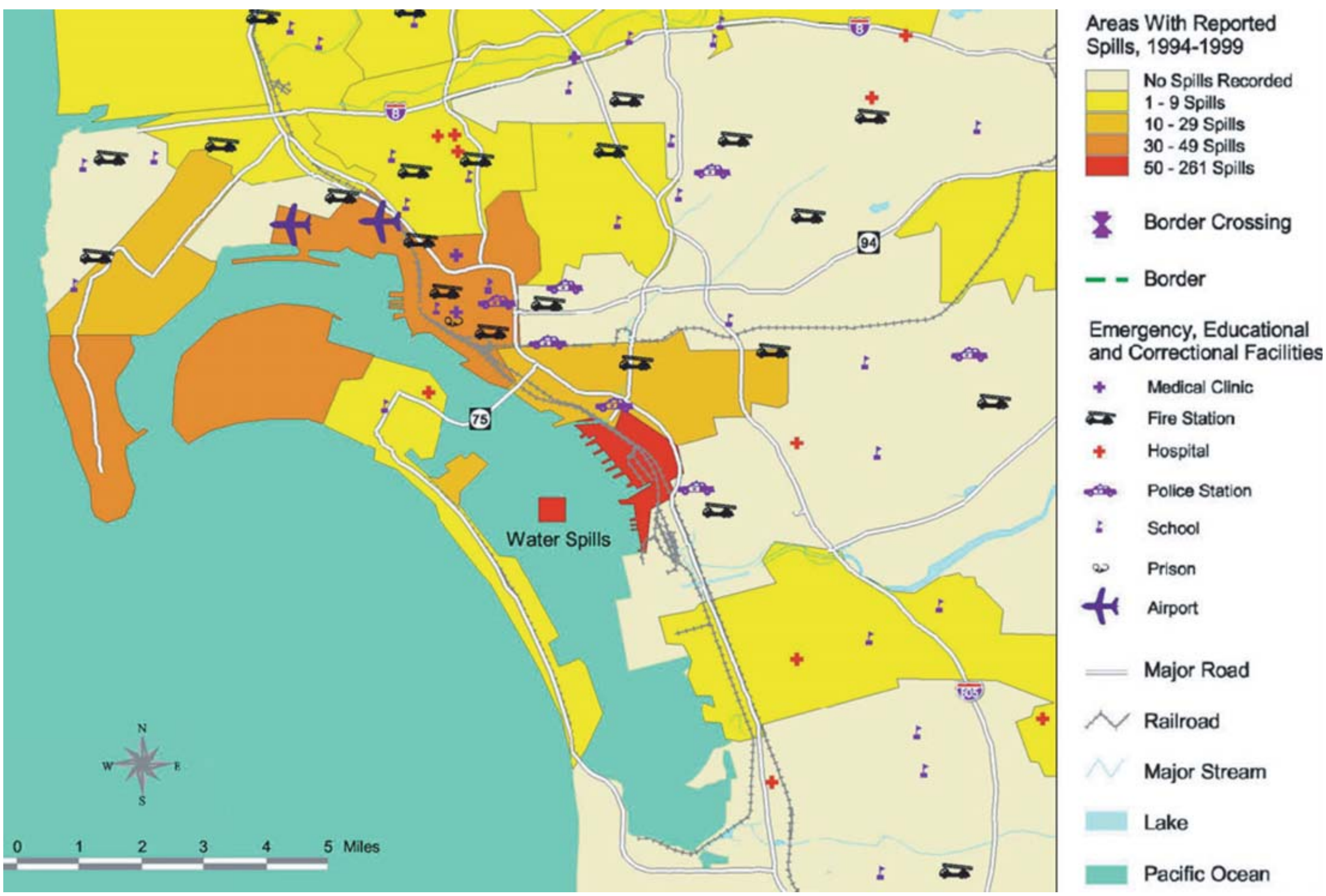
Periodic monitoring: Changing conditions on roadways and development patterns necessitate periodic review of the hotspots analysis. Regular reviews allow for minor adjustments to an existing analysis compared to entirely reformulating the analysis after conditions have significantly changed.

Example—San Diego Hazardous Material Commodity Flow Study

The San Diego Hazardous Material Commodity Flow Study, conducted by the EPA and published in June 2001 (*28*), contains a chapter on hotspots. The report indicates that hotspot analysis will assist in emergency preparedness for the region by determining the "placement for hazardous materials response equipment and facilities, and training priorities for emergency responders." The hotspots discussion addresses the following:

- San Diego Geography—includes a mention of the population growth experienced in the region and expected growth levels, major redevelopment areas in the study area, and hazardous material spills;
- Environmentally Sensitive Areas—includes the water supply and resources in the area;
- Human Sensitive Areas—includes schools, hospitals, public places (parks, etc.), and densely populated areas near heavy hazmat traffic flows; and
- Customhouse Brokers—includes warehouses operated by customhouse brokers that deal with hazmat shipments.

For the analysis, maps are utilized that show the relationships between the transportation infrastructure (i.e., roads, rail), environmentally sensitive areas (i.e., streams, lakes), human sensitive areas (i.e., hospitals, schools), emergency response facilities (i.e., fire stations, police stations), and cumulative reported hazmat spills for a 5-year period. A zoomed-in portion of the map included in the San Diego report follows.



Source: U.S. Environmental Protection Agency, *San Diego: Hazardous Material Commodity Flow Study*, June 2001, p 44.

An additional map displays the development and redevelopment activities in the region. Although not mapped against hazmat-related data, such as spills, this type of coordination between economic development, land use planning, and emergency planning works to provide a safer community.

Conducting A Hotspots Analysis has Advantages (A) and Disadvantages (D)	
A It provides a mechanism to combine multiple data layers into a single tool for analysis. A Many data sources and analysis tools are available online.	D Costly GIS software purchase may be required if free resources are not adequate for analysis. Running GIS software requires sufficient computer systems. Complex systems and analysis can require specialized skill sets. These can be overcome by use of free software such as QGIS, which is a multiplatform, GIS package available on the Internet, or by the use of overlays done by hand over/on printed area maps.

D.10 Use Risk Communication Checklist

Communication with stakeholders is a critical element of a successful HMCFS. Promising Practice 10: Use Risk Communication Checklist provides a list of entities with which HMCFS communication may be considered.

Promising Practice 10: Use Risk Communication Checklist

Problem

Limited communication of HMCFS restricts its utility for the community as a whole and the opportunity for feedback and validation.

Promising Practice

Locations, people, or offices to consider for the communication of the completed HMCFS are listed by group in the table that follows.

Risk Communication Checklist

Identify the user/user group communities in each category that will receive an HMCFS briefing, presentation, or training session focused on the results of the study. This checklist is not intended to be a comprehensive list of all people or offices that should receive a copy of the HMCFS but rather a list of potential users and user groups to be considered and expanded upon to meet unique local needs.

Emergency Planning and Response/ Other Departments:

- ☐ LEPC/TERC members
- ☐ Fire departments
- ☐ Police & sheriffs' departments
- ☐ SERC and other state agencies
- ☐ Hospitals and public health officials
- ☐ Community planning offices
- ☐ Transportation planning offices
- ☐ School officials
- ☐ Other LEPCs in area
- ☐ Federal agencies

Public Administration:

- ☐ County commissioners
- ☐ City manager offices
- ☐ Mayors' offices
- ☐ Council members
- ☐ County judges

General Public:

- ☐ Public meetings
- ☐ Local media (newspaper/TV/radio)
- ☐ Internet
- ☐ Public library
- ☐ Newsletters to local residents

Using a Risk Communication Checklist has Advantages (A) and Disadvantages (D)

A Suggests a comprehensive list of potential HMCFS users.

A Identifies groups of offices, officials, and people that may have a vested interest in the HMCFS outcomes.

A Identifies groups of offices, officials, and people that could be approached to support the HMCFS effort.

D Checklists may limit the dissemination of the HMCFS by substituting for innovative approaches some LEPCs use in such circumstances (e.g., hazmat fairs, or brochures/posters/flyers, targeted presentations). This is overcome by encouraging innovative approaches to two-way risk communication among stakeholders.

D Some unique circumstances may suggest keeping HMCFS information confidential; however, journalists and the public can file a Freedom of Information Act request. This is overcome by redacting sensitive material from the HMCFS in unique cases where public safety may be harmed or sensitive information disclosed.

D.11 Demonstrate Local Risk

Using the results of the HMCFS to inform the public, public officials, and community leadership is one very useful outcome of the HMCFS process. Implementation involves actively engaging various groups of interested parties, stakeholders, community leaders, industry, and other end users. Demonstrating local risk also can be a key element to obtaining support of local leaders for addressing hazmat emergency planning and response needs, including funding support. Promising Practice 11, Demonstrate Local Risk encourages users to employ the HMCFS results to demonstrate local risk.

Promising Practice 11: Demonstrate Local Risk

Problem

As predominantly volunteer organizations, LEPCs often report limited support for their activities. Because of low probabilities associated with initiating events (catastrophic incidents), emergency managers often report difficulty attaining support from local authorities and the public for emergency planning. Compared to routine activities, demonstrating the need for new equipment, expanded personnel, or enhanced training is difficult when the likelihood of the needs being realized is perceived to be low by decision makers.

Promising Practice

Communicating the risks associated with hazmat transportation through an area can help local leaders understand the importance of preemptive actions for risk reduction and mitigation. Certainly, risks that have greater likelihoods than others will require attention with high priority, but the relative likelihood of lower probability events may not compete with everyday routine activities. Hence, trying to demonstrate hazard potential with low-probability risk often meets with frustration.

Focus on outcomes and their associated consequences for people in the community. Give the consequences a human quality. For example, rather than "the expected loss of life from such an accident is 3.6 people," present the loss as a parent, child, and the child's friend—the only child of their neighbors. How would the decision maker feel if it happened on their street, to their child? Make it personal. Point out especially vulnerable populations with special needs. Remember the risk may have equal likelihoods of occurrence, but the same consequence is not uniformly valued. Consider the value associated with the deaths of various people (e.g., an infant, a father, a single mother, a homeless man, a high-school senior, or a senior citizen).

Use the media to help the public understand the risks in the area. LEPCs have media members to help get the message out. Enlist their help in composing the message and getting the attention it deserves. Make a big deal of it when short falls are not improved by making local leaders responsible for their decisions. Be sure to compliment leaders when they are responsive.

Demonstrating Local Risk

Use empirical data where possible to characterize the distribution of risk in the community and show statistically where the risks of interest are located in the distribution relative to other known risks.

Characterize the consequences of the risk in terms of the anecdotal evidence when possible. For example, the loss of a hazmat team member is a life-time of earnings that can be calculated until a typical retirement date; it can be a detriment to morale on the team and in the department and may even lead to turnover issues if it is related to decisions made in the organization. In some cases, it may mean children growing up without one parent and the outcomes associated with that situation.

Demonstrating Local Risk has Advantages (A) and Disadvantages (D)	
A Gaining attention for hazmat issues can help attain equipment and personnel, change hazmat routes, and engage in better community planning to enhance preparedness and decrease the likelihood of serious accidents.	D Dramatic overload can result when dealing with technical subjects that involve high risks and low probabilities. This can be overcome by keeping discussions about risks and probabilities of consequences realistic. D The desire to bring attention to hazmat risks may lead to the temptation of embellishing HMCFS results. In the long run, this can create misunderstandings and result in loss of credibility. This can be avoided by sticking to the facts about what was observed and the HMCFS project's limitations.

APPENDIX E

HMCFS Sampling and Scheduling

E.1 HMCFS Sampling and Scheduling

Identifying exactly how much HMCFS data needs to be collected can be challenging. Although more good quality data is not a negative by itself, collecting much more data than is necessary may result in misdirected use of scarce resources, such as funding or personnel time. Traditional survey sampling designs may identify the number of units to be sampled (e.g., 1,000 persons), while traffic sampling procedures identified in FHWA's *Traffic Monitoring Guide* (*14*) recommend 24-, 48-, or even 72-hour samples. Neither of these are practical for most local HMCFS because

- Traffic levels may not be known or highly variable by time of day, day of week, or season of year;
- Long duration samples can be very difficult to achieve in practice when conducted manually, as is the case for HMCFS data collection of UN/NA placard IDs; or
- A high level of sampling may not be required to develop a general characterization of hazmat traffic, which may be sufficient for some HMCFS objectives.

The following sections describe six different types of sampling and their scheduling: convenience, representative, cluster, stratified and proportional, random, and census. Several of the descriptions include examples of how that sampling technique might be implemented for a hypothetical HMCFS.

E.2 Convenience Sample Scheduling

For a convenience sample, data are collected at opportune times and locations. For example, data collectors might conduct truck counts before work, during lunch breaks, and after work at an intersection or location between their home and workplace, or some other location when they have time to do so on any given day. These data may provide a general sense of traffic levels at certain times and locations, but are unlikely to give a reliable estimate of traffic patterns in the area. However, as the number of data collectors and range of times and locations for which data are collected increases, the quality and reliability of data for some locations may improve. Without a very large pool of convenience sample data it will be difficult to determine traffic patterns across a jurisdictional area at different times (aside from chance). However, convenience sampling can be used to provide a very general idea of hazmat transportation in certain areas of the community. Moreover, some routes or route segments are likely to be well represented, but others are likely to be left unobserved.

For example, three health professionals from a local hospital located on an Interstate bypass in a rural county's main city (the county seat, located at the center of the county) volunteer to participate in HMCFS data collection. One volunteer occasionally has some extra time for data collection on Monday and Tuesday mornings before work, one during lunch break on Mondays and Wednesdays, and one after work on Thursdays. Whenever they have some extra time, the volunteers conduct truck and placard counts from the hospital parking lot that overlooks the roadway. Because of how the roadway is constructed, they can only collect data for westbound traffic. These data can provide only a very general indication of hazmat traffic patterns for the westbound traffic on the roadway throughout the week. Note that if the volunteers collected a lot of data (say, at least five different data counts) for each of those days and times, that could provide a better picture of traffic patterns but only for those particular days and times for that roadway.

E.3 Representative Sample Scheduling

With representative sampling, the data collection locations are selected to represent major types of hazmat transport corridors in the community. For example, data collection might be conducted at one location on an Interstate, one location on a bypass loop, one location on a major urban arterial, and one location at a downtown intersection of primary roads. The data collection would be scheduled at each location at different times during the morning, daytime, and evening but not on any particular day of the week or month of year. The collected data can be used to establish general traffic patterns for these particular locations throughout the day (e.g., lower traffic levels during morning/evening and higher traffic levels during the day). The data also can be used to generally characterize the type of traffic on similar roads, but they cannot be used to accurately describe traffic characteristics on other roads or determine patterns of truck transport throughout an area. Without a very large pool of representative sample data, it will be difficult to determine differences in traffic patterns across different days of the week or months of the year.

For example, a volunteer fire department is located in a community near an Interstate highway. Three firefighters from the department participate in HMCFS data collection. Over the course of several months, the volunteers conduct truck and placard counts on each direction of the Interstate during weekdays. They make sure that they have at least a half-hour of collected data for each daytime hour (e.g., 8–9 A.M.) and for each direction. They also coordinate to collect data during the daytime on Saturdays—on one Saturday they count in the morning and on another Saturday they count in the afternoon. The LEPC assumes that these traffic counts represent traffic on the Interstate at the other end of the county and that the truck and placard traffic is similar for all weekdays at other times of the year for the weekday counts and for all weekend days at other times of the year based on the Saturday counts.

E.4 Cluster Sample Scheduling

Cluster samples expand representative samples and are often best suited for situations where the goals and objectives are focused on very specific routes and route segments. For example, data locations are selected on an Interstate on both sides of a community, on major highways and arterials, and at key intersections. Data are collected at multiple times for each day of the week, throughout each day, at all locations. Data collection may be expanded to represent different months or seasons of the year. Although data may not be usable to characterize traffic flow patterns for an entire transport network, the traffic levels for the individual major components of a transportation network can begin to be identified for different days of the week and different times of the year, assuming that the observed traffic patterns apply to other times for which traffic is not observed.

For example, a school complex (elementary, junior high, and high school) is located near an Interstate highway. This section of Interstate has had several major truck accidents in the past decade. Community officials are concerned that their emergency warning and communication system and shelter-in-place procedures are appropriate to the hazards that may be present, especially since the schools, including playground and outdoor athletic facilities, were constructed on land near the Interstate. The LEPC schedules data collection for this section of the Interstate over the course of 3 months during the spring (March–May). The schedule over the 3-month period includes three half-hour counts during each daytime hour (e.g., 8–9 A.M.), on three weekdays (e.g., Monday, Wednesday, and Friday) during school and after-school hours (7 A.M.–7 P.M.) and on each direction of the Interstate. The schedule is repeated so that there are two datasets per sampled weekday.

