



Buildings and Infrastructure Protection Series

Integrated Rapid Visual Screening of Tunnels

BIPS 03/March 2011



**Homeland
Security**

Science and Technology

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Foreword and Acknowledgments

Since the events of September 11, 2001, government officials, law enforcement, the design community, transportation specialists, and first responders have understood that the risk environment has changed and that the Nation's critical assets must be protected. The Department of Homeland Security (DHS) has identified transportation infrastructure as a Critical Infrastructure and Key Resource (CIKR) Sector.

DHS has sponsored the development of a methodology for assessing the risk and resilience of tunnels to terrorist attacks and selected natural hazards. The methodology, referred to as the integrated rapid visual screening (IRVS) for tunnels, was developed by the DHS Science and Technology Directorate (DHS S&T), Infrastructure Protection and Disaster Management Division, in partnership with the public and private-sector stakeholders involved in the design, operation, and management of critical infrastructure.

The result of an IRVS of tunnels is a quantifiable assessment of the risk of a given tunnel to a terrorist attack or natural disaster that leads to catastrophic losses (fatalities, injuries, damage, or business interruption) and a quantifiable assessment of the resiliency of the tunnel (ability to recover from such an event).



“Integrated” in IRVS indicates that the methodology includes the risk of both terrorist acts and natural hazards and an assessment of both risk and resiliency.

Needs and Purpose

Transportation tunnels have been identified as an attractive target for terrorist attacks because of their accessibility and potential impact on human lives and economic activity. Numerous tunnels in the United States are located at critical chokepoints. A critical choke point is a point in the transportation network where many trip paths intersect to get through a geographic barrier.

The U.S. transportation system includes approximately 337 highway tunnels and 211 mass transit tunnels, and many have limited alternative routes because of geographic constraints. Many transit tunnels are underwater. The loss of critical tunnels could result in hundreds or thousands of casualties, billions of dollars of direct reconstruction costs, and even greater socioeconomic costs. The downtime associated with an attack on a tunnel could range from days to years (FHWA, 2003).

The U.S. transportation system includes approximately 337 highway tunnels and 211 mass transit tunnels.

There has not been a direct attack on a highway or mass transit tunnel in the United States, but terrorist plots involving tunnels have been discovered and thwarted. In 2006, U.S. authorities discovered a plot in the early planning stage to attack mass transit tunnels under New York's Hudson River (Hsu and Wright, 2006).

Tunnels can receive collateral damage from attacks on other targets because of their underground or underwater location. For example, collateral damage from the attacks of September 11, 2001, rendered the Port Authority Trans-Hudson (PATH) commuter rail line unusable for 2 years. The PATH station and tunnel were connected to the World Trade Center towers via an underground concourse and shopping center. The collapse of the towers resulted in a partial collapse of several areas of the tunnel lining and led to flooding in certain areas. The rail line carried 67,000 passengers to Lower Manhattan every weekday (FHWA, 2003).

The loss of critical tunnels could result in hundreds or thousands of casualties, billions of dollars of direct reconstruction costs, and even greater socioeconomic costs.

The goals of terrorists are to attract attention, disrupt the economy, create fear, and disrupt the social fabric. Selected targets may not have a pattern. Terrorists may use methods that have been used before or they may use new methods. The possibility that new methods may be used complicates mitigation.

To better quantify, qualify, and mitigate the risks to mass transit systems, DHS S&T has dedicated resources to developing risk assessment and mitigation tools to protect tunnels and mass transit stations. The assessment of tunnels is described in this document, and the assessment of mass transit stations is described in the Integrated Rapid Visual Screening of Mass Transit Stations (DHS, 2011a).



The primary purpose of the IRVS of tunnels is to rank the risk in a group of tunnels in a transportation system or region.

The primary purpose of the IRVS of tunnels is to rank the risk in a group of tunnels in a transportation system or region. The results of an IRVS can also be used in infrastructure-specific risk assessments and higher level assessments of threats, consequences, and vulnerabilities.

This document is the manual for conducting an IRVS of tunnels and provides guidance in rating a tunnel's potential risk of and resiliency to terrorist attacks and selected natural disasters (fire and flooding).

Relationship of the IRVS of Tunnels to the Risk Management Series

The technical concepts and field application of the methodology are based on the Risk Management Series (RMS), a widely accepted series of publications that provide risk evaluation methods and design guidance for mitigating multi-hazard events. The design concepts from the RMS are represented in the IRVS methodology in the evaluation of favorable and unfavorable characteristics of a tunnel that influence the risk of the structure to specific threats.

Furthermore, the field application of the IRVS reflects the procedures for risk assessment outlined in several RMS publications. The series was developed by DHS's Federal Emergency Management Agency (FEMA) after the events of September 11, 2001. The IRVS methodology is drawn largely from the following three RMS publications:

- FEMA 426, *Reference Manual for the Protection of Buildings Against a Terrorist Attack* (DHS, 2011c)
- FEMA 452, *Risk Assessment, A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings* (FEMA, 2005)
- FEMA 455, *Handbook for Rapid Visual Screening of Buildings to Evaluate Terrorism Risks* (FEMA, 2009)

The differences between the rapid visual screening (RVS) described in FEMA 455 and the IRVS of tunnels described in this manual are:

- RVS is used to screen buildings, and IRVS is used to screen tunnels
- RVS focuses on the risk of terrorist acts, and IRVS focuses on both terrorist acts and selected natural hazards (fire and flooding)
- RVS focuses on risk, and IRVS focuses on both risk and resiliency

“Integrated” in IRVS indicates that the methodology includes the risk of both terrorist acts and natural hazards and an assessment of both risk and resiliency.