With the approval of their supervisors and senior administrators, four city firefighters, four city police officers, and four school teachers participate in HMCFS data collection using truck and placard ID counts. The firefighters take responsibility for the 7–11 A.M. period, the police officers for the 11 A.M.–3 P.M. period, and school teachers for the 3–7 P.M. period. With 72 hours of data collection per group (0.5 hours per sample × 3 samples per hour of the day × 4 hours of the day per period × 3 days per week × 2 directions of the roadway × 2 samples per weekday = 72 hours), and 4 data collectors per group, this works out to around 18 hours of data collection for each participant over 3 months. Assuming that the observed traffic represents the overall traffic during this time period, this should provide the community with a very good idea of the springtime, weekday, daytime hazmat transport hazards on that portion of the Interstate.

E.5 Stratified and Proportional Sample Scheduling

Both stratified and proportional samples require prior knowledge of the sampled population to determine the required data collection parameters. For example, previous data on traffic counts might be used to identify average expected traffic levels on a daily basis at key transportation network locations. Previous information about traffic levels at each location may also be available. For example, at one location it may be known that peak traffic during the day is three times the level that is seen during the night, with mid-morning and mid-afternoon traffic levels twice that seen during the night, on average. Based on this information, a stratified sample determines the total number of vehicles that need to be counted in the morning, at peak hours, in the afternoon, and at night. This calculation is completed for each network location. Data are fully collected when the number of sampled vehicles is obtained at each location and each designated time.

A proportional sample might separate the time periods into fixed length segments (e.g., 30-minute or 1-hour slots), and sample them proportionally to the expected traffic in each time period. The schedule of data collection at each location would then reflect the expected volume of traffic in these locations. Given daily and seasonal variations in traffic patterns, either process may need to be repeated for each location and time period. Overall estimates of average annual daily traffic may be available from metropolitan and state planning agencies for major roadways and combined with estimates of daily and seasonal traffic patterns. However, the statistical computations associated with determining stratified and proportional sampling make this method generally impractical for most hazmat traffic survey applications other than those that require very in-depth knowledge of traffic patterns and have sufficient resources available for coordinating and conducting the data collection.

Local entities whose HMCFS requires stratified and proportional sampling may consider asking a transportation professional, consultant, university faculty member, or other person with statistical training in traffic analysis for assistance with sampling design.

E.6 Random Samples

Traffic observations are made in a random manner, either by time of day/week/month or by number of vehicles, throughout a transportation network. Random samples are most appropriate when goals and objectives are focused on a limited number of routes or route segments, and when the decision objectives require high degrees of reliability. Otherwise, random samples can result in data collection that is expensive and time consuming. Random samples are usually unnecessary except for all but the most extreme hazmat transport applications, especially since other less expensive sampling procedures can yield adequate information for most objectives. A data collector simply going out to different locations at different times as convenient (see Section D.2) is not a random sample. Local entities whose HMCFS requires random sampling may consider asking a transportation professional, consultant, university faculty member, or other person with statistical training in traffic analysis for assistance with sampling design.

E.7 Census

A complete census of all traffic on a transportation network is nearly impossible to obtain without automated data collection procedures such as tag readers or video-based systems that collect data about vehicle locations and commodities carried. Although systems capable of conducting a census of hazmat traffic have been conceptualized, none warrant serious consideration in the immediate timeframe for local jurisdictions. As future technology development and data collection procedures develop, collection of hazmat transport census data may become feasible.

APPENDIX F

Sample Railroad Data Request Form

[Company LOGO]

REQUEST FOR HAZARDOUS MATERIALS COMMODITY FLOW INFORMATION

Organization Requesting Information: ____

Contact Person: ____

Phone Number: ____

Email Address: ____

Mailing Address: ____
(Street Address)
____
(City, State, Zip)

Geographical Description of Area for Study: ____
____

Preferred Method to Receive Report: ☐ Email ☐ U.S. Mail (Mark One)

By signing below I acknowledge and agree to the terms set forth by **[RAILROAD NAME]** for use and dissemination of the [**RAILROAD'S]** Hazardous Materials Commodity Flow Information. [RAILROAD'S NAME] considers this information to be restricted information of a security sensitive nature. I thus affirm and agree that the information provided by **[RAILROAD NAME]** in this report will be used solely for and by bona fide emergency planning and response organizations for the expressed purpose of emergency and contingency planning. This information will not be distributed publicly in whole or in part without the expressed written permission of **[RAILROAD NAME**].

____
(Signature of Person Requesting Commodity Flow Information)

Return Completed Form to:	**[INSERT RAILROAD NAME AND ADDRESS]**

– –

For [RAILROAD] Use Only

[**PERSON RESPONSIBLE FOR APPROVAL**]: ___Yes___ No Date: __________

Hazardous Materials Service Support:

Date Request Received: ____________________________________
Time Period Covered: ______________________________________
Date Report Sent: _________________________________
Report sent via: ☐ Email ☐ U.S. Mail

APPENDIX G

Electronic Database and Report Descriptions

G.1 Electronic Database and Map Source Descriptions

The following sections provide descriptive information about electronic database and map sources. Descriptive material for each source is attributable to the referenced Web pages.

1. Hazards U.S. Multi-Hazard (HAZUS-MH) Software, Federal Emergency Management Administration (FEMA), DHS.

Web site: http://www.fema.gov/plan/prevent/hazus/index.shtm

HAZUS-MH "is a nationally applicable standardized methodology that estimates potential losses from earthquakes, hurricane winds, and floods." HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). HAZUS-MH uses state-of-the-art Geographic Information Systems (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. The primary application of the software is that it allows users to estimate the impacts of earthquakes, hurricane winds, and floods on populations. Its primary value for an HMCFS is the spatial data that comes with the software. HAZUS-MH provides readily available, geo-referenced, national data to enable identification of inventory assets in a community, classified according to the following seven categories:

1. General Building Stock: General building types (residential, commercial, industrial, public service) and occupancy classes (single family, retail, industrial, church).
2. Essential Facilities: Facilities essential to the health and welfare of the community (hospitals, police, fire, emergency centers, schools).
3. Hazardous Material Facilities: Storage facilities for industrial hazardous materials (corrosives, flammables, explosives, radioactive, and toxins).
4. High Potential Loss Facilities: Facilities that, if affected by disaster, would have a high loss or impact on the community (nuclear power plants, dams, levees, military installations).
5. Transportation Lifeline Systems: Transportation systems for
   - Air (airports, runways, heliports),
   - Road (bridges, tunnels, road segments),
   - Rail (tracks, light rail, tunnels, bridges, facilities [railyards and depots]), and
   - Water (ports, harbors, locks, ferries).
6. Utility Lifeline Systems: Potable water, wastewater, oil, natural gas, electric power, and communication systems.
7. Demographics: Population statistics (total population, age, gender, race, income, workforce location).

HAZUS-MH requires spatial analysis software such as ESRI's ArcGIS in addition to personal computer hardware and software. Federal, state, and local government agencies, as well as the private sector, can order HAZUS-MH free of charge from the FEMA publication warehouse.

2. Freight Analysis Framework (FAF 2.2), Freight Management and Operations, FHWA, U.S.DOT.

Web site: http://ops.fhwa.dot.gov/freight/freight_analysis/faf/index.htm

The FAF is basically a commodity origin–destination database whose latest version 2.2 covers the period 2002–2035. FAF estimates commodity flows and related freight transportation activity among states, sub-state regions, and major international gateways. It also forecasts future flows among regions and relates those flows to the transportation network. FAF includes an origin–destination database of commodity flows among regions, and a road network database in which flows are converted to truck payloads and related to specific routes.

The FAF includes tons and value of commodity movements among regions by mode of transportation (truck, rail, water, air, truck-rail, and pipeline) and type of commodity Standard Classification of Transported Goods (SCTG). FHWA bases provisional estimates for goods movement in the most recent calendar year (2006) on the 2002 base year database. It is built entirely from public data sources including the 2002 Commodity Flow Survey (CFS), developed by the Census Bureau, U.S. Department of Commerce, and the Bureau of Transportation Statistics (BTS), U.S.DOT; Foreign Waterborne Cargo data, developed by the U.S. Army Corps of Engineers; and a host of other sources. FAF statistics do not match those in mode-specific publications primarily due to different definitions that were used to avoid double counting. Methods in developing the 2002 base year data are transparent, and FAF has been expanded to cover all modes and significant sources of shipments. Future projected data covering years from 2010–2035 with a 5-year interval are based on Global Insight's proprietary economic and freight modeling packages.

The FAF itself or subsequent reports, summaries, and maps can be downloaded from the Web site in MS Access format and in Microsoft Excel comma delimited (csv) format for use with programming software. Associated geographical files also are available but require use with GIS desktop products, either by ESRI or TransCad. As in the CFS, SCTG numbers are used with hazardous materials included in select SCTG classes.

The FAF estimates commodity movements by truck and the volume of long-distance trucks over specific highways. Models are used to disaggregate interregional flows from the Commodity Origin–Destination Database into flows among individual counties and assign the detailed flows (truck traffic) to individual highways. These models are based on geographic distributions of economic activity rather than a detailed understanding of local conditions. While providing reasonable estimates for national and multi-state corridor analyses, **FAF estimates are not a substitute for local data to support local planning and project development.**

3. National Transportation Atlas Database (NTAD), Research and Innovative Technology Administration (RITA), BTS, U.S.DOT.

Web site: http://www.bts.gov/publications/national_transportation_atlas_database/

NTAD "is a set of nationwide geographic databases of transportation facilities, transportation networks, and associated infrastructure. These datasets include spatial information for transportation modal networks and intermodal terminals, as well as the related attribute information for these features" (e.g., rail and road networks). A desktop GIS is required for using NTAD. The data can be ordered in the form of two CD-ROMs or directly downloaded from the Web site to "support research, analysis, and decision making across all modes of transportation. They are most useful at the national level but have major applications at regional, state, and local scales throughout the transportation community."

Hazmat routes and road segments from the HPMS are two of the layers in NTAD. Individual road segments can be selected graphically by county FIPS (Federal Information Processing Standard) code and highway number, for example. However, only selected attributes of road segments are present in the NTAD GIS tables. Truck route designation (or not) of a segment is present, but the percent trucks is not. The HPMS data file (or FAF network file) will have to be consulted directly on the latter for each segment selected graphically. Traffic data on rail routes or waterways are even poorer.

An advantage of NTAD is that it includes intermodal terminal locations (e.g., an airport would be an air and truck intermodal terminal). The majority of spill and release incidents occur in transfer and NTAD may be of help in a community trying to locate those. NTAD allows professional maps of the study area and corridors to be produced in order to visually aid the conduct of a local/regional CFS. An alternative to NTAD would be Google maps or state-provided maps.

4. Incident Reports Database, Office of Hazardous Materials Safety (OHMS), Pipeline and Hazardous Materials Administration (PHMSA), U.S.DOT.

Web site: http://www.phmsa.dot.gov/hazmat/library/data-stats/incidents

Web site: https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/

The Pipeline and Hazardous Materials Safety Administration (PHMSA) Office of Hazardous Materials Safety (OHMS) maintains the Hazardous Materials Incident Reporting System (HMIRS). It is the most detailed, comprehensive source for reported hazmat incidents on all modes excluding pipeline. Transportation carriers are required to report hazmat-related accidents to the National Response Center. Deep-sea vessel incidents are included, but not inland waterway incidents. Incidents are defined as spills or releases of a material classified as hazardous, whether a vehicular accident occurred or not. The OHMS compiles and updates the incident data from incident reports as they are received and makes the data publicly available via an online user search. Because the records are self-reported and based on conditional criteria for incidents, the dataset may substantially under-report all incidents involving vehicles carrying hazardous materials. Further information about HMIRS underreporting may be found in *HMCRP Report 1: Hazardous Materials Transportation Incident Data for Root Cause Analysis* (*29*).

Among reports and summaries, summary statistics are prepared by OHMS and available for download in PDF format from the Web site. At the national level, 10-year and annual summaries of incidents are available. The 10-year summaries are of an aggregate nature, providing number of incidents, injuries, fatalities, and property damage dollar values by hazmat type (RAM or waste), incident type (total or serious), year, and mode. The annual summaries are more refined to include number of incidents, injuries, fatalities, and property damage values by mode, state, cause, hazard class, incident type (total or serious), incident result, and transportation phase. At the state level, incident summaries are refined only by mode to provide number of incidents, injuries, fatalities, and property damage values.

Users can employ the search tool on PHMSA's Hazmat Incident Reports Database Web site and state their individual constraints (after selecting a year) by filling in any field(s) on the incident reports database search form. These constraints offer a more customized incident search than the ready-made summaries. Although the search tool user interface does not include county as a constraint, complete datasets for an entire state, for example, can be downloaded to a CSV (comma-separated value) file and then converted to spreadsheet or database file such as Microsoft Excel or Access. If users were to download the entire file for their state over the date range desired, they could then sort the dataset by county, city, or zip code to identify those incidents that occurred within specific jurisdictional boundaries.

Therefore, a more accurate, disaggregate analysis of hazardous materials incidents down to the regional or local level necessitates a modest exercise to search and retrieve the desired data directly from the database.

5. National Hazardous Materials Route Registry and Route Maps, FMCSA, U.S.DOT.

Web site: http://hazmat.fmcsa.dot.gov/nhmrr/index.asp?page=route

Web site: http://hazmat.fmcsa.dot.gov/nhmrr/index.asp?page=maps

Based on the *Federal Register* route listing, the FMCSA Web site provides additional useful and interactive ways to search and display the latest information on one or more hazardous materials route designations. A mapping application also displays the hazardous materials route(s) that should be traveled after an origin and a destination address is entered.

6. Highway Performance Monitoring System (HPMS), Office of Highway Policy Information, FHWA, U.S.DOT.

Web site: http://www.fhwa.dot.gov/policy/ohpi/hpms/index.cfm

HPMS is "a national-level highway information system that includes [a wide array of] data on the extent, condition, performance, use, and operating characteristics of the nation's highways. The major purpose of the HPMS is to support a data driven decision process within FHWA, DOT, and Congress [for legislative and funding purposes]. HPMS is a nationally unique source of highway system information that is made available to the transportation community for highway and transportation planning and other purposes through the annual *Highway Statistics* and other data dissemination media."

The latest annual edition of HPMS at the time of this writing is 2006. Usually, the file can be obtained by regions and localities that contact the local office of the State Department of Transportation. Segment attributes of interest include truck route designation, and the percent daily or peak-hour traffic that are combination trucks. An in-house exercise of considerable expertise and resources will have to be conducted by the region or locality to extract the segment data of need from the larger database if a custom-made dataset is not readily provided by the local state DOT office. A more user friendly alternative is the HPMS Map Viewer in the above link that enables selection of truck routes to the traffic network level showing truck routes and overall traffic volumes (not truck specific). The viewer also displays population demographic information.

7. 2002 Vehicle Inventory and Use Survey (VIUS), Census Bureau, U.S. Department of Commerce.

Web site: http://www.census.gov/svsd/www/vius/2002.html

According to the program documentation provided on the Web site, VIUS "provides data on the physical and operational characteristics of the nation's truck population. Its primary goal is to produce national and state-level estimates of the total number of trucks. . . . [It] is a probability sample of all private and commercial trucks registered (or licensed) in the United States . . . [and] excludes vehicles owned by federal, state, or local governments; ambulances; buses; motor homes; farm tractors; and non-powered trailer units." Additionally, trucks that were included in the sample but reported to have been sold, junked, or wrecked prior to the survey year (date varies) were deemed out of scope. The sampling frame was stratified by geography and truck characteristics. The 50 states and the District of Columbia made up the 51 geographic strata. Body type and gross vehicle weight (GVW) determined the following five truck strata:

1. Pickups;
2. Minivans, other light vans, and sport utilities;
3. Light single-unit trucks (GVW 26,000 lbs. or less);
4. Heavy single-unit trucks (GVW 26,001 lbs. or more); and
5. Truck-tractors.

Therefore, the sampling frame was partitioned into 255 geographic-by-truck strata. Within each stratum, a simple random sample of truck registrations was selected without replacement. Samples are available for nine different years between (and including) 1963 and 2002. The 2002 year had a sample of 136,113 trucks. As of this report date, the VIUS sample has been discontinued.

8. Safety and Fitness Electronic Records System Company Snapshot, FMCSA, U.S.DOT.

Web site: http://safer.fmcsa.dot.gov/CompanySnapshot.aspx

"The Company Snapshot is a concise electronic record of a company's identification, size, commodity information, and safety record, including the safety rating (if any), a roadside out-of-service inspection summary, and crash information." Database users can search by company name, U.S.DOT Number, or FMCSA MC/MX number. It is a very useful tool for local entities desiring to identify inspection and safety statistics about hazmat transporters.

9. Company Registration Look-Up Tool, Office of Pipeline Safety (OPS), PHMSA, U.S.DOT.

Web site: http://www.phmsa.dot.gov/hazmat/registration

"Offerors and transporters of certain quantities and types of hazardous materials, including hazardous wastes, are required to file an annual registration statement with the U.S.DOT and to pay a fee that provides funds for grants distributed to states and Indian tribes for hazmat emergency response planning and training." Any user can search for a company's registration history and view the certificates through the Company Registration Look-Up tool. The minimum requirement is a zip code but one can also search by company name, existing PHMSA registration number, U.S.DOT Number, or FMCSA MC/MX number, if available. It is a very useful tool for local entities that want to locate hazmat transporters based in their area.

10. Carload Waybill Sample, Surface Transportation Board (STB), U.S.DOT.

Web site: http://www.stb.dot.gov/stb/industry/econ_waybill.html

STB's Carload Waybill Sample "is a stratified sample of carload waybills" for terminated shipments by railroad carriers. These waybill data are used to create a movement-specific Confidential Waybill File and a less detailed Public Use Waybill File. The elements and the file structure for both the Confidential File and the Public Use File are described in the user guide, which is available for download from the Web site, as is the Public Use Waybill File.

The sample includes waybill information from Class I, Class II, and some of the Class III railroads. STB requires that these railroads submit waybill samples if, in any of the 3 preceding years, they terminated on their lines at least 4,500 revenue carloads. The waybill sample currently encompasses over 99 percent of all U.S. rail traffic. It is a continuous sample that is released in yearly segments. For the past several years, it has contained information on approximately 600,000 movements.

Data from the Master Waybill Sample File are used as input to many STB projects, analyses, and studies. Federal agencies (DOT, Department of Agriculture, etc.) use the waybill sample as part of their information base. The waybill sample is also used by states as a major source of information for developing state transportation plans. In addition, non-government groups seek access to waybill sample data for such uses as market surveys, development of verified statements in STB and state formal proceedings, forecast of rail equipment requirements, economic analysis and forecasts, academic research, etc.

The Master Waybill File contains sensitive shipping and revenue information, so access is restricted to railroads; federal agencies; the states; transportation practitioners, consultants and law firms with formal proceedings before the STB or state boards; and certain other users. Anyone can access the non-confidential data in the Public Use File by downloading it from the Web site or sending a written request to STB.

The Public Use File only provides an indication of the presence of a hazardous commodity in the car as hazardous via an "H" designation in the field for Hazardous/Bulk Material in Boxcar, and the 5-digit STCC of the commodity, that would only indicate the hazard class and division (at best). STCC codes at the 7-digit level that would identify the chemical name of the hazardous material are not provided in the Public Use File. The Confidential Waybill File however does provide the STCC hazmat code at the 7-digit level as well as the 49xxxxx series railroad code specifically for hazardous commodities in the Hazardous/Bulk Material in Boxcar field. In addition, the public file only indicates the origin and termination BEA (business economic area) whereas the confidential file disaggregates origins and terminations to the MSA (metropolitan statistical area) or county level, which is more appropriate for local use. Depending on the resources available for conducting a CFS and the level of detail a community desires in it, it may decide to go into the legal and technical trouble of obtaining and analyzing the Confidential Waybill File. However, it might be more resource efficient to simply request commodity flow information on the top 10 hazardous materials transported through the area from the operating railroad(s).

11. Rail Safety Data, Office of Safety Analysis, FRA, U.S.DOT.

Web site: http://safetydata.fra.dot.gov/officeofsafety/Default.asp

The FRA Office of Safety Analysis Web site makes railroad safety information readily available to a broad constituency, including FRA personnel, railroad companies, research and planning organizations, and the general public. Visitors have access to railroad safety information including accidents and incidents, inspections and highway–rail crossing data. From this site users can run dynamic queries, download a variety of safety database files, publications, and forms, and view current statistical information on railroad safety. Dynamic queries dating back to 1978 can be run for accident/incident data for individual railroads, by railroad group, by region, state, or county, and for any multi-annual, annual, multi-monthly, or monthly timeframe. An online report is created and displayed that contains the number of cars that released hazardous material and the number of cars that released hazardous material as a result of damage or derailment. Additional queries offer further constraints, such as accident cause, type, damage, or the hazmat option. Constraints under the hazmat option include cars carrying hazardous material, cars carrying hazardous material that were damaged, cars that released hazardous material, or if evacuation occurred.

The geographic detail lends itself to use in regional/local CFS since it goes down to the county and railroad line levels. However, FRA accident/incident data do not contain any information on the quantities, classes, or chemical names of the hazardous materials released. The PHMSA HMIRS database is a more detailed source for hazmat incident data.

12. Office of Pipeline Safety (OPS) National Pipeline Mapping System. PHMSA, U.S.DOT.

Web site: http://www.phmsa.dot.gov/pipeline

OPS, through the Pipeline Safety Community portal of the PHMSA Web site, makes available gas and liquid pipeline maps down to the street level, through the National Pipeline Mapping System (www.npms.phmsa.dot.gov/). The OPS Web site also provides pipeline incident and mileage profiles by state and county, and by aggregate commodity (hazardous liquid or natural gas). The user can click on the button or link for the NPMS Public Map Viewer. The maps include information about gas transmission lines and hazardous liquid trunk lines but do not contain gathering and distribution pipelines. The mapping application requires selection of the state and county for which a map is desired. The map output allows the user to zoom in or zoom out, identify particular pipelines by type and operator, and includes contact information. However, individual operators will have to be contacted in order to obtain the levels of flow of a given pipeline through a region/locality. Users should make sure that pop-ups are allowed by their browsers, and using web browsers other than Microsoft Internet Explorer may limit visibility of information.

The National Pipeline Mapping System also operates a secured access repository of pipeline data. Local, state, and federal government officials may request access to these data by sending requests to npms-nr@mbakercorp.com with "Pipeline Data Request" in the subject line, and including name, title, organization, mailing address, phone number, fax number, and e-mail address. Applicants are screened to ensure they are qualified to access NPMS data; more information is available on the Web site.

13. Significant Incident Data Access Page. PHMSA, U.S. DOT.

Web site: http://primis.phmsa.dot.gov/comm/reports/safety/SIDA.html

As part of PHMSA's Pipeline Safety Program, pipeline incident report data files are made available to the public. The Web site contains a link to current incident data files that are used to create Pipeline Incidents and Mileage Reports (also linked at the site), and have been flagged by PHMSA as follows: "(1) they have been flagged to indicate incident significance, (2) they have been flagged to indicate fire-first gas distribution incidents, and (3) they include indexed costs in addition to raw (nominal) costs to indicate the significance of the pipeline incidents." Links to previous incident files also are provided, and the Web site notes that all reported incidents are provided, not only significant and fire-first incidents as indicated for current incident data files.

14. Hazardous Commodity Code Cross-Reference File, Navigation Data Center (NDC), U.S. Army Corps of Engineers (USACE).

Web site: http://www.iwr.usace.army.mil/ndc/data/datahazc.htm

USACE developed a Hazardous Commodity Code Cross-Reference File "in an effort to associate the Waterborne Commerce Statistics Center (WCSC) Commodity Codes, which are based on the Standard International Trade Classification (SITC), with hazardous commodity codes used by other federal agencies and internationally." WCSC codes were matched with North American Emergency Response Guide (NAERG) guide numbers and hazard classes. These consist of the United Nations' (UN) Hazard Identification Codes used worldwide to track international hazardous material cargoes and a number of general codes to cover hazardous materials not specified by the UN Codes.

A further effort interrelates the WCSC Commodity Codes with the USCG Chemical Hazard Response Information System (CHRIS) Codes, the NAERG Hazard Identification Numbers, and Chemical Abstract Service Registry Numbers (CAS). CHRIS Numbers "are used domestically by the U.S. shipping industry and the USCG to designate hazardous cargo moving by vessel. The CAS Registry is the worldwide definitive chemical identification system." Both of these files are also publicly available for download through the NDC Web site.

15. Marine Casualty and Pollution Database, Marine Information for Safety and Law Enforcement (MISLE), Marine Safety Management System, U.S. Coast Guard (USCG).

Web site: http://transtats.bts.gov/Tables.asp?DB_ID=610&DB_Name=Marine%20Casualty%20And%20Pollution%20Database&DB_Short_Name=Marine%20Casualty/Pollution

The Marine Casualty and Pollution Database contains data related to marine casualty investigations and pollution investigations by the U.S. Coast Guard concerning vessel and waterfront facility accidents and marine pollution incidents throughout the United States and its territories. The data-current data, user guide, and data dictionary are posted on the web. The data are contained in nine (text) files and are publicly available on CD-ROM upon request from the USCG through the Bureau of Transportation Statistics Web site. MISLE provides comprehensive information on all waterway incidents and accidents and lend themselves to diversified analysis purposes. Records can be joined and filtered to satisfy a variety of objectives to a low level of geographic detail. At least an elementary level of software and database analysis skills is required because the records are in comma delimited text format and need to be imported into a spreadsheet or database application for analysis.

16. *United States Census 2000,* Census Bureau, U.S. Department of Commerce (DOC).

Web site: http://www.census.gov/

The Census Bureau collects, compiles, analyzes, and makes publicly available national data through the Population and Housing Census (every 10 years), the Economic Census (every 5 years), the American Community Survey (annually), several other surveys (both demographic and economic), and economic indicators (each released on a specific schedule). The topics range from data on people and households (housing, income, poverty, etc.) to data on business and industry (trade, employment, economic indicators). The output format ranges from on-screen data and map output to geographic data (i.e., GIS maps—shapefiles) that are already prepared or custom made. The data can be queried at the state, county, or census tract level via a simple zip code entry. The most recent U.S. Census was in 2000; the 2010 Census is underway at the time of this writing. GIS-based maps would require a desktop GIS but are an invaluable tool for hotspots analyses. Overall, the Census Bureau Web site is a valuable source of data, especially in creating a community's profile for inclusion in the CFS document and overall support of local CFS efforts.

17. The National Map, U.S. Geological Survey (USGS).

Web site: http://nationalmap.gov/

USGS collaborates with other federal, state, and local partners to improve and deliver topographic information in the form of the National Map. It can be used for many purposes including scientific analysis, recreation, and emergency response. It is accessible for display via the Web or as downloadable data for use locally. Information available includes elevation, hydrography, orthoimagery, boundaries, transportation, structures, and land cover. Additional geographic information can be added either through the viewer or integrated with the National Map data in a GIS. The GIS-based maps require a desktop GIS but are an invaluable tool for hotspots analyses. Overall, the National Map is a valuable source of data, especially in creating a geographic profile for inclusion in the CFS document and overall support of local CFS efforts.

18. Web Soil Survey, U.S. Department of Agriculture, Natural Resources Conservation Service.

Web site: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

The Web Soil Survey provides soil data and information produced by the National Cooperative Soil Survey. Operated by the USDA Natural Resources Conservation Service (NRCS) the Web Soil Survey accesses the largest natural resource information system in the world. NRCS soil maps and data for more than 3,000 counties are available online. Updated and maintained online, the Web Soil Survey is the single authoritative source of soil survey information. Soil survey data such as soil type, topographic, and ecological data can be used for local and wide-area planning as well as emergency planning and response. The Web Soil Survey provides a useful resource for attaining soil information pertinent to hazmat spills for inclusion in the HMCFS document.

19. National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA).

Web site: http://www.ncdc.noaa.gov/oa/ncdc.html

The National Climatic Data Center of the U.S. Department of Commerce and NOAA provide land- and marine-based data about upper air-flows, weather and climate patterns and events, paleoclimatology, and satellite imagery. These data are summarized monthly and annually; unedited weather station data for the United States also is provided. Products include extreme weather and climate events, climate normals, storm database, and climate maps of the United States. These data may require desktop GIS, but some are available as maps. Overall, the NCDC/NOAA Web site is a valuable resource for climate data for areas of the United States. These data provide useful profiles for inclusion in the CFS document and overall support of CFS efforts.

G.2 Electronic Report Source Descriptions

The following sections provide descriptive information about electronic report sources. Descriptive material for each source is attributable to the referenced Web pages.

1. *United States 2007 Commodity Flow Survey,* BTS, U.S.DOT, and Economics and Statistics Administration, Census Bureau, U.S. Department of Commerce, December 2009.

Web site: From BTS: The majority of 2007 CFS data products are made available *only* via electronic media released on the BTS Web site, http://www.bts.gov/publications/commodity_flow_ survey/, or the Census Bureau's American FactFinder Web site at www.factfinder.census.gov. The final data release includes only three printed publications at the national level. These reports include national-level data for the United States, hazardous materials, and exports.

The CFS is a primary data source in the world of freight transportation. It is conducted every 5 years. The data from the 2007 survey were released in December 2009. The industry sectors surveyed include manufacturing, mining, wholesale, and select retail.

The hazmat transportation series of the data provides information—at a national level—on hazmat shipments by mode (tonnage, value, and ton-miles shipped), class/division, UN number, origin and destination state, interstate and intrastate transport, toxic inhalation hazards, packing groups, and other categories and various combinations of these categories (e.g., mode by hazard class/division). Additional CFS sections report on all commodities originating from individual states, not just hazardous materials at the national level. Shipment value, tons, and ton-miles originating in the state are reported by mode, distance, and weight of shipment; by two-digit commodity code (Standard Classification of Transported Goods [SCTG]) and mode; and by state of destination. In the SCTG section, the codes most heavily populated with hazardous materials are 17 (Gasoline and Aviation Turbine Fuel), 18 (Fuel Oils), 19 (Coal and Petroleum Products), 20 (Basic Chemicals), and 23 (Chemical Products and Preparations).

Overall, the lowest level of detail in the hazmat section of the CFS is the state level, which on its own cannot support analyses at the regional or local level. Also, detailed information on chemicals or routes used cannot be gleaned. The latest CFS can be consulted in order to develop a good sense of the hazmat shipment characteristics to and from the entire state. Data from the 2002 survey and 1997 survey are available as well and can be used to identify general changes in hazmat transportation characteristics over time.

2. National Statistics and Maps, Freight Management and Operations, FHWA, U.S.DOT.

Web site: http://www.ops.fhwa.dot.gov/freight/freight_analysis/nat_freight_stats/index.htm

This webpage contains several links related to freight transportation, including a link to the FAF, several FAF by-products, and links to external sites such as BTS.

Freight Facts and Figures is an annual publication that culminates from the FAF data and projections as they are updated annually. Individual sections can be viewed online (html), or it can be downloaded in its entirety in Adobe Acrobat format. It consists of tables and figures in the form of charts or maps. This publication is a "snapshot of the volume and value of freight flows in the United States, the physical network over which freight moves, the economic conditions that generate freight movements, the industry that carries freight, and the safety, energy, and environmental implications of freight transportation. This snapshot helps decision makers, planners, and the public understand the magnitude and importance of freight transportation in the economy.

Chapter 1 summarizes basic demographic and economic characteristics of the United States that contribute to the demand for raw materials, intermediate goods, and finished products. Chapter 2 identifies the freight that is moved and the trading partners who move it. Chapter 3 describes the freight transportation system; volumes of freight moving over the system; the amount of truck, train, and other activities required to move the freight; and the performance of the system. Chapter 4 highlights the transportation industry that operates the system. Chapter 5 covers the safety aspects, energy consumption, and environmental implications of freight transportation. Many of the tables and figures are based on the Economic Census, which is conducted once every 5 years. The most recently published data from the Economic Census are for

2007. Several of the tables and maps in this report are based on the FAF, version 2.2, which builds on the Economic Census, to estimate all freight flows to, from, and within the United States except shipments between foreign countries that are transported through the United States."

The National Freight Transportation Maps in *Freight Facts and Figures* are also made available independently on the main Web page for download in html, jpg, or pdf format. *Freight Facts and Figures* is primarily applicable to the national and, sometimes, regional levels. However, the main Web page provides links to freight profiles (statistics and maps) of individual states. FAF-based statistics are output directly in html or pdf format, whereas external information links the user to other FHWA offices such as BTS, the Census Bureau, or state-specific Web sites such as DOTs.

Additional links also provide access to other internal or external publications and resources related to freight transportation, including links to the source of the freight statistics and maps, for example the FAF (FHWA), CFS (BTS), and Carload Waybill Sample (STB).