Relationship of the IRVS of Tunnels to the National Infrastructure Protection Plan

The IRVS methodology closely follows the general risk management framework and definitions identified in DHS’s National Infrastructure Protection Plan (NIPP) (DHS, 2009b), including the Critical Infrastructure and Key Resources (CIKR) Sectors. The risk management framework in the NIPP involves scenario-based consequence and vulnerability estimates and an assessment of the likelihood that a postulated threat will occur. The IRVS is based in part on the NIPP’s core criteria for risk assessments, as follows:

- **Documented** – This manual includes the types of information that are collected during the IRVS and how the information is synthesized to generate a risk and resiliency assessment. All assumptions, weighting factors, and subjective judgments are explained.
- **Reproducible** – The methodology has been tested to ensure that the results are reproducible.
- **Defensible** – The components of the methodology are integrated logically, and disciplines that are relevant to the methodology are incorporated appropriately (e.g., engineering, architecture, construction, emergency management, security). The methodology has been tested to ensure that the results are reproducible, and the results produced by the methodology have been validated.
- **Complete** – The methodology includes an assessment of consequences, threats, and vulnerabilities for every defined scenario and an assessment of the resiliency to postulated threats.

The NIPP includes the 18 CIKR Sectors that are identified in Homeland Security Presidential Directive 7. CIKR Sectors are the assets, systems, and networks that provide similar functions to the economy, government, or society. The IRVS incorporates the 18 CIKR Sectors in the target density

evaluation and includes all sectors in determining the threat of collateral damage from attacks on other targets.

Partnerships

DHS S&T worked in partnership with several public and private sector organizations to develop the IRVS methodology. The partners reviewed the factors involved in risk and resiliency scoring and conducted pilot and field studies of a variety of tunnels throughout the Nation. Equally important was the cooperation provided by the Metro Boston Transportation Agency and the Port Authority of New York and New Jersey. All agencies provided DHS with invaluable information, including how the methodology could realistically be expected to be used, which helped determine the scope of the methodology.



“Integrated” in IRVS indicates that the methodology includes the risk of both terrorist acts and natural hazards and an assessment of both risk and resiliency.

Intended Audience

This manual is intended for both technical and stakeholder audiences. Technical audiences include potential screeners and personnel who are knowledgeable about tunnels but who may not have a high level of expertise. Stakeholders include owners, operators, and decision-makers involved in the planning and maintenance of tunnels.

The intended audience includes:

- Transportation authorities
- City, county, and State officials
- Emergency managers
- Law enforcement personnel
- Facility managers
- Security consultants
- Engineers, architects, and other design professionals

This publication has been produced by the Department of Homeland Security (DHS) Science and Technology (S&T), Infrastructure Protection and Disaster Management Division (IDD).

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Table of Contents

Foreword and Acknowledgments	i
Need and Purpose	ii
Relationship of the IRVS of Tunnels to the Risk Management Series.....	iii
Relationship of the IRVS of Tunnels to the National Infrastructure Protection Plan	iv
Partnership	v
Intended Audience	v
Acknowledgments.....	vi
Project Officer.....	vi
Authors	vi
Software Developer	vi
External Review Committee	vi
Pilot Test Partners.....	vii
Graphic Designer.....	vii
1 Overview	1-1
1.1 IRVS Family.....	1-3
1.2 Validation	1-3
1.3 Risk and Resilience	1-4
1.3.1 Risk	1-4
1.3.2 Resilience	1-5
1.4 Organization of the Manual.....	1-6

2	Introduction to IRVS of Tunnels	2-1
2.1	Purpose of the IRVS of Tunnels.....	2-2
2.2	Stakeholders.....	2-4
2.3	Screeners.....	2-4
2.4	Time Required for the IRVS	2-5
2.5	Characteristics, Attributes, and Data	2-5
2.5.1	Consequences, Threat, and Vulnerability.....	2-5
2.5.2	Subjective Judgments	2-6
2.5.3	IRVS Catalog.....	2-6
2.5.4	Electronic Data Collection Form.....	2-6
2.5.5	IRVS Database.....	2-7
2.5.5.1	Database Synchronization	2-7
2.5.5.2	Use of the Database by Mass Transit Managers.....	2-7
2.5.6	Links.....	2-7
2.6	IRVS Risk and Resilience Scores.....	2-8
2.6.1	Risk Score.....	2-8
2.6.1.1	Consequences, Threat, and Vulnerability Ratings	2-8
2.6.1.2	Threat Types and Scenarios	2-9
2.6.1.3	Calculation of the Risk Score	2-11
2.7	Other Considerations.....	2-15
2.7.1	Evaluating Risk for a Transit Station Connected to a Building.....	2-15
2.7.2	Evaluating Risk for Multiple Mass Transit Stations	2-15
2.7.3	Evaluating Risk for Interconnected Tunnels and Other Infrastructure.....	2-16
3	Conducting an IRVS of Tunnels	3-1
3.1	Pre-Field Activities	3-2
3.1.1	Selecting Tunnels To Be Assessed	3-3
3.1.2	Identifying the IRVS Team	3-3
3.1.3	Training the IRVS Team	3-3
3.1.4	Identifying the IRVS Objectives.....	3-4

3.1.5	Evaluating Target Zones and Density	3-4
3.1.6	Gathering Pre-Field Data	3-6
3.1.7	Identifying Conditions for the Field Assessment.....	3-6
3.1.8	Scheduling a Meeting with Key Staff and Stakeholders and Scheduling the Station Tour.....	3-7
3.1.9	Assembling the Equipment for the Field Assessment.....	3-8
3.2	Field Assessment	3-8
3.2.1	Interviewing Key Staff and Stakeholders	3-8
3.2.2	Touring the Station	3-9
3.3	Post-Field Activities	3-9
3.3.1	Transferring Data to the DCF.....	3-9
3.3.2	Using the IRVS Scores.....	3-9
3.3.3	Identifying Tunnels That Require Further Analysis.....	3-10
3.3.4	Preparing a Written Report	3-10
4	Completing the Data Collection Form	4-1
4.1	Accounting for Uncertainty	4-2
4.2	Page One of the DCF.....	4-3
4.3	Step One: Consequences Rating	4-4
4.3.1	Consequences Characteristics	4-4
4.3.2	Catalog of Tunnel Characteristics and Attribute Options for the Consequences Rating.....	4-5
4.4	Step Two: Threat Rating.....	4-15
4.4.1	Threat Rating Characteristics	4-15
4.4.2	Catalog of Tunnel Characteristics and Attribute Options for the Threat Rating	4-15
4.5	Step Three: Vulnerability Rating	4-23
4.5.1	Vulnerability Rating Characteristics	4-23
4.5.1.1	Site Vulnerability.....	4-23
4.5.1.2	Architectural Vulnerability	4-24
4.5.1.3	Structural Vulnerability	4-24
4.5.1.4	Ventilation Vulnerability.....	4-24