3. Freight Data and Statistics, BTS, RITA, U.S.DOT.

Web site: http://www.bts.gov/programs/freight_transportation/

The BTS Web site provides several publicly available reports for download. They are developed based on individual data sources or databases already discussed and are primarily based on the 2002 Commodity Flow Survey. However, users may find access to the same freight data through the BTS portal to be more concise, concentrated, structured, and ultimately more user friendly.

4. Accident Reports, NTSB.

Web site: http://www.ntsb.gov/Publictn/publictn.htm

The NTSB Web site provides publicly available reports for aviation, highway, marine, pipeline, hazardous materials, and railroad accidents. Each report summarizes accidents of national significance that were evaluated by the NTSB. Information in the reports includes an incident overview, parties involved, conditions, causation, mitigating factors, and outcomes (including fatalities, injuries, and property damages).

5. Crash Statistics, Analysis & Information Online (A&I), FMCSA, U.S.DOT.

Web site: http://ai.fmcsa.dot.gov/CrashProfile/CrashProfileMainNew.asp

Crash Statistics "are summarized crash statistics for large trucks and buses involved in fatal and non-fatal crashes that occurred in the United States. They are derived from two databases: the Fatality Analysis Reporting System (FARS) and the Motor Carrier Management Information System (MCMIS)." They are compiled through SAFETYNET, a database management system that allows entry, access, analysis, and reporting of data from driver/vehicle inspections, crashes, compliance reviews, assignments, and complaints that have been entered online by state agencies.

Access to the actual data is restricted to authorized users (e.g., state and federal government agencies). However, compilations of Crash Statistics data are made publicly available online. They contain information that can be used to identify safety problems in specific geographical areas or to compare state statistics to the national crash figures. The statistics are represented in state profile summaries in the following focus areas: Summary, Vehicle, Driver, Environment, Crash, Carrier, and Maps. Historical State Profiles are provided for the most recent 5 years and feature dynamic colorful state maps highlighting the large truck crash location data. National Crash Profile Reports (and maps) are also available online.

The Vehicle area of the state profiles includes a hazmat report that summarizes crashes by presence or absence of a hazmat placard on the truck, by whether a release occurred or not, and by hazmat class (if released). The state profile summaries include total number of large trucks involved in crashes in the last 5 years, by county. Generally though, the lowest level of geographic detail is the state level, and the lowest level of commodity release detail is the class of hazmat as opposed to chemical name—both of which may limit support for route/local/regional analyses and emergency response plans. The PHMSA HMIRS database remains the most detailed source for hazmat incident data.

6. *Waterborne Commerce of the United States (WCUS)*, Navigation Data Center (NDC), USACE.

Web site: http://www.iwr.usace.army.mil/ndc/index.htm

Published annually in five volumes, Volumes 1 through 4 present tonnage and ton-mile information on domestic and foreign cargo transported over waterways and through harbors on the Atlantic Coast, Gulf Coast/Mississippi River system, Great Lakes, and Pacific Coast, respectively, while Volume 5 presents national summary statistics. All volumes are publicly available online for download through the NDC Web site. All types of commodities moving in domestic waterborne commerce are covered, including more than 20 distinct chemical products. Commodity codes are unique to USACE waterborne data but the classification reflects the hierarchical structure of the Standard International Trade Classification (SITC). Hazardous materials are not identified specifically or by chemical name by the WCSC codes, but by and large populate the Petroleum & Petroleum Products and Chemicals & Related Products categories. The USACE's 4-digit WCSC code aggregates specific commodities into commodity groups. These 4-digit codes can be further specified using a listing of 5-digit commodity code groups found in the Commodity Code Cross Reference File provided by USACE, at www.iwr.usace.army.mil/ndc/data/datacomm.htm. Finally, the USACE has developed a cross-reference between these 5-digit codes and associated UN Hazard ID (placard number), described in Appendix C.1.

7. Lock Performance Monitoring System (LPMS), NDC, USACE.

Web site: http://www.iwr.usace.army.mil/ndc/lpms/lpms.htm

The LPMS contains annual commodity tonnage data for all locks on the inland waterways. LPMS data and reports are also publicly available for download through the NDC Web site. In addition, Key Lock Reports are available that include monthly summaries and year-to-date totals of commodity tonnages and barge traffic for key locks. However, commodities are aggregated into only nine classes in LPMS data and reports, an aggregated level of detail. Unlike the WCUS data, the nine classes are not broken down further, but hazardous materials by and large make up the commodities in the Petroleum & Petroleum Products and Chemicals & Related Products categories.

8. *Waterborne Transportation Lines of the United States, Vol. 2: Vessel Company Summary*, NDC, USACE.

Web site: http://www.ndc.iwr.usace.army.mil/veslchar/veslchar.htm

USACE publishes a vessel company summary as part of its *Waterborne Transportation Lines of the United States* report, which can be found at www.ndc.iwr.usace.army.mil/veslchar/veslchar.htm. The summary lists vessel company names, contact information, commodities carried, locations of vessel operation, and operating fleet size. Users can identify which companies may be operating in their areas, and what products they are carrying and whether they are likely to be hazardous. These companies can then be contacted to request information on specific commodities and tonnage carried during specific timeframes, such as a previous calendar year.

9. Pipeline Incidents and Mileage Reports. PHMSA, U.S.DOT.

Web site: http://primis.phmsa.dot.gov/comm/reports/safety/PSI.html?nocache=7942

Information about pipeline incident trends over a 20-year period are provided in a series of reports on this Web page as part of PHMSA's Pipeline Safety Program. "The reports . . . are generated from numerous data sources maintained by PHMSA. These data sources span decades of collection, evolving methods of oversight, and multiple reporting formats. To generate these reports, PHMSA has standardized the data over various file formats, normalized incident costs over time to a common basis year, and standardized incident cause categories—all with the goal of producing a coherent and meaningful picture of national and state-specific trends in pipeline incidents. . . . In these reports, all the costs associated with incidents are provided in 2010 dollars." Links are provided to reports on serious incidents, significant incidents, consequences to the public and the pipeline industry. Also included is a Directory of State Detail Reports, a link to raw data at the significant incident data access, and tables and charts summarizing all reported incidents.

APPENDIX H

2002 Vehicle Inventory and Use Survey Data

U.S. Census Bureau's 2002 Vehicle Inventory and Usage Survey (VIUS) collected a wide range of information about transportation activities for registered vehicles. This includes information about transport of hazardous materials by truck. These data were evaluated by the Texas Transportation Institute (TTI) for hazmat transport by truck types. The trucks were classified into eight different cargo body types and three different configurations. The VIUS data were evaluated to identify the national average percentage of truck miles driven while a DOT placard was required, according to truck type and configuration. The Census Bureau's recommended mileage weighting was used to identify the national averages. It should be noted that this information, presented in Tables H.1 through H.6, does not include confidence intervals that reflect data variation due to sampling. Decimals are rounded up to the next integer (e.g., both 2.23% and 2.28% are rounded up to 2.3%).

H.1 Vehicle Types

Based on the evaluation of the 2002 VIUS data, eight truck cargo body types classifications are identified as relevant to differences in hazmat transportation:

- Liquid/gas tank trucks (note: designation of shipping container chassis configurations was not included in the 2002 VIUS—ISO tank containers were assumed to correspond to liquid/gas tanks);
- Vacuum tank trucks;
- Dry bulk tank trucks;
- "Standard" van box trucks, including basic enclosed, drop frame, step, walk-in, multistop, open top, other box trucks, and Curtainside trucks, which appear similar to standard van box trucks (note: designation of shipping container chassis configurations was not included in the 2002 VIUS—these were assumed to correspond to van configurations, with the exception of ISO tank containers which were assumed to correspond to liquid/gas tanks);
- Refrigerated van trucks;
- Utility and other service trucks;
- Flatbed, stake, and platform, etc. trucks; and
- Other truck types, including trash, garbage, or recycling; dump, concrete mixer, concrete pumper, low boy, crane, pole, logging, pulpwood, or pipe; beverage, livestock, and other trucks not classified above.

H.2 Vehicle Configurations

Truck configurations are classified into three categories based on the 2002 VIUS data: straight trucks, tractor-trailers (also including straight trucks with a trailer), and tractors with multiple trailers.

Table H.1. 2002 VIUS data for percentage of placarded U.S. truck miles, by type, for all hazmat, Class 3, and Class 8 placards.[1]

Truck/Trailer Type	Truck Configuration	Percent of U.S. Miles Driven by Trucks in Sample while Requiring DOT Placard[2]			
		Any Hazmat	Class 3		Class 8
			Cl. 3	Combust-able	
Liquid/gas tank	Straight	**37.1%**	12.1%	7.1%	0.4%
	Tractor-Trailer[3]	**36.8%**	16.6%	7.0%	4.3%
	Multi-Trailer	**35.4%**	22.6%	6.3%	1.0%
	Total	**36.8%**	**16.3%**	**7.0%**	**3.8%**
Vacuum	Straight	**5.3%**	2.8%	1.6%	0.6%
	Tractor-Trailer	--[5]	--	--	--
	Multi-Trailer	**--**	**--**	**--**	**--**
	Total	**5.1%**	**2.7%**	**1.6%**	**0.6%**
Dry bulk tank	Straight	**0.4%**	**[4]	**	0.002%
	Tractor-Trailer	**1.3%**	0.4%	0.02%	0.09%
	Multi-Trailer	**1.6%**	**	**	0.8%
	Total	**1.3%**	**0.3%**	**0.02%**	**0.2%**
Van–basic enclosed, drop frame, step, walk-in, multistop, open top, other; Curtainside	Straight	**1.5%**	0.4%	0.1%	0.5%
	Tractor-Trailer	**3.8%**	0.9%	0.4%	1.7%
	Multi-Trailer	**5.9%**	1.6%	0.7%	2.2%
	Total	**3.9%**	**0.9%**	**0.4%**	**1.7%**
Van–refrigerated	Straight	**0.002%**	**	**	**
	Tractor-Trailer	**0.9%**	0.4%	0.08%	0.5%
	Multi-Trailer	**1.1%**	0.03%	0.03%	1.0%
	Total	**0.9%**	**0.3%**	**0.07%**	**0.4%**
Service–utility or other	Straight	**2.1%**	0.6%	1.0%	0.02%
	Tractor-Trailer	**0.2%**	0.05%	**	**
	Multi-Trailer	**--**	**--**	**--**	**--**
	Total	**1.9%**	**0.6%**	**0.9%**	**0.01%**
Flatbed, stake, platform, etc.	Straight	**4.3%**	0.5%	0.2%	1.0%
	Tractor-Trailer	**0.8%**	0.2%	0.08%	0.2%
	Multi-Trailer	**0.5%**	**	**	0.03%
	Total	**1.4%**	**0.3%**	**0.1%**	**0.4%**
Other[6]	Straight	**0.2%**	0.002%	**	0.005%
	Tractor-Trailer	**0.6%**	0.03%	0.004%	0.005%
	Multi-Trailer	**0.2%**	**	**	**
	Total	**0.4%**	**0.02%**	**0.002%**	**0.004%**
Total	Straight	**3.1%**	0.9%	0.5%	0.4%
	Tractor-Trailer	**5.0%**	1.7%	0.8%	1.4%
	Multi-Trailer	**5.6%**	1.8%	0.7%	1.9%
	Total	**4.9%**	**1.6%**	**0.7%**	**1.3%**

1. Percentages were calculated by TTI using U.S. Census Bureau 2002 Vehicle Inventory and Use Survey microdata.
2. Not the percentage of trucks with a hazmat placard.
3. Includes straight trucks with trailers
4. Less than 0.001%, or one in ten thousand.
5. Insufficient information in survey.
6. Includes: dump; low boy; automobile carrier; trailer-mounted equipment; beverage; livestock; mobile home toter; pole, logging, pulpwood, or pipe; trash, garbage, or recycling; concrete mixer or pumper; crane; tow/wrecker; tractor only; and other truck and truck body configurations not classified elsewhere.

Table H.2. 2002 VIUS data for percentage of placarded U.S. truck miles, by type, for Class 2 placards.[1]

Truck/Trailer Type	Truck Configuration	Percent of U.S. Miles Driven by Trucks in Sample while Requiring DOT Placard[2]			
		Class 2			
		Div. 2.1	Div. 2.2	O_2 (Div.2.2)	Div.2.3
Liquid/gas tank	Straight	16.0%	0.6%	0.2%	0.1%
	Tractor-Trailer[3]	6.9%	2.5%	1.3%	0.3%
	Multi-Trailer	4.3%	**[4]	**	**
	Total	**7.6%**	**2.3%**	**1.2%**	**0.3%**
Vacuum	Straight	**	0.04%	**	**
	Tractor-Trailer	--[5]	--	--	--
	Multi-Trailer	--	--	--	--
	Total	**	**0.03%**	**	**
Dry bulk tank	Straight	**	**	**	**
	Tractor-Trailer	0.7%	0.3%	**	**
	Multi-Trailer	**	**	**	**
	Total	**0.6%**	**0.3%**	**	**
Van–basic enclosed, drop frame, step, walk-in, multistop, open top, other; Curtainside	Straight	0.07%	0.4%	0.4%	0.04%
	Tractor-Trailer	0.5%	0.5%	0.07%	0.05%
	Multi-Trailer	0.1%	0.2%	0.2%	0.03%
	Total	**0.4%**	**0.5%**	**0.09%**	**0.04%**
Van–refrigerated	Straight	**	**	**	**
	Tractor-Trailer	0.07%	0.2%	**	**
	Multi-Trailer	**	**	**	**
	Total	**0.06%**	**0.1%**	**	**
Service–utility or other	Straight	0.3%	0.002%	0.02%	**
	Tractor-Trailer	0.07%	**	**	**
	Multi-Trailer	--	--	--	--
	Total	**0.3%**	**0.002%**	**0.01%**	**
Flatbed, stake, platform, etc.	Straight	1.9%	1.8%	0.6%	0.7%
	Tractor-Trailer	0.2%	0.08%	0.08%	0.03%
	Multi-Trailer	**	**	**	**
	Total	**0.4%**	**0.4%**	**0.2%**	**0.2%**
Other[6]	Straight	0.05%	**	**	**
	Tractor-Trailer	0.03%	0.1%	0.004%	**
	Multi-Trailer	**	**	**	**
	Total	**0.04%**	**0.08%**	**0.002%**	**
Total	Straight	1.1%	0.4%	0.1%	0.2%
	Tractor-Trailer	0.8%	0.5%	0.2%	0.05%
	Multi-Trailer	0.2%	0.2%	0.09%	0.03%
	Total	**0.8%**	**0.5%**	**0.2%**	**0.06%**

1. Percentages were calculated by TTI using U.S. Census Bureau 2002 Vehicle Inventory and Use Survey microdata.
2. Not the percentage of trucks with a hazmat placard.
3. Includes straight trucks with trailers
4. Less than 0.001%, or one in ten thousand.
5. Insufficient information in survey.
6. Includes: dump; low boy; automobile carrier; trailer-mounted equipment; beverage; livestock; mobile home toter; pole, logging, pulpwood, or pipe; trash, garbage, or recycling; concrete mixer or pumper; crane; tow/wrecker; tractor only; and other truck and truck body configurations not classified elsewhere.

Table H.3. 2002 VIUS data for percentage of placarded U.S. truck miles, by type, for Class 5 and Class 6 placards.[1]

Truck/Trailer Type	Truck Configuration	Percent of U.S. Miles Driven by Trucks in Sample while Requiring DOT Placard[2]			
		Class 5		Class 6	
		Div. 5.1	Div. 5.2	Div. 6.1 Inh. Haz.	Div.6.1 Poison
Liquid/gas tank	Straight	**[4]	**	**	0.01%
	Tractor-Trailer[3]	0.2%	0.004%	0.4%	0.3%
	Multi-Trailer	0.3%	**	**	**
	Total	**0.2%**	**0.004%**	**0.4%**	**0.3%**
Vacuum	Straight	**	0.006%	0.006%	0.02%
	Tractor-Trailer	--[5]	--	--	--
	Multi-Trailer	--	--	--	--
	Total	**	**0.006%**	**0.006%**	**0.02%**
Dry bulk tank	Straight	0.08%	**	**	**
	Tractor-Trailer	0.008%	**	0.009%	0.008%
	Multi-Trailer	1.2%	**	**	**
	Total	**0.2%**	**	**0.008%**	**0.007%**
Van–basic enclosed, drop frame, step, walk-in, multistop, open top, other; Curtainside	Straight	0.2%	0.02%	0.04%	0.2%
	Tractor-Trailer	0.7%	0.3%	0.08%	0.3%
	Multi-Trailer	0.7%	0.2%	0.03%	0.2%
	Total	**0.7%**	**0.2%**	**0.07%**	**0.3%**
Van–refrigerated	Straight	**	**	**	**
	Tractor-Trailer	0.2%	0.1%	0.09%	0.03%
	Multi-Trailer	0.9%	**	**	**
	Total	**0.2%**	**0.09%**	**0.08%**	**0.03%**
Service–utility or other	Straight	0.007%	**	**	**
	Tractor-Trailer	**	**	**	**
	Multi-Trailer	--	--	--	--
	Total	**0.007%**	**	**	**
Flatbed, stake, platform, etc.	Straight	0.2%	**	0.04%	0.02%
	Tractor-Trailer	0.09%	0.02%	0.02%	0.07%
	Multi-Trailer	**	**	**	**
	Total	**0.1%**	**0.02%**	**0.02%**	**0.06%**
Other[6]	Straight	**	**	**	**
	Tractor-Trailer	0.1%	**	**	**
	Multi-Trailer	0.2%	**	**	**
	Total	**0.07%**	**	**	**
Total	Straight	0.07%	0.005%	0.02%	0.07%
	Tractor-Trailer	0.5%	0.2%	0.09%	0.2%
	Multi-Trailer	0.6%	0.2%	0.03%	0.1%
	Total	**0.5%**	**0.2%**	**0.07%**	**0.2%**

1. Percentages were calculated by TTI using U.S. Census Bureau 2002 Vehicle Inventory and Use Survey microdata.
2. Not the percentage of trucks with a hazmat placard.
3. Includes straight trucks with trailers
4. Less than 0.001%, or one in ten thousand.
5. Insufficient information in survey.
6. Includes: dump; low boy; automobile carrier; trailer-mounted equipment; beverage; livestock; mobile home toter; pole, logging, pulpwood, or pipe; trash, garbage, or recycling; concrete mixer or pumper; crane; tow/wrecker; tractor only; and other truck and truck body configurations not classified elsewhere.

Table H.4. 2002 VIUS data for percentage of placarded U.S. truck miles by type for Class 9 and Class 4 Placards.[1]

Truck/Trailer Type	Truck Configuration	Percent of U.S. Miles Driven by Trucks in Sample while Requiring DOT Placard[2]			
		Class 9	Class 4		
			Div. 4.1	Div. 4.2	Div.4.3
Liquid/gas tank	Straight	0.07%	0.002%	0.004%	**[4]
	Tractor-Trailer[3]	1.6%	0.9%	0.2%	0.005%
	Multi-Trailer	4.6%	**	**	**
	Total	**1.6%**	**0.8%**	**0.2%**	**0.005%**
Vacuum	Straight	0.2%	**	0.006%	**
	Tractor-Trailer	--[5]	--	--	--
	Multi-Trailer	--	--	--	--
	Total	**0.2%**	**	**0.006%**	**
Dry bulk tank	Straight	**	**	**	**
	Tractor-Trailer	0.09%	0.02%	**	**
	Multi-Trailer	**	**	**	**
	Total	**0.07%**	**0.02%**	**	**
Van–basic enclosed, drop frame, step, walk-in, multistop, open top, other; Curtainside	Straight	0.09%	0.04%	0.006%	0.05%
	Tractor-Trailer	0.5%	0.5%	0.08%	0.07%
	Multi-Trailer	0.2%	0.2%	0.04%	0.08%
	Total	**0.4%**	**0.4%**	**0.07%**	**0.07%**
Van–refrigerated	Straight	**	**	**	**
	Tractor-Trailer	0.2%	0.2%	**	0.03%
	Multi-Trailer	**	**	**	**
	Total	**0.2%**	**0.1%**	**	**0.03%**
Service–utility or other	Straight	0.1%	**	**	**
	Tractor-Trailer	**	**	**	**
	Multi-Trailer	--	--	--	--
	Total	**0.1%**	**	**	**
Flatbed, stake, platform, etc.	Straight	0.03%	**	**	0.2%
	Tractor-Trailer	0.04%	0.06%	0.05%	0.05%
	Multi-Trailer	**	**	**	**
	Total	**0.04%**	**0.05%**	**0.04%**	**0.07%**
Other[6]	Straight	0.02%	**	**	**
	Tractor-Trailer	0.3%	**	**	0.02%
	Multi-Trailer	**	**	**	**
	Total	**0.2%**	**	**	**0.01%**
Total	Straight	0.05%%	0.02%	0.003%	0.04%
	Tractor-Trailer	0.5%	0.4%	0.07%	0.05%
	Multi-Trailer	0.2%	0.2%	0.03%	0.06%
	Total	**0.4%**	**0.3%**	**0.06%**	**0.05%**

1. Percentages were calculated by TTI using U.S. Census Bureau 2002 Vehicle Inventory and Use Survey microdata.
2. Not the percentage of trucks with a hazmat placard.
3. Includes straight trucks with trailers
4. Less than 0.001%, or one in ten thousand.
5. Insufficient information in survey.
6. Includes: dump; low boy; automobile carrier; trailer-mounted equipment; beverage; livestock; mobile home toter; pole, logging, pulpwood, or pipe; trash, garbage, or recycling; concrete mixer or pumper; crane; tow/wrecker; tractor only; and other truck and truck body configurations not classified elsewhere.

Table H.5. 2002 VIUS data for percentage of placarded U.S. truck miles by type for Class 1, Divisions 1.1 through 1.4 placards.[1]

Truck/Trailer Type	Truck Configuration	Percent of U.S. Miles Driven by Trucks in Sample while Requiring DOT Placard[2]			
		Class 1			
		Div. 1.1	Div. 1.2	Div. 1.3	Div. 1.4
Liquid/gas tank	Straight	0.008%	**[4]	**	0.008%
	Tractor-Trailer[3]	0.05%	**	**	0.002%
	Multi-Trailer	**	**	**	**
	Total	**0.04%**	**	**	**0.002%**
Vacuum	Straight	**	**	**	**
	Tractor-Trailer	--[5]	--	--	--
	Multi-Trailer	--	--	--	--
	Total	**	**	**	**
Dry bulk tank	Straight	**	**	**	**
	Tractor-Trailer	**	0.02%	**	**
	Multi-Trailer	**	**	**	**
	Total	**	**0.02%**	**	**
Van–basic enclosed, drop frame, step, walk-in, multistop, open top, other; Curtainside	Straight	0.01%	**	**	0.006%
	Tractor-Trailer	0.2%	0.2%	0.06%	0.3%
	Multi-Trailer	0.02%	0.02%	0.02%	0.05%
	Total	**0.2%**	**0.2%**	**0.05%**	**0.3%**
Van–refrigerated	Straight	**	**	**	**
	Tractor-Trailer	**	**	**	**
	Multi-Trailer	**	**	**	**
	Total	**	**	**	**
Service–utility or other	Straight	**	**	**	0.2%
	Tractor-Trailer	**	**	**	**
	Multi-Trailer	--	--	--	--
	Total	**	**	**	**0.2%**
Flatbed, stake, platform, etc.	Straight	0.07%	**	**	0.07%
	Tractor-Trailer	0.3%	0.05%	0.04%	0.006%
	Multi-Trailer	0.009%	**	**	**
	Total	**0.2%**	**0.04%**	**0.03%**	**0.02%**
Other[6]	Straight	**	**	**	**
	Tractor-Trailer	**	**	**	0.004%
	Multi-Trailer	**	**	**	**
	Total	**	**	**	**0.003%**
Total	Straight	0.02%	**	**	0.02%
	Tractor-Trailer	0.1%	0.2%	0.04%	0.2%
	Multi-Trailer	0.009%	0.02%	0.02%	0.04%
	Total	**0.08%**	**0.09%**	**0.04%**	**0.2%**

1. Percentages were calculated by TTI using U.S. Census Bureau 2002 Vehicle Inventory and Use Survey microdata.
2. Not the percentage of trucks with a hazmat placard.
3. Includes straight trucks with trailers
4. Less than 0.001%, or one in ten thousand.
5. Insufficient information in survey.
6. Includes: dump; low boy; automobile carrier; trailer-mounted equipment; beverage; livestock; mobile home toter; pole, logging, pulpwood, or pipe; trash, garbage, or recycling; concrete mixer or pumper; crane; tow/wrecker; tractor only; and other truck and truck body configurations not classified elsewhere.

Table H.6. 2002 VIUS data for percentage of placarded U.S. truck miles by type for Class 1, Divisions 1.5 and 1.6, Class 7, and hazmat-not-classified placards.[1]

Truck/Trailer Type	Truck Configuration	Percent of U.S. Miles Driven by Trucks in Sample while Requiring DOT Placard[2]			
		Class 1		Class 7	HazMat Not Classified
		Div. 1.5	Div. 1.6		
Liquid/gas tank	Straight	0.01%	**[4]	**	2.6%
	Tractor-Trailer[3]	0.6%	**	0.08%	0.09%
	Multi-Trailer	**	**	**	0.2%
	Total	**0.6%**	**	**0.08%**	**0.4%**
Vacuum	Straight	**	**	**	1.0%
	Tractor-Trailer	--[5]	--	--	--
	Multi-Trailer	--	--	--	--
	Total	**	**	**	**0.9%**
Dry bulk tank	Straight	0.3%	**	**	0.002%
	Tractor-Trailer	**	**	**	**
	Multi-Trailer	**	**	**	0.04%
	Total	**0.006%**	**	**	**0.005%**
Van–basic enclosed, drop frame, step, walk-in, multistop, open top, other; Curtainside	Straight	0.005%	0.001%	0.007%	0.02%
	Tractor-Trailer	0.2%	0.2%	0.06%	0.3%
	Multi-Trailer	0.04%	0.04%	0.02%	0.6%
	Total	**0.1%**	**0.1%**	**0.05%**	**0.6%**
Van–refrigerated	Straight	**	**	**	0.002%
	Tractor-Trailer	**	**	**	0.03%
	Multi-Trailer	**	**	**	0.2%
	Total	**	**	**	**0.03%**
Service–utility or other	Straight	**	**	0.2%	0.006%
	Tractor-Trailer	**	**	**	**
	Multi-Trailer	--	--	--	--
	Total	**	**	0.2%	0.006%
Flatbed, stake, platform, etc.	Straight	**	**	**	0.4%
	Tractor-Trailer	0.005%	0.005%	0.08%	0.02%
	Multi-Trailer	**	**	**	0.5%
	Total	**0.004%**	**0.004%**	**0.07%**	**0.08%**
Other[6]	Straight	**	**	**	0.08%
	Tractor-Trailer	**	**	0.002%	0.04%
	Multi-Trailer	**	**	**	**
	Total	**	**	**0.002%**	**0.05%**
Total	Straight	0.003%	**	0.009%	0.3%
	Tractor-Trailer	0.2%	0.07%	0.05%	0.2%
	Multi-Trailer	0.03%	0.04%	0.02%	2.4%
	Total	**0.09%**	**0.06%**	**0.04%**	**0.4%**

1. Percentages were calculated by TTI using U.S. Census Bureau 2002 Vehicle Inventory and Use Survey microdata.
2. Not the percentage of trucks with a hazmat placard.
3. Includes straight trucks with trailers
4. Less than 0.001%, or one in ten thousand.
5. Insufficient information in survey.
6. Includes: dump; low boy; automobile carrier; trailer-mounted equipment; beverage; livestock; mobile home toter; pole, logging, pulpwood, or pipe; trash, garbage, or recycling; concrete mixer or pumper; crane; tow/wrecker; tractor only; and other truck and truck body configurations not classified elsewhere.

APPENDIX I

Large Truck Incident and Accident Information

I.1 Large Truck Incidents and Accidents

This appendix provides information that may be used in the absence of locally specific information about large truck incidents and accidents. Given their frequency, network proximity to populated areas, and impact on the traveling public, large truck accidents have been an ongoing focus of many studies by government agencies and academicians. Some of the more recent analyses are described below.

Information from U.S.DOT's NHTSA General Estimates System indicates that between 2002 and 2006, large truck accidents accounted for between 4.5 and 5.0 percent of reported accidents involving passenger cars, motorcycles, light trucks, large trucks, and buses (*20*).

FMCSA's *Large Truck and Bus Crash Facts 2007* report contains accident information for large truck crash occurrences by time of day, day of week, roadway type, body size and type, and hazmat cargo (including commodity groups) (*21*). According to the same report, 3.8 percent of large trucks involved in fatal crashes in 2007 were carrying hazmat cargo, while 3.1 percent of trucks involved in non-fatal crashes were carrying hazardous materials. An FMCSA analysis brief from 2004 reported that, on average, 4.2 percent of large trucks in fatal crashes were carrying hazmat cargo between 1991 and 2000, while 4.4 percent of trucks involved in non-fatal crashes that required a tow-away were carrying hazardous materials, suggesting some improvements (*22*). These statistics do not appear appreciably different from the proportion of U.S. truck miles traveled while requiring a hazmat placard, according to the 2002 Vehicle Inventory Use Survey data (as listed in Appendix H, Table H.1).

NHTSA's *Traffic Safety Facts 2007* report lists national accident rates for large trucks. Crash data reports suggest continuing improvement in accident rates from the 1970s through 2007. In 2007, the involvement rate per 100 million vehicle miles traveled was 2.02 fatal crashes, 33 injury crashes, and 147 property-damage-only crashes, for a combined involvement rate of 1.82 large truck crashes per million vehicle miles traveled (*23*).

To put this in perspective, a single 20-mile Interstate segment with approximately 2,000 trucks per day (on an annual average) would be expected to see more than 26 large truck accidents per year given the 2007 accident rates. If approximately 4 percent of large truck accidents involve hazardous materials according to FMCSA, and approximately 5 percent of all U.S. truck miles are driven while trucks are required to carry a hazmat placard, this roadway segment could expect to see between one to two placarded large truck accidents per year, assuming that national averages apply. Since trucks that carry hazardous materials below threshold levels are not required to have placards, it is likely that the actual number of large truck accidents involving hazardous materials on this segment would be greater. For heavily industrialized areas with even greater proportions of hazmat traffic, the number of hazmat accidents on this segment would be even larger.

The *Large Truck and Bus Crash Facts 2007 Report* also lists hazmat commodity groups involved in hazmat accidents for fatal and non-fatal crashes, including whether or not hazardous material was released. Flammable liquids are carried in the highest proportion of hazmat truck crashes, followed by gases, and then explosives, corrosives, and miscellaneous dangerous goods (order depending on whether fatal or non-fatal crashes are considered).

A more detailed accident analysis by hazmat commodity group is presented in Battelle's 2001 Report on *Comparative Risks of Hazardous Materials and Non-Hazardous Materials Truck Shipment Accidents/Incidents* (*24*). According to this report

> Class 3 shipments account for about 64 percent of the en route accidents with releases and about 52 percent of the non-release accidents. Class 3 shipments along with Categories 2.1, 2.2, 5.1, 5.2, 8, and 9, represent about 94 percent of all en route accidents with releases and about 93 percent of all en route non-release accidents (p ES-3).

The report also estimated total economic impacts for roadway hazmat accidents including injuries and deaths, cleanup costs, property damage, evacuation, product loss, traffic delay, and environmental damage. According to the report

> Class 3 represents 56 percent of all of the impacts, while Categories 8, 2.1, 2.2, and 9 represent 13 percent, 9 percent, 6 percent, and 7 percent, respectively. These five categories alone account for approximately 91 percent of the estimated annual impacts for HM shipments. No other category accounts for more than 3 percent of the total impacts (p ES-4).

Accounting for at least these five categories of hazmat transport is likely to be essential to understanding incident and accident impacts in most HMCFS studies that evaluate vulnerability and risk.

APPENDIX J

Truck/Hazmat Placard Identification Sheet and Count Tabulation Sheets

J.1 Truck Type, Configuration, and UN/NA Placard Example Sheet

The example sheet shown in Figure J.1 contains examples of truck types and configurations, as well as examples of UN/NA placard classes, grouped by placard class along with a tenth category for other types of placards not included in the nine classes. The sheet can be used by data collectors to help with vehicle or placard identification, but the images shown are not exhaustive of all truck or placard types or configurations.

J.2 Truck Count Sheet Template and Example

Figure J.2 contains a blank template for counts of trucks. The sheet can accommodate counts for up to seven time periods per roadway direction. Figure J.3 shows an example of the data sheet with count information completed for one time period.

J.3 Truck Type and Configuration Count Sheet Template and Example

Figure J.4 contains a blank template for counts of trucks by type and configuration. A separate count sheet should be used for each time period and roadway direction. Figure J.5 shows an example of the data sheet with count information completed for one time period.