4.5.1.5	Fire Protection System Vulnerability	4-25
4.5.1.6	Operational Systems Vulnerability	4-26
4.5.1.7	Nonstructural Vulnerability	4-26
4.5.1.8	Physical Security Vulnerability	4-26
4.5.1.9	Cyber Infrastructure Vulnerability	4-26
4.5.1.10	Operational Security Vulnerability	4-27
4.5.2	Catalog of Tunnel Characteristics and Attribute Options for the Vulnerability Rating	4-27

5 References.....5-1

Appendices

A	Acronyms	A-1
B	Glossary	B-1
C	IRVS Database User Guide	C-1
	Section 1: Overview and Installation	C-2
	Introduction	C-2
	Database Overview	C-2
	System Requirements	C-4
	Installation Process	C-5
	Install Wizard	C-5
	End User License Agreement (EULA)	C-6
	Customer Information	C-6
	Typical Installation	C-6
	Installation Completion	C-6
	Section 2: Open and Start the IRVS Process	C-8
	Open and Logon to the IRVS Database	C-8
	Logon to the Database	C-9
	IRVS Database Main Menu	C-9
	Help Function	C-10
	Section 3: Create and Display an IRVS Record	C-11
	IRVS Record Listing	C-11
	Create an IRVS Record	C-12
	Plot/Display IRVS Site Coordinates	C-14

Facility Screening Folders	C-16
Section 4: Conduct an IRVS Screening	C-18
Using the IRVS Data Forms	C-18
Conduct Pre-Field Data Entry.....	C-20
Hazard Tab (Building Screening Only).....	C-21
Pre-Field Questions Tab	C-22
Structure Type Tab (Building Screening Only)	C-22
Conduct on Site Evaluation	C-23
Threat Tab: Target Density Zones	C-24
Calculate and Review the Risk and Resiliency Summary Screen.....	C-25
Section 5: Finish the IRVS Process	C-27
Add Executive Summary.....	C-28
Screening Team.....	C-30
Adding Photos	C-31
Setting the Default Image.....	C-32
Deleting a Photo.....	C-32
Viewing Photos	C-32
Adding GIS Images.....	C-32
Deleting GIS Images.....	C-33
Viewing GIS Portfolio.....	C-33
Adding Miscellaneous Files.....	C-34
Deleting Miscellaneous Files.....	C-35
Export IRVS Records to Transfer Media.....	C-35
Erase a Screening Record from Field Team Database	C-36
Section 6: IRVS Management Processes	C-37
Create a Filtered Listing of Records.....	C-37
View All Summaries (Filtered List)	C-38
Plot Filtered Listing of Records.....	C-39
Print IRVS Reports	C-41
Section 7: Administrative Functions.....	C-43
Empty the Database.....	C-43
Delete a Single Screening Record.....	C-44



TABLE OF CONTENTS

	Import Field Team Database	C-45
	Detailed Diagnostics.....	C-47
	Manage User Accounts	C-48
	User Groups.....	C-49
	Delete a User	C-50
	Change a User's Group.....	C-51
	Export IRVS Records to Transfer Media.....	C-51
	Customize Report Handling Markings	C-52
	Change Passwords	C-53
D	Data Collection Form: Paper Version.....	D-1
E	DHS Infrastructure Taxonomy	E-1
	Infrastructure Taxonomy	E-1
	Agriculture and Food.....	E-1
	Banking and Finance	E-2
	Chemical	E-2
	Commercial Facilities.....	E-2
	Communications	E-5
	Critical Manufacturing.....	E-5
	Dams.....	E-5
	Defense Industrial Base.....	E-5
	Emergency Services.....	E-6
	Energy	E-6
	Government Facilities	E-6
	Healthcare and Public Health.....	E-9
	Information Technology.....	E-9
	National Monuments and Icons.....	E-9
	Nuclear Reactors, Materials and Waste.....	E-10
	Postal and Shipping	E-10
	Transportation Systems	E-10
	Water	E-10

Tables

Table 2-1:	Threat Types and Threat Scenarios	2-9
Table 2-2:	Risk Levels.....	2-12
Table 2-3:	Resilience Levels.....	2-14
Table 3-1:	Steps in the IRVS of Tunnels	3-2
Table 4-1:	Catalog of Tunnel Characteristics and Attribute Options for the Consequences Rating.....	4-6
Table 4-2:	Catalog of Tunnel Characteristics and Attribute Options for the Threat Rating.....	4-16
Table 4-3a:	Catalog of Tunnel Characteristics and Attribute Options for Site Vulnerabilities	4-27
Table 4-3b:	Catalog of Tunnel Characteristics and Attribute Options for Architectural Vulnerabilities ...	4-34
Table 4-3c:	Catalog of Tunnel Characteristics and Attribute Options for Structural Vulnerabilities.....	4-40
Table 4-3d:	Catalog of Tunnel Characteristics and Attribute Options for Ventilation Vulnerabilities.....	4-45
Table 4-3e:	Catalog of Tunnel Characteristics and Attribute Options for Fire Protection System Vulnerabilities.....	4-47
Table 4-3f:	Catalog of Tunnel Characteristics and Attribute Options for Operations Vulnerabilities	4-52
Table 4-3g:	Catalog of Tunnel Characteristics and Attribute Options for Nonstructural Vulnerabilities..	4-57
Table 4-3h:	Catalog of Security Systems for Physical Security Vulnerabilities	4-59
Table 4-3i:	Catalog of Tunnel Characteristics and Attribute Options for Cyber Vulnerabilities	4-68
Table 4-3j:	Catalog of Tunnel Characteristics and Attribute Options for Operational Security Vulnerabilities.....	4-69

Figures

Figure 1-1: Example of resilience 1-5

Figure 2-1: Interior of a subway car 2-2

Figure 2-2: Platform area of a mass transit station 2-3

Figure 2-3: Collateral effects of an attack on a nearby plaza could threaten the operations of the transit station 2-10

Figure 2-4: An explosive or CBR attack on the platform of a transit station is a threat scenario..... 2-10

Figure 2-5: Example of a transit station connected to a building..... 2-15

Figure 3-1: Target Zones 1 and 2..... 3-5

Figure 4-1: Data Collection Form, page 1 4-3

Figure 4-2: Data Collection Form (paper version), page 1..... 4-4

Figure 4-3: The “Tunnel Plug” is an example of an innovative fire suppression system under development for tunnels..... 4-25

Overview



In this chapter:

The methodology, referred to as integrated rapid visual screening (IRVS), can be used by transit agencies to assess a transit system that includes buildings, tunnels, and mass transit stations.