J.4 UN/NA Hazmat Placard ID Sheet Template and Example

Figure J.6 contains a blank template for identification of UN/NA hazmat placards. The sheet can accommodate counts for up to five different time periods, per roadway direction. Figure J.7 shows an example of the data sheet with placard ID information completed for one time period.

J.5 Truck Count and UN/NA Hazmat Placard ID Sheet Template and Example

Figure J.8 contains a blank template for a count of trucks and identification of UN/NA hazmat placards. The sheet can accommodate counts for up to four different time periods per roadway direction. Figure J.9 shows an example of the data sheet with count and placard ID information completed for one time period.

J.6 Truck Type and Configuration Count and UN/NA Hazmat Placard ID Sheet Template and Example

Figure J.10 contains a blank template for a count of trucks by type and configuration and for identification of UN/NA hazmat placards. Spacing provided for truck counts or placard information should be sufficient to record information for most roadways during a 30-minute or longer count period. A separate count sheet should be used for each time period and roadway direction. Figure J.11 shows an example of the data sheet with count and placard ID information completed for one time period.

J.7 Directional and Intersection Survey Sheet Template

Figure J.12 is based on a truck traffic survey form developed by the Colorado State Patrol's Hazardous Materials Transport Safety and Response Team and modified for truck types, configurations, and directional information. It contains a blank template for directional and intersection surveys of trucks by type and configuration (straight trucks [ST], tractor-trailers or straight trucks with a trailer [TT] and tractor with multi-trailer [MT]) and UN/NA hazmat placards for the nine hazmat classes along with a tenth category for other placards (e.g., "Dangerous," "Marine Pollutant," etc.), and there is space for recording more specific placard information such as numbers or words. "Un" is used to identify "unknown" or "uncertain" information for all categories. Multiple sheets may be required for each time period. Abbreviations for truck body types, configurations, and placard groups correspond to categories shown on the identification sheet in Appendix J.1. Figure J.13 shows an example of the data sheet with count and placard ID information completed for a portion of one time period.

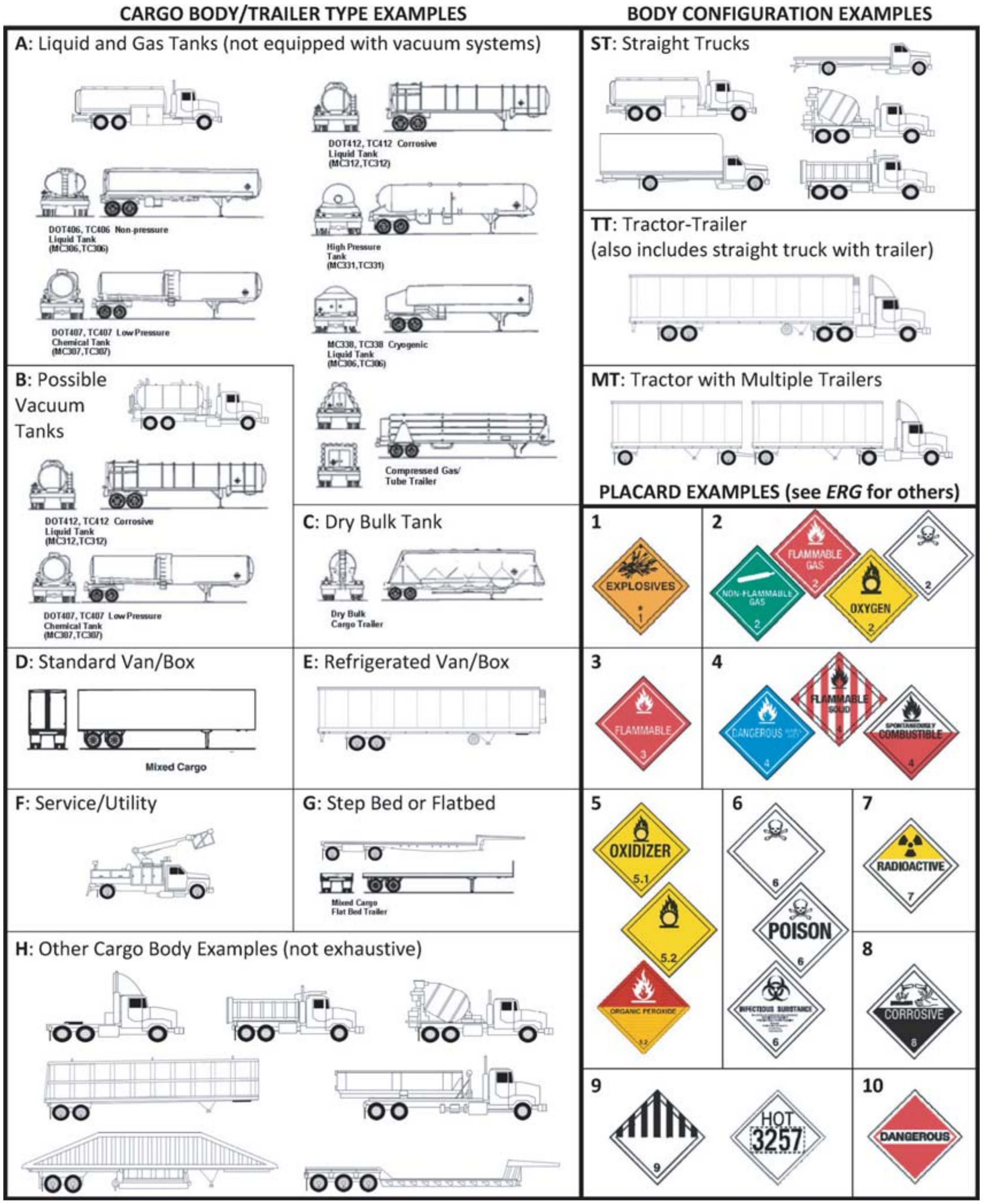


Figure J.1. Truck type, configuration, and placard examples.
Source: Truck/trailer images from *Hazardous Materials Guide for First Responders* (USFA) and by Texas Transportation Institute. Placard images from 2008 *Emergency Response Guidebook*.

Name:

Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Comments:				

Figure J.2. Truck count sheet.

Name: B. Nelson

Location/Direction: US-59 NB, Polk County, Texas	**Day:** Monday	**Date:** 10/16/10	**Times:** 1:30-2:00 p.m.	**Weather:** Sunny, Hot
Trucks: 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 II				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:				
Comments: Use this sheet for counting trucks. Use one sheet for up to seven data collection time periods. Without information about HazMat placards, you will need to make assumptions about the HazMat transported on those trucks. For example, you might assume that national averages of percentage HazMat transport by truck from the VIUS database apply to the sampled location. You will also need to make assumptions about the types and configurations of trucks used to transport HazMat.				

Figure J.3. Truck count sheet.

Name:

Location/Direction:	Day:	Date:	Times:	Weather:

Truck Type	Configuration		
Standard Tank (liquid and gas)	Straight:	Tractor-Trailer:	Multi-Trailer:
Vacuum Tank	Straight:	Tractor-Trailer:	Multi-Trailer:
Dry-Bulk Tank	Straight:	Tractor-Trailer:	Multi-Trailer:
Standard Van (including containers)	Straight:	Tractor-Trailer:	Multi-Trailer:
Refrigerated Van	Straight:	Tractor-Trailer:	Multi-Trailer:
Service/Utility	Straight:	Tractor-Trailer:	Multi-Trailer:
Flatbeds and Stepbeds	Straight:	Tractor-Trailer:	Multi-Trailer:
Other Trucks	Straight:	Tractor-Trailer:	Multi-Trailer:
Comments:			

Figure J.4. Truck type and configuration count sheet.

Name: B. Nelson

Location/Direction: US-59 NB, Polk County, Texas	**Day:** Monday	**Date:** 10/16/10	**Times:** 1:30-2:00 p.m.	**Weather:** Sunny, Hot

Truck Type	**Configuration**		
Standard Tank (liquid and gas)	Straight:	Tractor-Trailer: 卌 |||	Multi-Trailer:
Vacuum Tank	Straight:	Tractor-Trailer: ||	Multi-Trailer:
Dry-Bulk Tank	Straight:	Tractor-Trailer: 卌	Multi-Trailer:
Standard Van/ (including containers)	Straight: |||	Tractor-Trailer: 卌 卌 卌 卌 卌 |||	Multi-Trailer:
Refrigerated Van	Straight: |	Tractor-Trailer: 卌 ||	Multi-Trailer:
Service/Utility	Straight: ||	Tractor-Trailer:	Multi-Trailer:
Flatbeds and Stepbeds	Straight:	Tractor-Trailer: 卌 卌 卌 卌 卌 |	Multi-Trailer:
Other Trucks	Straight: |||	Tractor-Trailer: 卌 ||	Multi-Trailer:

Comments: Use this sheet for counting trucks by type and configuration. Use one sheet for each data time period. Counting only truck types and configurations is easy. However, without information about HazMat placards, you will need to make assumptions about the HazMat transported on those trucks. For example, you might assume that national averages of percentage HazMat transport by truck type and configuration from the VIUS database apply to the sampled location.

Figure J.5. Truck type and configuration count sheet.

Name:

Location/Direction:	Day:	Date:	Times:	Weather:
UN/NA Placard IDs (circle multiple placards on same truck):				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Comments:				

Figure J.6. UN/NA hazmat placard ID sheet.

Name: B. Nelson

Location/Direction: US-59 NB, Polk County, Texas	**Day:** Monday	**Date:** 10/16/10	**Times:** 1:30-2:00 p.m.	**Weather:** Sunny, Hot
UN/NA Placard IDs (circle multiple placards on same truck): 1075, 1230, 1993, 1993, Hot 3257, 1993, Flammable, Class 4, 3082				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
UN/NA Placard IDs:				
Comments: Use this sheet for counting and identifying HazMat placards for up to five different time periods. Circle multiple placards observed on the same truck. Record the most specific information about the placards as you can: 1) whether the truck is placarded; 2) placard color; 3) HazMat class or division; or 4) specific words or numbers written on the placard. See the *ERG* for placard configuration examples. Without information about truck types and configurations, you will need to make assumptions about the types and configurations of vehicles used to transport the HazMat, and you will not be able to identify overall truck traffic levels or patterns.				

Figure J.7. UN/NA hazmat placard ID sheet.

Name:

Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:		**UN/NA Placard ID** (circle multiple placards on same truck)**:**		
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:		**UN/NA Placard ID:**		
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:		**UN/NA Placard ID:**		
Location/Direction:	**Day:**	**Date:**	**Times:**	**Weather:**
Trucks:		**UN/NA Placard ID:**		
Comments:				

Figure J.8. Truck count and UN/NA hazmat placard ID sheet.

Name: B. Nelson

<table>
<tr><td>Location/Direction: US-59 NB, Polk County, Texas</td><td>Day: Monday</td><td>Date: 10/16/10</td><td>Time: 1:30-2:00 p.m.</td><td>Weather: Sunny, Hot</td></tr>
<tr><td colspan="2">Trucks:
𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
𝍸 𝍸 𝍸 𝍸 𝍸 ||</td><td colspan="3">UN/NA Placard ID (circle multiple placards on same truck):
1075, 1230, 1993, 1993, Hot 3257, 1993, Flammable, Class 4, 3082</td></tr>
<tr><td>Location/Direction:</td><td>Day:</td><td>Date:</td><td>Time:</td><td>Weather:</td></tr>
<tr><td colspan="2">Trucks:</td><td colspan="3">UN/NA Placard ID:</td></tr>
<tr><td>Location/Direction:</td><td>Day:</td><td>Date:</td><td>Time:</td><td>Weather:</td></tr>
<tr><td colspan="2">Trucks:</td><td colspan="3">UN/NA Placard ID:</td></tr>
<tr><td>Location/Direction:</td><td>Day:</td><td>Date:</td><td>Time:</td><td>Weather:</td></tr>
<tr><td colspan="2">Trucks:</td><td colspan="3">UN/NA Placard ID:</td></tr>
<tr><td colspan="5">Comments: Use this sheet for counting trucks and identifying HazMat placards for up to four different time periods. This information can be used to identify the percentage of overall truck traffic that is placarded. Circle multiple placards observed on the same truck. Record the most specific information about the placards as you can: 1) whether the truck is placarded; 2) placard color; 3) HazMat class or division; or 4) specific words or numbers written on the placard. See the ERG for placard configuration examples. Without information about truck types and configurations, you will need to make assumptions the types and configurations of vehicles used to transport the HazMat.</td></tr>
</table>

Figure J.9. Truck and UN/NA hazmat placard ID sheet.

Location:		**Name:**	**Page:** of
Day:	**Date:**	**Times:**	**Weather:**

Truck Type	**Truck Configuration**	**UN/NA Placard ID** (circle multiple placards on same truck)
Std. Tank: Low Press. Liquid, Comp. Gas, Cryogenic	Straight	
	Tractor-Trailer	
	Multi-Trailer	
Vacuum Tank	Straight	
	Tractor-Trailer	
Dry Bulk Tank	Straight	
	Tractor-Trailer	
Std. Van: Box, Open Top, Curtainside, etc.; and Container	Straight	
	Tractor-Trailer	
	Multi-Trailer	
Refrigerated Van	Straight	
	Tractor-Trailer	
	Multi-Trailer	
Stepbed or Flatbed	Straight	
	Tractor-Trailer	
	Multi-Trailer	
Service or Utility	Straight	
	Tractor-Trailer	
Other	Straight	
	Tractor-Trailer	
Comments:		

Figure J.10. Truck and hazardous materials placard count sheet.

Location: US-59 Northbound, Polk County, Texas		**Name:** B. Nelson	**Page:** 1 of 1
Day: Monday	**Date:** August 16, 2010	**Times:** 1:30-2:00 p.m.	**Weather:** Sunny, Hot

Truck Type	**Truck Configuration**	**UN/NA Placard ID** (circle multiple placards on same truck)
Std. Tank: Low Press. Liquid, Comp. Gas, Cryogenic	Straight	
	Tractor-Trailer 卌 |||	1075, 1230, 1993, 1993, Hot 3257
	Multi-Trailer	
Vacuum Tank	Straight	
	Tractor-Trailer ||	
Dry Bulk Tank	Straight	
	Tractor-Trailer 卌	
Std. Van: Box, Open Top, Curtainside, etc.; and Container	Straight |||	
	Tractor-Trailer 卌 卌 卌 卌 卌 |||	1993, Flammable, Class 4, 3082
	Multi-Trailer	
Refrigerated Van	Straight		
	Tractor-Trailer 卌 ||	
	Multi-Trailer	
Stepbed or Flatbed	Straight	
	Tractor-Trailer 卌 卌 卌 卌 卌 卌		
	Multi-Trailer	
Service or Utility	Straight ||	
	Tractor-Trailer	
Other	Straight |||	
	Tractor-Trailer 卌 ||	

Comments: Use one sheet for each data time period. Record the most specific information about the placards as you can: 1) whether the truck is placarded; 2) placard color; 3) HazMat class or division; or 4) specific words or numbers written on the placard. See the *ERG* for placard configuration examples.

Figure J.11. Truck and hazardous materials placard count sheet.

****PLEASE USE BLACK OR BLUE PEN ONLY ****

HAZARDOUS MATERIALS COMMODITY FLOW STUDY - DATA COLLECTION SHEET

Road, Location, Intersection: ______ √ Weather: ______ √ Page: ___ of ___

Day: S | M | T | W | R | F | S √ Date: ______ √ Start Time: ______ √ End Time: ______

Observer Name(s): ______ √ Agency Name(s): ______

	CARGO BODY/TRAILER TYPE √									BODY CONFIGURATION √				PLACARD TYPE												PLACARD/UN IDs √	APPROACHING ON √				DEPARTING ON			
1	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
2	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
3	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
4	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
5	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
6	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
7	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
8	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
9	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
10	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
11	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
12	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
13	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
14	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
15	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
16	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
17	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
18	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
19	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
20	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
21	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
22	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
23	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
24	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB
25	A	B	C	D	E	F	G	H	Un	ST	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		NB	SB	EB	WB	NB	SB	EB	WB

Figure J.12. HMCFS data collection sheet.

****PLEASE USE BLACK OR BLUE PEN ONLY ****

HAZARDOUS MATERIALS COMMODITY FLOW STUDY - DATA COLLECTION SHEET

Road, Location, Intersection: US 59 NB, Polk County, Texas √ **Weather:** Sunny, Hot √ **Page:** 1 of 4

Day: S (M) T W R F S √ **Date:** August 16, 2010 √ **Start Time:** 1:30 p.m. √ **End Time:** 2:00 p.m.

Observer Name(s): B. Nelson √ **Agency Name(s):** Holiday Lakes VFD

	CARGO BODY/TRAILER TYPE √									BODY CONFIGURATION √				PLACARD TYPE												PLACARD/UN IDs √	APPROACHING ON √				DEPARTING ON			
1	(A)	B	C	D	E	F	G	H	Un	ST	(TT)	MT	Un	1	(2)	3	4	5	6	7	8	9	10	Un	X	1075	(NB)	SB	EB	WB	(NB)	SB	EB	WB
2	(A)	B	C	D	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
3	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
4	A	B	C	D	(E)	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
5	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
6	A	B	C	D	E	F	(G)	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
7	A	B	C	D	E	(F)	G	H	Un	(ST)	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
8	A	B	C	D	E	F	G	(H)	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
9	(A)	B	C	D	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
10	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	(3)	(4)	5	6	7	8	9	10	Un	X	1993, Flamm., Cl. 4	(NB)	SB	EB	WB	(NB)	SB	EB	WB
11	A	B	(C)	D	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
12	(A)	B	C	D	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X	1230	(NB)	SB	EB	WB	(NB)	SB	EB	WB
13	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
14	A	B	C	D	E	F	(G)	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
15	A	B	C	D	E	F	(G)	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
16	A	B	C	D	(E)	F	G	H	Un	(ST)	TT	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
17	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
18	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
19	A	B	C	D	E	F	(G)	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
20	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
21	A	B	C	D	E	F	G	(H)	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
22	A	B	C	D	E	F	G	(H)	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
23	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
24	A	B	(C)	D	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB
25	A	B	C	(D)	E	F	G	H	Un	ST	(TT)	MT	Un	1	2	3	4	5	6	7	8	9	10	Un	X		(NB)	SB	EB	WB	(NB)	SB	EB	WB

Figure J.13. HMCFS data collection sheet.

APPENDIX K

Existing and New HMCFS Data Analysis Examples

K.1 Existing Data from Freight Analysis Framework Database

Description

The spatial data from FHWA's Freight Analysis Framework (FAF) are available at county and state levels in terms of estimated tons and values for commodity groups. The commodity classification system in the FAF uses the Standard Classification of Transported Goods (SCTG) codes at the two-digit level.

Limitations

Because the data are modeled based on a stratified national sample of economic activity and not actual traffic flows, they are only generally applicable for a local HMCFS and should only be interpreted in terms of commodity groups that can be expected to be present in a region or state. Data can only be approximately associated with hazmat class level for the vast majority of commodities.

Supported Objectives

Increasing awareness about hazmat transport and minimum scenarios definition.

How to Use the Data

1. Develop a listing of commodity flows for your state using Geographic Information Systems (GIS).
2. Identify commodity groups associated with hazmat transport and use the listing to indicate what may be transported in your region.

K.2 Existing Data from BTS/Census Bureau *Commodity Flow Survey*

Description

The Bureau of Transportation Statistics/Census Bureau 2007 Commodity Flow Survey (CFS) data are applicable at a state or national level. If an LEPC is interested in using national estimates of hazmat shipments by different modes (including trucks) for local estimates, this is a good source.

Limitations

Data should only be considered generally applicable for a local HMCFS in terms of commodities that may be expected to be present in a region or state. Estimates have a very high degree of variability for local networks since they are drawn from a national sample of shipments. They may be off by a large degree, and additional survey data are necessary to provide further information about the validity of the data.

Supported Objectives

Increasing awareness about hazmat transport and minimum scenarios definition.

How to Use the Data

1. Access the report at the Internet address listed for the report in Appendix G.
2. Select the desired table, and review the information for hazmat shipments by mode, class, or characteristic for your state.
3. Develop corresponding listings and tables as an indication of what may be transported in your region.

Application Example

A local entity is interested in information about transportation of all hazardous materials and Hazard Class 3 materials. First, they need to access the 2007 Commodity Flow Survey information. There they might identify Table Sector 00: CF0700H04: Hazardous Materials Series: HazMat Shipment Characteristics by Mode by Hazardous vs. Nonhazardous Status for the United States: 2007. This table shows that a total of 3,344,658 million ton-miles of all commodities (hazardous and non-hazardous) were shipped in the United States, including 1,342,104 million ton-miles by truck. A total of 103,997 million ton-miles of truck transport were of hazardous materials. Around 7.7 percent of truck ton-miles shipped were associated with transport of hazardous materials (103,997/1,342,104).

Another table of interest might be Table Sector 00: CF0700H07: Hazardous Materials Series: HazMat Shipment Characteristics by Mode by Hazardous Class or Division for the United States: 2007 & 2002. This table shows that a total of 181,615 million ton-miles shipped for all modes are associated with Hazard Class 3, Flammable or Combustible Liquids, and 55,934 million ton-miles by truck.

- Hazard Class 3, Flammable or Combustible Liquids, corresponds to 5.4 percent of all ton-miles shipped for all commodities by all modes (181,615/3,344,658), and 4.2 percent of all truck ton-miles shipped (55,934/1,342,104).
- Of the hazardous materials shipped by truck in the United States, 53.8 percent were Hazard Class 3, Flammable or Combustible Liquids (55,934/103,997).

A third table of interest might be Table Sector 00: CF0700H08: Hazardous Materials Series: HazMat Shipment Characteristics by Mode by UN Number for the United States: 2007. This table shows that a total of 23,665 million ton-miles shipped by truck are associated with UN/NA Number 1203 (Gasoline), 16,408 million ton-miles with UN/NA Number 1993 (Various Petroleum Distillates, including diesel fuel), and 5,729 million ton-miles with UN/NA Number 1202 (Diesel Fuel), for a total of 45,802 million ton-miles for these UN/NA numbers by truck. (Note that there also are other UN/NA IDs that are for Class 3 hazardous materials. These IDs are used as examples).

- Of the Hazard Class 3 Flammable or Combustible Liquids shipped in the United States by truck, 82 percent were associated with UN/NA Numbers 1203, 1993, or 1202 (45,802/55,934).

- Of the hazardous materials shipped by truck in the United States, 44 percent were associated with UN/NA Numbers 1203, 1993, or 1202 (45,802/103,997).

K.3 Existing Data from HPMS Combined with Existing Data from VIUS or CFS

Description

The FHWA's Highway Performance Monitoring System (HPMS) contains information for annual average daily traffic (AADT) levels for major roadway segments including the state and national highway systems. The U.S. Census Bureau's 2002 Vehicle Inventory and Use Survey (VIUS) data are summarized in Appendix H. CFS data are described in the previous section.

Limitations

Commodity flows estimated using these sources should only be considered generally applicable for a local HMCFS. They have a very high degree of variability since they mix a local estimate, a local annual sample, and a national annual sample; they may differ from the true value by a large degree. Additional survey data are necessary to provide further information about the validity of the data.

Supported Objectives

Increasing awareness about hazmat transport and minimum scenarios definition.

How to Use the Data

1. Obtain AADT estimates for major roadway segments in your jurisdiction.
2. Determine the percentage of truck traffic in the local area that makes up total traffic (estimate or other information source).
3. Apply the percentage of total traffic that is trucks to the AADT values to estimate the truck traffic levels.
4. Apply the overall percentages of hazmat truck traffic from the bottom row of the 2002 VIUS data table to the estimated truck traffic levels, or apply percentages of hazardous materials by truck versus all commodities by truck from the 2007 CFS, for a crude estimate of numbers of hazmat trucks on applicable segments
5. Present the information in lists and tables, as applicable.

Application Example

A local entity is interested in estimating the number of trucks per day transporting Hazard Class 3 materials over a particular Interstate highway segment. According to the HMPS traffic volume map, the AADT of an Interstate section is over 100,000 (all vehicles). The local entity assumes that truck traffic is 15 percent of the overall traffic volume (*caution:* this value is used as an example only and has no applicability to roadways in your jurisdiction). This corresponds to over 15,000 trucks per day, on average.

Based on the 2002 VIUS data, a total of 2.3 percent of U.S. miles are driven by trucks while requiring a Class 3 placard or "Combustible" placard. According to the 2007 CFS, Hazard Class 3, Flammable or Combustible Liquids, corresponds to 4.2 percent of all truck ton-miles shipped for all commodities. Using these estimates and assuming that all trucks on the roadway section are driven the same distance through the jurisdiction, the local entity might expect to have between

350 and 630 trucks per day carrying Class 3 liquids on the Interstate segment ($15{,}000 * 0.023 = 345$; $15{,}000 * 0.042 = 630$).

K.4 Total Truck Counts Combined with Existing Data from VIUS or CFS

Description

This method uses counts of the number of trucks on different roadway segments to identify truck traffic volumes, rather than HPMS traffic level estimates. However, this method still necessitates application of national percentages of hazmat truck traffic from the bottom row of the 2002 VIUS data table (found in Appendix H) or 2007 CFS data.

Limitations

By eliminating some of the measurement error from the previous method, this method is probably slightly more relevant at the local level than estimates generated entirely from existing data sources. However, commodity flows estimated using these sources should still only be considered generally applicable for a local HMCFS. They have a very high degree of variability since they mix a local annual sample with a national annual sample; they may differ from the true value by a large degree. Additional survey data are necessary to provide further information about the validity of the data.

Supported Objectives

Conducted with convenience or representative sampling, supported objectives may include increasing awareness about hazmat transport and minimum definition of training scenarios (depending on the quantity and quality of data).

How to Use the Data

1. Determine truck traffic levels and patterns. This may range from a general estimate of truck traffic in the entire jurisdiction to levels of truck traffic by time for represented locations.
2. Apply the overall percentages of hazmat truck traffic from the bottom row of the VIUS data table to the estimated truck traffic levels, or apply percentages of hazardous materials by truck versus all commodities by truck from the 2007 CFS, for a crude estimate of numbers of hazmat trucks for represented locations.
3. Present the information in lists, tables, or charts, as applicable.

Application Example

A local entity is interested in estimating the number of trucks per day transporting Hazard Class 3 materials over a particular Interstate highway segment. A state DOT performs counts of trucks on a section of Interstate highway and provides the data to the local entity. The 2007 average annual daily truck traffic (AADTT) for the Interstate section was 9,210.

Based on the 2002 VIUS data, a total of 2.3 percent of U.S. miles are driven by trucks while requiring a Class 3 placard or “Combustible” placard. According to the 2007 CFS, Hazard Class 3, Flammable or Combustible Liquids, corresponds to 4.2 percent of all truck ton-miles shipped for all commodities. Using these estimates and assuming that all trucks on the roadway section are driven the same distance through the jurisdiction, the local entity might expect to have between 210 and 390 trucks per day with a Hazard Class 3 Flammable Liquids placard on the Interstate segment (9,210 * 0.023 = 212; 9,210 * 0.042 = 387).

K.5 Truck Type/Configuration Counts Combined with Existing Data from VIUS

Description

This method uses counts of trucks by type and configuration on different roadway segments, rather than generic truck counts. This allows for application of national percentages of hazmat traffic for each truck type and configuration from respective rows of the 2002 VIUS data table (see Appendix H).

Limitations

By further specifying the nature of truck traffic over the generic truck counts, it is probably slightly more relevant at the local level than estimates generated using only generic truck counts. However, these estimates still have a high degree of variability since they mix a local annual sample with a national annual sample; they may be off by a large degree. Additional survey data are necessary to provide further information about the validity of the data. These estimates should be considered as only having low-to-medium applicability for a local HMCFS in terms of level of hazmat traffic that may be expected to be present in a community.

Supported Objectives

Conducted with convenience or representative sampling, supported objectives may include increasing awareness about hazmat transport, minimum scenarios definition, and maximum scenarios definition (depending on the quantity, quality, and validity of data).

How to Use the Data

1. Determine truck traffic levels and patterns by type and configuration. This may range from estimates of truck traffic in the entire jurisdiction to levels of truck traffic by time for specific locations.
2. Apply the percentages of hazmat truck traffic from the corresponding rows of the VIUS data table to the observed truck traffic levels by type and configuration for a crude estimate of numbers of hazmat trucks for represented locations.
3. Present the information in lists, tables, or charts, as applicable.

Application Example

A local entity is interested in estimating the number of trucks per day transporting Hazard Class 3 materials over a particular Interstate highway segment. They have information that shows that the 2009 truck traffic on the Interstate segment was 500 tank trucks per day, 2,500 flatbed trucks per day, 3,000 refrigerated van trucks per day, and 3,500 standard van trucks per day (the LEPC only counted trucks by type, not configuration).

Based on the 2002 VIUS data, 23.3 percent of U.S. tank truck miles, 0.4 percent of flatbed miles, 0.4 percent of refrigerated van miles, and 1.3 percent of standard van miles are driven while requiring a Class 3 placard or "Combustible" placard. Using these estimates and assuming that all trucks on the roadway section are driven the same distance through the jurisdiction, the local entity might expect to see around 190 Hazard Class 3 Flammable or Combustible Liquids trucks per day on the Interstate segment ((500 * 0.233) + (2,500 * 0.004) + (3,000 * 0.004) + (3,500 * 0.013) = 184).

K.6 Placard Counts Combined with Total Truck Counts

Description

By counting the total number of trucks observed on a roadway segment and observing whether or not each truck has a hazmat placard, a locally relevant estimate of the total percentage of truck traffic that has a hazmat placard can be made. This may be particularly useful for locations for which specifically identifying a placard (e.g., by class/division or number) are challenging, such as locations that are some distance from the observed traffic, or where traffic is travelling at high rates of speed with limited time for truck observations.

Limitations

For purposes of locally relevant identification of presence or absence of hazardous materials, this method is sufficient. However, it does not inform about the types of hazardous materials being transported without application of national estimates such as the 2002 VIUS data. When this is done, estimates mix locally relevant survey data with local and national samples. They may be off by a moderate-to-high degree. Follow-on survey data may provide further information about the validity of the information.

Supported Objectives

Conducted with convenience or representative sampling, supported objectives may include increasing awareness about hazmat transport and minimum scenarios definition (depending on the quantity and quality of data).

How to Use the Data

1. Determine truck traffic levels and patterns. This may range from a general estimate of truck traffic in the entire jurisdiction to levels of truck traffic by time for represented locations.
2. Determine placarded truck traffic levels and patterns. This may range from a general estimate of placarded truck traffic in the entire jurisdiction to levels of truck traffic by time for represented locations.
3. Create a ratio of placarded trucks to overall trucks that can be estimated for applicable locations and times.
4. Present the information in lists, tables, or charts, as applicable.

Application Example

A local entity is interested in estimating the number of trucks per day transporting Hazard Class 3 materials over a particular Interstate highway segment. They conduct a 24-hour placard count during a weekday on the Interstate segment. Four-hundred trucks were observed to have a hazmat placard during the count. The 2007 AADTT for this section of roadway was 9,250, according to the state DOT. The entity assumes this represents the daytime, weekday traffic level during their placard count. Using the observed placarded truck count, over 4.3 percent (400/9,210) of trucks on the Interstate might display a hazmat placard if current truck traffic levels are similar to 2007 traffic levels. After applying some statistics (see Section K.10) and assuming the placard counts follow a

Poisson distribution, the local entity is 90 percent confident that the true placard count falls somewhere between 368 and 434 observations, or between 4.0 and 4.7 percent of AADTT.

Based on the 2002 VIUS data, a total of 2.3 percent of U.S. miles are driven by trucks while requiring a Class 3 placard or "Combustible" placard. Based on the 2007 CFS, 53.8 percent of hazardous materials shipped by truck in the United States were Hazard Class 3, Flammable or Combustible Liquids. Using the state DOT AADTT numbers with VIUS data and assuming that all trucks on the roadway section are driven the same distance through the jurisdiction, around 210 Hazard Class 3, Flammable and Combustible Liquids trucks per day (9,210 * 0.023 = 212) could be expected on the Interstate. Using the placard count with 2007 CFS data, around 220 Hazard Class 3, Flammable and Combustible Liquids trucks per day (400 * 0.538 = 215) could be expected.

K.7 UN/NA Placard ID Counts

Description

Observing and identifying specific placards enables recognition of particular truck/roadway transport hazmat hazards, including the relative proportion of different types of hazardous materials carried by trucks. Since it does not include a count of trucks, this method may be appropriate for use by a single data collector at busy traffic locations where both counting of trucks and identifying UN/NA placard IDs is too difficult.

Limitations

When conditions permit, it is more advantageous to count the number of trucks or number of trucks by type/configuration in addition to counts of specific UN/NA placard IDs. Reliability of information will depend on the sampling framework applied and the accuracy of data collection.