In response to the need to improve the protection of the Nation's critical assets, the Department of Homeland Security's Science and Technology Directorate (DHS S&T) has initiated the development of a methodology for assessing the risk and resilience of buildings, tunnels, and mass transit stations to terrorist attacks and natural disasters that result in catastrophic losses (fatalities, injuries, damage, or business interruption). Resilience is the ability of a facility to recover from a terrorist attack or natural hazard (see Section 1.3.2 for more information on resilience).

The methodology, referred to as integrated rapid visual screening (IRVS), can be used by transit agencies to assess a transit system that includes buildings, tunnels, and mass transit stations.

1.1 IRVS Family

The IRVS of Tunnels (described in this Manual) is just one type of infrastructure in the IRVS family developed by DHS S&T. Infrastructure-specific IRVS assessments have also been developed for buildings and mass transit stations. The IRVS family is described in the following documents published by DHS S&T:

- BIPS 02, Integrated Rapid Visual Screening of Mass Transit Stations (DHS, 2011)
- BIPS 03, Integrated Rapid Visual Screening of Tunnels (DHS, 2011b)
- BIPS 04, Integrated Rapid Visual Screening of Buildings (DHS, 2011a)

Each IRVS assessment is tailored to evaluate the unique characteristics of the infrastructure type that influence the risk and resiliency. The IRVS family can be used in conjunction to evaluate a system that may include mass transit stations, tunnels, and buildings.

1.2 Validation

DHS S&T validated the IRVS through alpha and beta testing in partnership with the Transportation Security Administration (TSA) and in cooperation with Massachusetts Bay Transportation Authority (MBTA) and Port Authority of New York and New Jersey (PANYNJ). One objective of the alpha and beta testing was to evaluate or determine the following:

- User-friendliness of the documentation and software
- Clarity of the description of the methodology
- Duration of a typical tunnel evaluation by newly trained assessors
- Sensitivity of the scoring system (attribute weights) to various tunnel attributes
- Variation among scores for different tunnel types
- Consistency of results

A second objective of the testing was to collect data on a wide array of tunnels with unique characteristics throughout the Nation.

The results of the alpha and beta testing were used as a basis for:

- Adding, deleting, and modifying tunnel characteristics
- Modifying the weighting factors for tunnel attribute options

- Calibrating the tool to obtain accurate, consistent, and reasonable risk scores for each IRVS for different types of tunnels. Calibration of scoring includes the overall risk score and the scores for each threat scenario and the consequences rating, threat rating, and vulnerability rating.

The IRVS of MTS was validated in four of the largest mass transit systems in the United States: New York City, Washington D.C., Boston, Cleveland, and St. Louis. In addition, this manual was reviewed by TSA, MBTA, and PANYNJ.

DHS S&T is developing a design program that promotes high performance in resistance to hazard events, resilience, security, sustainability, and energy efficiency.

1.3 Risk and Resilience

The two objectives of the IRVS of Tunnels are to assess the risk and resilience of a tunnel to a terrorist attack or selected natural hazards (fire and flooding).

1.3.1 Risk

Risk is the likelihood of the occurrence of an unfavorable event that leads to catastrophic losses (fatalities, injuries, damage, or business interruption). The three components of risk are consequences, threat, and vulnerability. Consequence is the level, duration, and nature of loss from an unfavorable event; threat is the likelihood of a manmade or natural unfavorable event with the potential to harm life, information, operations, the environment, and/or property; and vulnerability is defined

as a physical feature or operational attribute that renders an entity open to exploitation or susceptible to a given hazard. See Section 2.5.2 for more information about consequences, threat, and vulnerability..

Risk is the likelihood of the occurrence of an unfavorable event that leads to catastrophic losses (fatalities, injuries, damage, or business interruption).

The three components of risk are consequences, threat, and vulnerability.

1.3.2 Resilience

Resilience is defined as “the ability to resist, absorb, recover from, or successfully adapt to adversity or a change in conditions” (DHS, 2009b). Figure 1-1 shows an example of an asset’s resilience after an event.



Resilience is defined as the effectiveness of protective measures to reduce the impact of a catastrophic event and the capacity to absorb, adapt, and rapidly recover from the event.

Resilience depends on robustness, resourcefulness, and recovery.

- **Robustness** is defined as “the ability to maintain critical operations and functions in the face of crisis” (DHS, 2009a). Robustness measures include barriers, cameras, alarms, access control, redundancy of critical infrastructure systems and components. Robustness measures also include mitigating construction techniques that are designed to prevent a structure from collapsing after an explosion; structural retrofits; and debris mitigation techniques such as window films.
- **Resourcefulness** is defined as “the ability to skillfully prepare for, respond to and manage a crisis or disruption as it unfolds” (DHS, 2009a). Resourcefulness factors include training and preparedness, exercises, information sharing, security awareness programs, and ongoing assessment of risk.
- **Recovery** is defined as “the ability to return to and/or reconstitute normal operations as quickly and efficiently as possible after a disruption” (DHS, 2009a).

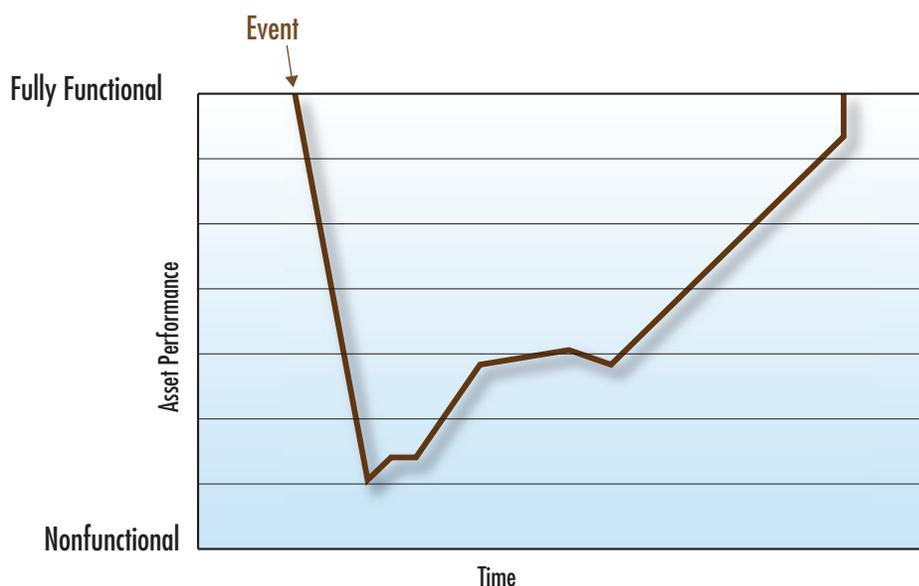


Figure 1-1:
Example of resilience

1.4 Organization of the Manual

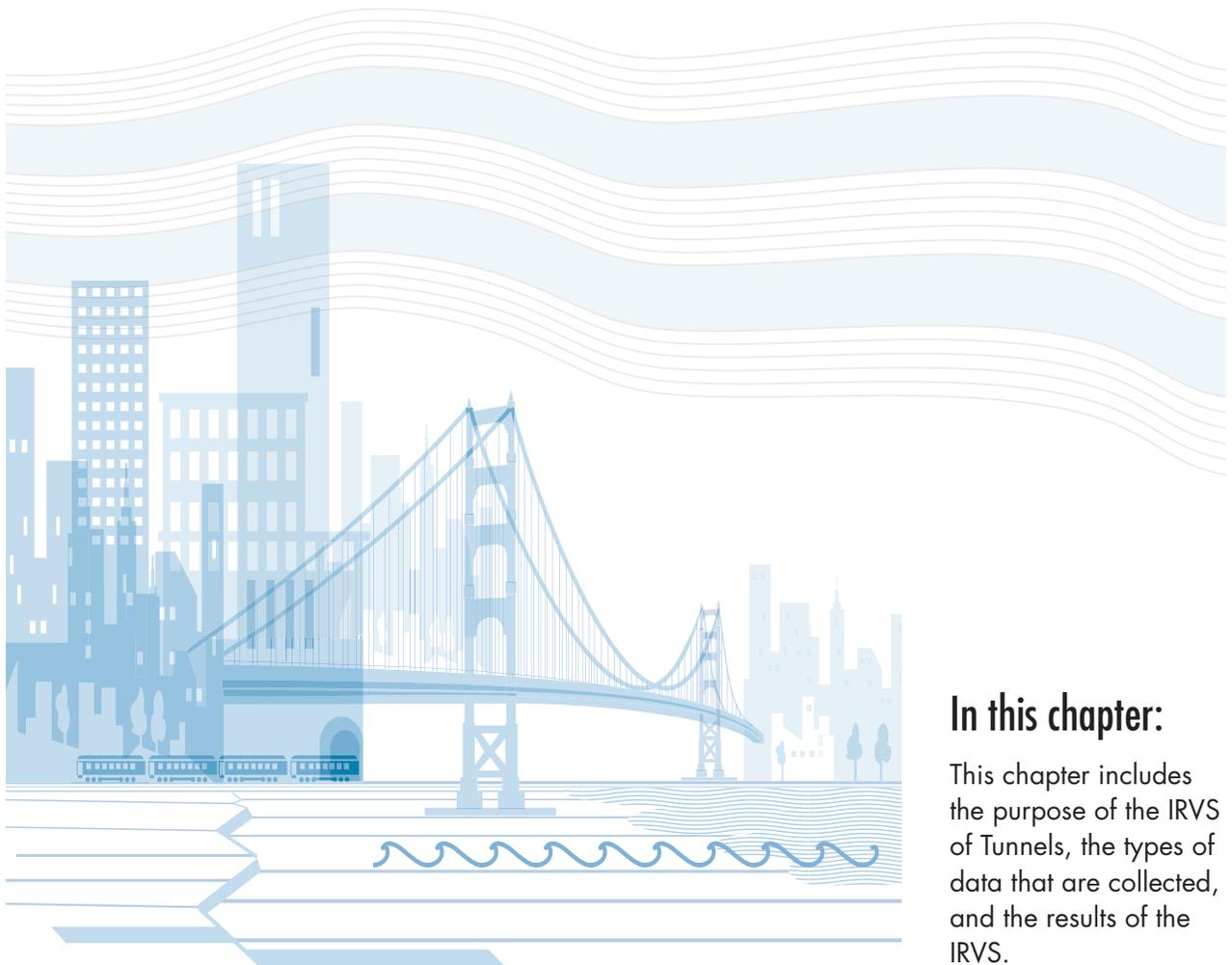
The information in this manual is organized as follows:

- Introduction to the IRVS of Tunnels (Chapter 2)
- Conducting an IRVS of Tunnels (Chapter 3)
- Completing the Data Collection Form (Chapter 4)
- References (Chapter 5)

Supplemental information is provided in the following appendices:

- Appendix A: Acronyms and Abbreviations
- Appendix B: Glossary
- Appendix C: IRVS Database User Guide
- Appendix D: Data Collection Form: Paper Version
- Appendix E: DHS Infrastructure Taxonomy

Introduction to IRVS of Tunnels



In this chapter:

This chapter includes the purpose of the IRVS of Tunnels, the types of data that are collected, and the results of the IRVS.

This chapter includes the purpose of the IRVS of Tunnels, the types of data that are collected, and the results of the IRVS. Chapters 3 and 4 explain how to conduct the IRVS input data into the IRVS Database, respectively.

2.1 Purpose of the IRVS of Tunnels

A tunnel is defined as a passageway through or under an obstruction such as a city, mountain, river, or harbor. A tunnel may be used for pedestrian traffic, vehicular road traffic, or rail traffic or as a canal. Tunnels are typically completely enclosed except for openings for egress, commonly at each end. Only tunnels used in transportation systems (mass transit and highway) are addressed in the IRVS of Tunnels methodology.



A tunnel is defined as a passageway through or under an obstruction such as a city, mountain, river, or harbor.

The purpose of the IRVS of Tunnels is to assess a tunnel's risk of a terrorist attack or selected natural disaster (fire or flooding) and the resiliency of the tunnel (the ability to recover from such an event).

The purpose of the IRVS of Tunnels is to assess a tunnel's risk of a terrorist attack or selected natural disaster (fire or flooding) and the resiliency of the tunnel (the ability to recover from such an event). The results of the assessment can be used to avoid or minimize catastrophic losses—fatalities, injuries, tunnel destruction or damage, and business interruption—from a terrorist attack or natural disaster.

The IRVS provides an assessment of the risk of a tunnel by evaluating the consequences of, threat of, and vulnerability to a terrorist attack or natural disaster. The IRVS also provides an assessment of the resilience of a tunnel by evaluating the tunnel's robustness, resourcefulness, and potential for recovery.

- The IRVS generates separate scores for risk and resilience. The information that is collected and the scores can be used to help:
- Identify, collect, and store vulnerability data that allow re-examination of risks during consideration of protective measures or after protective measures have been implemented
- Collect and store reported assessment information for tunnel management
- Prioritize vulnerabilities and consequences in a mass transit system indicating which tunnels may be more at risk and require more detailed analysis and/or higher protection

- Determine and report risks in a particular highway or mass transit tunnel in order to allocate potential resources to reduce major vulnerabilities cost effectively
- Understand potential cascading effects to the mass transit system by assessing a group of mass transit tunnels
- Understand resilience, potential down time, and economic and social implications if a tunnel is affected by a catastrophic event
- Identify which security measures should be implemented immediately during high alerts
- Anticipate the increased risks during special events that affect the peak flows of the tunnel in order to plan properly and implement protective measures; special events(e.g., sporting events, concerts, festivals) cause an abnormally high volume of ridership



The **risk score** is a numeric value that describes the risk of catastrophic loss from a terrorist attack or natural disaster at a mass transit station.

The **resilience score** is a numeric value that describes the ability of a mass transit station to resist, absorb, and recover from a potentially disruptive event at a mass transit station.

2.2 Stakeholders

The stakeholder is the group or entity that decides to conduct an IRVS, owns the results of the IRVS, and makes many of the decisions regarding the IRVS. In most cases, the stakeholder is the owner or operating authority of the tunnel or group of tunnels but can also be a law enforcement agency or a Federal, State, or local government agency.

The stakeholder or stakeholder's personnel may conduct the IRVS. For example, a mass transit authority may create a task group consisting of its security personnel and engineers to conduct an IRVS of the mass transit system. The mass transit system may opt to hire a consulting group to conduct the IRVS.

2.3 Screeners

The IRVS was developed so that screeners can be local operators, law enforcement officers, or others outside the design community without a high level of expertise. Screeners can conduct an IRVS with a reasonable level of certainty after brief training, thus reserving technical experts such as engineers and architects for more in-depth assessments. See Section 3.3 for more information about screeners and the IRVS team.

2.4 Time Required for the IRVS

One of the strengths of the IRVS of Tunnels is how quickly it can be completed. An assessment can typically be conducted in approximately 2 days by one or two screeners, facility management, and key staff. The field assessment is designed to be completed by two screeners in a few, depending on the complexity of the tunnel and the availability of information prior to the assessment.

2.5 Characteristics, Attributes, and Data

This section describes the types of data that are collected during the IRVS and how the data are recorded and stored.

The various characteristics of tunnels are evaluated in the IRVS. A characteristic is a physical component, function, or operation that relates to consequences, threat, and vulnerability. Examples of characteristics are the number of tracks/lanes, number of entrances, natural protective barriers, presence of hazardous materials, construction material, and tunnel medium.

“Characteristic” refers to the physical components, function, and operation of a mass transit station. **“Attribute”** is a subcategory of a characteristic.

An attribute is a subcategory of a characteristic. For example, for tunnel medium (characteristic), the attribute may be above grade (above water table), below grade (below water table), or

under water. Screeners select one attribute from a set of attribute options for each characteristic. Some characteristics have multiple sets of attributes, which reflect the need to normalize regional and other types of disparities.

Attributes are weighted depending on their degree of risk. For example, an underwater tunnel has the most risk compared to other elevations and is therefore given the heaviest weight of the attribute options for elevation.

Characteristics are grouped into the risk components of consequences, threat, and vulnerability, depending on which component the characteristic would affect. See Section 2.5.2 for information on the components of risk. Some characteristics affect more than one component.

The attributes of characteristics that are more important than others are weighted more heavily than the attributes of less important characteristics. Characteristics with heavily weighted attributes require careful evaluation because of their influence on the risk score. A small difference in the assessment of these characteristics can change the risk and resilience scores significantly.

2.5.1 Consequences, Threat, and Vulnerability

As noted in Section 2.5.1, characteristics are grouped into the components of risk—consequences, threat, and vulnerability.

- **Consequence** is defined as the effect of an event, incident, or occurrence and reflects the level, duration, and nature of the loss resulting from the incident (DHS, 2009a). Consequences are divided into four categories: public health and safety, economic, psychological, and governance/mission impacts.
 - The category of **public health and safety** reflects the effect on human life and physical well-being (e.g., fatalities, injuries/illness). **Economic loss** includes direct loss (e.g., cost to rebuild an asset, cost to respond to and recover from the event) and indirect loss (e.g., costs resulting from the disruption of a product or service, long-term costs from environmental damage). The **psychological effect** refers to the effect on public morale, which includes the possible changes in the public's sense of safety and well-being after a significant event and possible subsequent aberrant behavior. The **governance/mission effect** is the effect on government's or industry's ability to maintain order, deliver minimum essential public services, ensure public health and safety, and carry out national security-related missions.
 - The consequences that are considered in the IRVS are based on the criteria set forth in Homeland Security Presidential Directive 7 (HSPD-7), Critical Infrastructure Identification, Prioritization, and Protection. HSPD-7 establishes a framework to identify, prioritize, and protect CIKR from terrorist attacks and natural hazards, with an emphasis on protecting against catastrophic health effects and mass casualties.
- **Threat** is defined as a natural or manmade occurrence that harms or indicates the potential to harm life, information, operations, the environment, and/or property.
- **Vulnerability** is defined as a physical feature or operational attribute that renders a station open to exploitation or susceptible to a given hazard. Vulnerabilities may be associated with physical, cyber, or human factors. The assessment of vulnerabilities involves evaluation of specific threats to the asset to identify areas of weakness that could result in consequences of concern.



Consequence is the effect of an event, incident, or occurrence and reflects the level, duration, and nature of the loss resulting from the incident.

Consequences are divided into four categories: public health and safety, economic, psychological, and governance/mission impacts.

2.5.2 Subjective Judgments

Screeners may use subjective judgment when selecting attributes. The information in the catalog is intended in part to minimize the number of times the screener must use subjective judgment.

2.5.3 IRVS Catalog

The IRVS catalog contains the characteristics and associated attributes that are evaluated during the IRVS as well as information about the characteristics and attributes to help the screener. Characteristics are divided into consequences, threat, and vulnerability.

The catalog is essential in an IRVS assessment. The catalog is provided in Chapter 4 of this manual and also digitally in the IRVS database. See Section 2.5.5 for information about the IRVS database.

2.5.4 Electronic Data Collection Form

In the IRVS assessment, the screener records data using the electronic Data Collection Form (DCF) in the IRVS Database (see Section 2.5.5). The screener may opt to use a paper version of the DCF (not recommended). If this is the case, information has to be transferred to the electronic version. The screener can input data into the electronic DCF using a laptop or tablet computer. The paper version is provided in Appendix D.

The first page of the DCF contains general tunnel information and target density information (i.e., the number of high-value targets near the tunnel). The subsequent pages of the DCF contain characteristics and attribute options for consequences, threat, and vulnerability. The attribute options are listed in order of least degree of risk to highest degree of risk.

See Chapter 4 for information on completing the DCF.

2.5.5 IRVS Database

The IRVS database is a user-friendly data collection and management tool that includes the IRVS catalog and the DCF. The database is a stand-alone application that runs on computers with MS Access. Reports are generated as text files or files that can be imported into MS Word or MS Excel for editing and formatting.

2.5.5.1 Database Synchronization

The database can be accessed by multiple computers simultaneously. For example, screeners use the DCF in the database to record data in

the field, and a computer at an organization's headquarters analyzes the data and prints reports. The database is kept up-to-date using the import/export feature (see Appendix C) and by synchronizing the database through the authority's secure network.

2.5.5.2 Use of the Database by Tunnel Managers

The IRVS database can be used to facilitate the management of tunnel. Tunnel managers can use vulnerability and risk data when considering the implementation of protective measures. During periods of high alert, the database can be used to identify which security measures should be put in place immediately.

2.5.6 Links

Some characteristics affect more than one risk component. For example, the number of riders affects both consequences and threat. As the number of riders increases, the consequences and threat ratings are both expected to increase. The number of riders is therefore linked to two risk components and has a similar effect on both components.

Some characteristics affect more than one risk component.

Some linked characteristics have different effects on risk components. For example, an underwater tunnel would increase flooding vulnerability while reducing the vulnerability to external attacks.

2.6 IRVS Risk and Resilience Scores

The IRVS generates scores for risk and resilience.

2.6.1 Risk Score

The risk score is based on the consequences, threat, and vulnerability ratings for each of the 10 threat scenarios. Consequences, threat, and vulnerability ratings are explained in Section 2.6.1.1, and threat scenarios are explained in Section 2.6.1.2.

2.6.1.1 Consequence, Threat, and Vulnerability Ratings

The IRVS generates ratings for consequences, threat, and vulnerability.

- A **consequences rating** represents the degree of debilitation that would result from the incapacitation or destruction of an asset after a catastrophic event that causes injuries or fatalities, social and economic losses, and/or business interruption. Consequences are rated from the perspective of a tunnel's stakeholders, not terrorists.

- The **threat rating** represents the likelihood that a tunnel will be affected by a terrorist attack or natural disaster (fire or flooding) and that the losses will be catastrophic (fatalities, injuries, damage, or business interruption).
- The **vulnerability rating** is defined as the likelihood of damage and loss at a tunnel as a result of a terrorist attack or natural hazard (fire, flood).

The vulnerability rating is the most important and in-depth part of the IRVS. Unlike consequences and threats, vulnerabilities can be controlled or mitigated by the stakeholder. The vulnerability rating is crucial for determining protective measures and corrective actions that can be designed or implemented to reduce the identified vulnerabilities.

2.6.1.2 Threat Types and Scenarios

In the IRVS, risk is assessed with respect to a threat scenario or set of scenarios. The IRVS includes an assessment of the risk of both terrorist attacks and selected natural hazards. Risks are divided into four categories: (1) blast, (2) chemical, biological, or radiological (CBR) attack, (3) fire, and (4) other. Each category is subdivided into threat scenarios (see Table 2-1). The scenarios represent the location of the source of harm. All components of risk (i.e., consequences, threat, and vulnerability) are evaluated for each scenario.

Table 2-1: Threat Types and Threat Scenarios

Threat Type	Threat Scenario
Blast	Internal External (direct) External (collateral)
CBR	Internal External (direct)
Fire	External Tunnel/Track/Smoke
Other	Flood Collision (grade/elevated) Cyber

CBR = chemical, biological, or radiological

- **Blast**
 - **Internal** – Intrusion into the tunnel by a person or persons with the intent to attack the tunnel with an explosive device.
 - **External (direct)** – Use of an explosive device to attack the tunnel from the exterior. The tunnel is the primary target.
 - **External (collateral)** – An attack with explosive devices on a target within a 300-foot radius of the tunnel (e.g., a bomb explosion in a plaza adjacent to a tunnel). The tunnel is not the primary target but is susceptible to collateral damage. The severity depends on the proximity to the target and the magnitude of the threat.
- **Chemical, biological, or radiological (CBR) release**
 - **Internal** – Ground release of an airborne CBR agent inside the tunnel.
 - **External** – The ground release of an airborne chemical, biological, or radiological agent from the exterior of the tunnel.
- **Fire**
 - **Internal** – A fire outside the tunnel entrances that threatens the operations of the tunnel itself. An example would be a tunnel entrance next to or under a building that is on fire, thus threatening the operations and structure of the tunnel.
 - **Tunnel/Track/Smoke** – The spread of fire inside the operating areas servicing vehicles/trains of the tunnel. This includes smoke from the tracks of trains using the tunnel.
- **Other**
 - **Flood** – The tube of the tunnel being submerged in water threatening the operations and users inside the tunnel.
 - **Collision** – A vehicular impact to the tunnel causing damage to the structure and threatening operations.
 - **Cyber** – An attack on the tunnel through any combination of facilities, equipment, personnel, procedures, and communications integrated through cyber networks or control systems.

2.6.1.3 Calculation of the Risk Score

The risk scoring procedure used in the IRVS is based on the risk assessment equation in P-426, *Reference Manual to Mitigate Potential Terrorist Attack Against Buildings* (DHS, 2011c) and the NIPP framework assessing risks (DHS, 2009b).

The procedure is as follows:

1. The consequences, threat, and vulnerability ratings are generated for each threat scenario.
2. The consequences, threat, and vulnerability ratings for each scenario are combined using the following equation to produce a risk score for the scenario (de-aggregated risk score).

 Equation

$$\text{Risk} = C \times T \times V \quad (1)$$

where

C = Consequences Rating – degree of debilitation that would be caused by the incapacity or destruction of an asset. The consequences rating includes both monetary value and the value to a system or community.

T = Threat Rating – any indication, circumstance, or event with the potential to cause loss of, or damage to, an asset.

V = Vulnerability Rating – any weakness that can be exploited by an aggressor to make an asset susceptible to damage.

The de-aggregated risk score for each scenario ranges from 0.1 to 10. De-aggregated risk scores are color-coded as low (green), moderate (yellow), and high risk (red) in the IRVS database.

The de-aggregated risk score for each threat scenario provides more information about a station's risk to a specific threat than the overall risk (aggregated) score.

3. The 12 de-aggregated risk scores are combined using the statistical algorithm shown below to produce a single overall risk score (aggregated risk score) for the station.

 Equation

$$R = \alpha \sqrt[n2]{\sum_{i=1}^{n2} R_i^{n1}} \quad (2)$$

and

 Equation

$$R_i = \sqrt[3]{C_i \times T_i \times V_i} \quad (3)$$

where

α = scaling factor of 1/12

R = aggregated (overall) risk

$n2$ = 12 (total number of threat scenarios)

$n1$ = 10 (power value)

- R_i = risk score of the i^{th} threat scenario
 C_i = consequences rating of the i^{th} threat scenario
 T_i = threat rating of the i^{th} threat scenario
 V_i = vulnerability rating of the i^{th} threat scenario

C_i , T_i , and V_i are all scaled to be in the range of 0.1 to 10. As such, the resulting risk score for the i^{th} threat scenario is also in the range of 0.1 to 10. The overall risk score (aggregated) is displayed as a percentage to indicate the level of risk associated with the tunnel.

The risk score are color-coded as low (green), moderate (yellow), and high risk (red) in the IRVS database. Table 2-2 indicates the different levels of risk.

Table 2-2: Risk Levels

Risk Level	Risk Score
High	>66%
Moderate	≥33%, ≤66%
Low	<33%

2.6.2 Resilience Score

The characteristics in the IRVS cover most of the important issues that affect the resilience of a tunnel. Each characteristic can affect the quality of performance (robustness), resourcefulness, and/or time and speed of recovery. Each attribute option for the characteristics that pertain to resilience is assigned a weight ranging from 0 to 10. The weight represents the importance of the attribute in the resiliency of the tunnel. At the end of the assessment, all of the adjusted weights of the attributes that control quality of performance, Q_j , are summed. The quality of performance describes the ability of the tunnel to maintain critical operations and function. Similarly, all of the adjusted weights of the characteristics that control recovery and resourcefulness, also known as the time measure, T_i , are summed. The time measure describes preparedness efforts (such as training, plans, and policies) and the ability to re-institute operations after a hazard event. The sum of Q_j and T_i are inserted into the following equations:

 Equation

$$Q_{TOTAL} = 10 \left(\frac{\sum_{i=1}^N Q_i}{\sum_{i=1}^N Q_i|_{MAX}} \right) \quad (4)$$

and

 Equation

$$T_{TOTAL} = 10 \left(\frac{\sum_{i=1}^N T_i}{\sum_{i=1}^N T_i|_{MAX}} \right) \quad (5)$$

where

Q_{TOTAL} = scaled quality of performance

T_{TOTAL} = scaled time measure

Q_i = quality of performance (robustness)

N = upper boundary (number of characteristics with a weight being summed)

T_i = time measure (recovery and resourcefulness)

$Q_i|_{MAX}$ = maximum quality of performance

$T_i|_{MAX}$ = maximum time measure

$Q_i|_{MAX}$ and $T_i|_{MAX}$ represent the maximum weighted values of the quality of performance and the recovery/robustness values, respectively. Now the values of Q_{TOTAL} and T_{TOTAL} represent a scaled, accurate measure of quality of performance and time measure that control resiliency (the two axes in Figure 1-1). The scale for both variables ranges from 0.1 to 10. The objective value of the tunnel resiliency is

 Equation

$$RES = 100 - (Q_{TOTAL} T_{TOTAL}) \quad (6)$$

where

RES = *resiliency*

Thus, a RES of 0% indicates there is no resiliency in the tunnel when affected by the postulated hazard. A RES of 100% indicates a perfect resiliency in the tunnel when affected by the postulated hazard.

Resiliency scores can be used in decision-making and planning for hazardous events for the asset (tunnel). These scores can also be used in planning for community (network) resiliency. Table 