Supported Objectives

Conducted with convenience, representative, or cluster sampling, supported objectives may include increasing awareness about hazmat transport, minimum scenarios definition, maximum scenarios definition, emergency planning, and identifying equipment needs (depending on the quantity and quality of data).

How to Use the Data

1. Group UN/NA placard ID information according to class/division, specific ID, TIH classification, and associated initial response actions, or other categories.
2. Determine levels and patterns of observed placards (by hazmat grouping). This may range from a general estimate of observed placards for the entire jurisdiction to levels of observed placards by time for specific locations.
3. Calculate proportions of hazmat placards observed for each grouping.
4. Present the information in lists, tables, or charts, as applicable.

Application Example

A local entity is interested in estimating the percentage of placarded trucks transporting Hazard Class 3 materials over a particular Interstate highway segment during the daytime. They determine the following information for a daytime, weekday 8-hour placard ID count on the Interstate segment:

- 50 placards with UN/NA placard ID 1203 (Gasoline),
- 25 placards with UN/NA placard ID 1993 (Various Petroleum Distillates),
- 12 placards with UN/NA placard ID 1863 (Aviation Fuel),
- 5 placards labeled "Combustible" or "Fuel Oil,"
- Total number of placards counted: 200, and
- Peak hourly placard count rate from 11 A.M. to 12 P.M. is 35 placards per hour.

Approximately 46 percent of the trucks observed with placards on the Interstate had a Hazard Class 3, Flammable or Combustible Liquids placard ((50 + 25 + 12 + 5) / 200). After applying some statistics (see Section K.10) using a binomial distribution and assuming that daytime, weekday hazmat traffic patterns are consistent with the observed time period, the entity identifies that this percentage can be expected to range between 39 and 53 percent with 90 percent confidence. These data provide some estimates, and since the sample was over a limited time period, follow-on data are necessary to validate the information. The same type of estimates can be repeated for individual placard IDs that are included in the sample.

K.8 UN/NA Placard ID Counts Combined with Total Truck Counts

Description

This method includes a count of total trucks and counts of specific UN/NA placard IDs. Not only can it be used to identify the presence of commodities associated with specific UN/NA placard IDs, it also can be used to estimate the proportion of observed truck traffic that is placarded. More locally relevant information is obtained about hazmat transportation using these counts, but the complexity of the survey is limited because only the total number of trucks is counted, not the different types of trucks.

Limitations

Reliability of information will depend on the sampling framework applied and the accuracy of data collection.

Supported Objectives

Conducted with convenience, representative, cluster, stratified/proportional, or random sampling, supported objectives may include increasing awareness about hazmat transport, minimum definition of training scenarios, maximum definition of training scenarios, emergency planning, identifying equipment needs, comprehensive planning, and route analysis (depending on the quantity and quality of data).

How to Use the Data

1. Group UN/NA placard ID information according to class/division, specific ID, TIH classification and associated initial response actions, or other categories.
2. Determine levels and patterns of observed placards (by hazmat grouping). This may range from a general estimate of placarded truck traffic in the entire jurisdiction to levels of placarded truck traffic by time for specific locations.

3. Determine truck traffic levels and patterns. This may range from a general estimate of truck traffic in the entire jurisdiction to levels of truck traffic by time for specific locations.
4. Calculate proportions of hazmat placards observed (by grouping) to total truck traffic.
5. Present the information in lists, tables, charts, or maps, as applicable.

Application Example

A local entity is interested in estimating the percentage of all trucks transporting Hazard Class 3 materials over a particular Interstate highway segment during the daytime. The entity collects the following information for a daytime, weekday 8-hour placard count on the Interstate segment:

- 50 placards with UN/NA placard ID 1203 (Gasoline),
- 25 placards with UN/NA placard ID 1993 (Various Petroleum Distillates),
- 12 placards with UN/NA placard ID 1863 (Aviation Fuel),
- 5 placards labeled “Combustible” or “Fuel Oil,”
- Total number of placards counted: 200,
- Total number of trucks counted: 5,000,
- Peak hourly placard count rate for 11 A.M. to 12 P.M. is 35 placards per hour, and
- Peak hourly truck count rate for 1 P.M. to 2 P.M. is 600.

In addition to estimates discussed for the previous example, the following are identified. Approximately 1.8 percent of all trucks observed on the Interstate had a Hazard Class 3, Flammable or Combustible Liquids placard ((50 + 25 + 12 + 5) / 5,000). Approximately 4 percent of all trucks observed on the roadway had a hazmat placard (200/5,000), assuming that daytime, weekday hazardous materials and overall traffic patterns are consistent with the observed time period. Hazardous materials truck traffic appears to peak during the late morning. These data provide some estimates, and since the sample was over a limited time period, follow-on data are necessary to validate the information. The same type of estimates can be repeated for individual placard IDs that are included in the sample.

K.9 Placard ID Counts Combined with Truck Type Counts

Description

This method includes a count of trucks by size/configuration in addition to counts of specific UN/NA placard IDs. It can be used to identify the presence of commodities associated with specific UN/NA placard IDs, estimate the proportion of observed total truck traffic that is placarded, as well as proportions of different types/configurations of trucks that are placarded. Although more complex observational truck traffic sampling can be performed without conducting interviews or examining shipping manifests, this method is probably the most complex that can be accomplished using HMCFS volunteers.

Limitations

Reliability of information will depend on the sampling framework applied and accuracy of data collection.

Supported Objectives

Conducted with convenience, representative, cluster, stratified/proportional, or random sampling, supported objectives may include increasing awareness about hazmat transport, minimum scenarios definition, maximum scenarios definition, emergency planning, identifying equipment needs, comprehensive planning, and route designation (depending on the quantity and quality of data).

How to Use the Data

1. Group UN/NA placard ID information according to class/division, specific ID, TIH classification and associated initial response actions, or other categories.
2. Determine levels and patterns of observed placards (by hazmat grouping) for each truck type. This may range from a general estimate of placarded truck traffic in the entire jurisdiction to levels of placarded truck traffic by time for specific locations.
3. Determine truck traffic levels and patterns by type and configuration. This may range from estimates of truck traffic in the entire jurisdiction to levels of truck traffic by time for specific locations.
4. Proportions of hazmat placards observed (by grouping) to truck traffic (by type and configuration) may be calculated.
5. Present the information in lists, tables, charts, or maps, as applicable.

Application Example

A local entity is interested in estimating the percentage of all trucks transporting Hazard Class 3 materials over a particular Interstate highway segment during the daytime, as well as variations in traffic levels. The local entity collects information for truck type, configuration and UN/NA placards for a daytime, weekday 8-hour count on an Interstate segment. The LEPC assumes that daytime, weekday traffic patterns are consistent with the observed time-period, and summarizes the information as listed in Table K.1.

Table K.1. Example summary of truck type, configuration, and UN/NA placard information.

Location:	Roadway Segment Description				
Date:	June 20, 2011				
Time:	8:00 A.M. to 4:00 P.M.				
Truck Type	**Truck Configuration**	**Trucks Observed with**			**All Trucks Observed**
		Class 3 Placards	**Other Placards**	**Total Placards**	
Tank	Straight	10	10	20	50
	Tractor-Trailer	74	56	130	250
	Subtotal	84	66	150	300
Box Van	Straight	0	1	1	400
	Tractor-Trailer	7	22	29	1,600
	Subtotal	7	23	30	2,000
Refrigerated Van	Straight	0	0	0	200
	Tractor-Trailer	0	1	1	1,000
	Subtotal	0	1	1	1,200
Flatbed	Straight	1	8	9	200
	Tractor-Trailer	0	6	6	500
	Subtotal	1	14	15	700
Other	Straight	0	1	1	200
	Tractor-Trailer	0	3	3	600
	Subtotal	0	4	4	800
Total		**92**	**108**	**200**	**5,000**

Table K.2. Example summary of percentage trucks with UN/NA placards, by truck type and configuration.

Location:	Roadway Segment Description				
Date:	June 20, 2011				
Time:	8:00 A.M. to 4:00 P.M.				
Truck Type	**Truck Configuration**	**% Placarded Trucks with**		**% All Trucks with**	
		Class 3 Placard	**Other Placard**	**Class 3 Placard**	**Any Placard**
Tank	Straight	50%	50%	20%	40%
	Tractor-Trailer	57%	43%	30%	52.0%
	Subtotal	56%	44%	28%	50%
Box Van	Straight	0%	100%	0.0%	0.3%
	Tractor-Trailer	24%	76%	0.4%	1.8%
	Subtotal	23%	77%	0.4%	1.5%
Refrigerated Van	Straight	--	--	0%	0%
	Tractor-Trailer	0%	100%	0.0%	0.1%
	Subtotal	0%	100%	0.0%	0.1%
Flatbed	Straight	11%	89%	0.5%	4.5%
	Tractor-Trailer	0%	100%	0.0%	1.2%
	Subtotal	7%	93%	0.1%	2.1%
Other	Straight	0%	100%	0.0%	0.5%
	Tractor-Trailer	0%	100%	0.0%	0.5%
	Subtotal	0%	100%	0.0%	0.5%
Total		**46.0%**	**54.0%**	**1.8%**	**4.0%**

Table K.2 summarizes the proportions of hazmat trucks and proportions of all trucks with a Hazard Class 3 placard and other placards.

Table K.3 summarizes the hourly 90 percent confidence intervals using statistics (see Section K.10) for proportions of placarded trucks versus all trucks.

As shown, these estimates have a moderate degree of variability. They are based on locally relevant survey data, but the sample was over a limited time period. They may be off by a moderate degree, but appear to suggest that some differences in hazmat traffic patterns exist, if they follow the same pattern. They also provide information about the type of hazmat transport hazards that may be expected, and when risk is greatest. Follow-on survey data may provide further information about the validity of the information.

Table K.3. Example summary of percentage trucks with UN/NA placards, including confidence intervals.

Hour of Day	**No. Trucks Observed with Placards**		**% Trucks with Hazmat Placard**		
			Mean	**90% Confidence Intervals**	
	With Hazmat Placard	**Total**		**Lower**	**Upper**
8 A.M.	25	500	5.0%	3.62%	6.86%
9 A.M.	25	650	3.8%	2.78%	5.29%
10 A.M.	20	550	3.6%	2.53%	5.19%
11 A.M.	40	700	5.7%	4.43%	7.34%
12 P.M.	25	550	4.5%	3.29%	6.24%
1 P.M.	25	800	3.1%	2.26%	4.31%
2 P.M.	20	650	3.1%	2.14%	4.40%
3 P.M.	20	600	3.3%	2.32%	4.76%
Total	**200**	**5,000**	**4.0%**	**3.6%**	**4.5%**

K.10 Comments on Statistical Analyses

The 1995 *Guidance* (*1*) includes a discussion of statistical considerations for traffic count data, including flows that vary randomly, or in daily, weekly, or seasonal patterns. A table is provided in the *Guidance* for confidence intervals based on a Poisson distribution, which can be used for calculating probabilities of discreet event data such as truck counts. This is not the only distribution that is applicable for count information. For example, the data in Table K.3 were evaluated using a binomial distribution modified for extreme proportions (below 0.1 and above 0.9). Other analyses might include regression models.

The research team is not minimizing the technical expertise of local entities in their primary fields, but the fact is that most (e.g., LEPCs) do not have actively involved personnel who are well versed in transportation statistical methods. The team suggests that LEPCs and other local entities conducting an HMCFS at objective levels where statistical considerations are important (see Appendix D) seek the advice of transportation professionals who are trained in these analyses. Individuals with this sort of expertise can often be found at universities, local (e.g., MPO), state, or federal agencies, or consulting firms. A number of potential statistical methods may be applied and these can be found in statistics and transportation engineering textbooks or other sources.

K.11 Interviews with Hazmat Shippers, Receivers, and Carriers

Description

Interviews with hazmat shippers, receivers, and carriers, as well as with emergency responders and managers, and other key informants, are discussed in Chapter 5. Limited information from interviews can be used to confirm hazmat presence and help define priority sampling locations and frameworks.

Limitations

Unless many interviews are conducted, it is unlikely that sufficient information will be obtained using this method to develop reliable estimates of hazmat transportation over roadway network segments.

How to Use the Data

1. For each interview, list the date, time, and identity of the individual, along with a description of information relevant to the HMCFS project.
2. Compile the interview results in lists or paragraphs.

K.12 Shipping Manifests (Origin/Destination)

Description

This is the most resource-intensive new data collection method described in this guidebook for an HMCFS. An examination of shipping manifests can be used to confirm hazmat presence, help define priority sampling locations and frameworks, and provide information about the percentage of non-placarded shipments that are carrying hazmat.

Limitations

As with interviews with shippers, receivers, and carriers, a great deal of shipping manifest information is needed to develop reliable estimates of hazmat transportation over local roadway networks, and full use of information obtained from shipping manifests requires advanced transportation modeling techniques.

How to Use the Data

1. For each manifest examined, list the date, time, carrier, hazmat commodity and quantities, along with a description of information relevant to the HMCFS project provided by the carrier, including their origin and destination, routes taken, and the ultimate origin and destination of the shipment, if known.
2. Compile the results in tables, and summarize data accordingly.

K.13 Hypothetical Application of HMCFS Data

To illustrate these applications, consider the hypothetical case study of "Center County LEPC." Sometown, Texas, is the main city in Center County. Sometown is approximately 30 miles from Megacity and has an Interstate highway that runs through it. The county has a history of agricultural production and is the location for an industrial facility that uses and ships hazardous materials, and it has a small crude petroleum processing facility. Sometown is a demographically young and growing community with a small paid fire department and a mostly unincorporated surrounding area that is served by volunteer fire departments (VFDs). It has been several years or longer since most of the VFDs have conducted any hazmat training or reviewed their standard operating guidelines for hazmat response. The last time mutual aid agreements or emergency response service incident command procedures were reviewed for any department in the county was in 2003, and the county population has grown by 50 percent since then.

Although the Center County LEPC is interested in hazmat transport throughout the county, they are particularly interested in a stretch of Interstate highway east of Sometown that has the industrial facility on one side and subdivisions on the other side, including a large elementary school. Center County LEPC decides to conduct a hazmat CFS mostly to help them define training needs but possibly other applications as well. The LEPC wants to better understand the variability underlying the collected data and understand whether hazmat transportation patterns may vary by time of day. One of the LEPC members knows a faculty member from Megacity University who lives in Center County and agrees to assist with statistically evaluating the data, where needed, as part of a class project.

Assume that the analysis examples given in this appendix apply to the Interstate segment of interest to Center County LEPC, and that the LEPC might have obtained information about hazmat transport over the segment by any one of those methods. Using information from Sections K.1, K.2, K.3, or K.4, the LEPC might be able to raise awareness of local officials about the potential magnitude of the problem, or identify that a large number of Class 3 hazmat trucks may be going through their community and plan for training accordingly. Beyond that, however, few conclusions can be drawn. Using the information from Sections K.5 or K.6, the LEPC has better information about the types of incidents that can be expected, and although some estimates of the magnitude of potential exposure improve, the reliability of conclusions is still lower.

Using information from Sections K.7 or K.8, the LEPC can start to get a better handle on the type, magnitude, and source of potential exposures, although additional data would be advised. Using information from Section K.9 improves on this even further by providing information about when potential exposures might occur. Not only does the LEPC have better information about hazmat transport over the segment, but the locally relevant evidence provides justification if the LEPC needs to request modifications to practices or allocation of additional resources from other local, state, or federal agencies.

For example, by examining the statistical variability of the data (confidence intervals), it appears that the proportion of truck traffic carrying hazardous materials during the late morning period (11 A.M.–12 P.M.) over the segment may be significantly higher than the early afternoon period (1 P.M.–3 P.M.). This information is not conclusive since the intervals identify the likely range of hourly hazmat truck traffic averages at a 90 percent level of confidence. But it appears to make sense since the shipping manager of the industrial facility near the segment was interviewed (Section K.11) and indicated they do most of their shipments in the late morning. Occasionally, some of those shipments are Class 2.3 gases by large flatbed truck. Although traffic during the 8 A.M. to 9 A.M. period has a high average as well, it is not statistically different from any other time period. Say, for example, the elementary school sends half-day students home at 11:30 A.M., and those buses use the roadway segment of concern (it is the shortest, most direct route). The LEPC, the school district, and the industrial facility may want to consider whether there are alternate routing options for buses or tractor-trailers, even if these routes are less direct. The community and school may also wish to review building air infiltration rates and shelter-in-place, evacuation, and emergency notification systems to ensure that protocols and procedures reflect potential hazards.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation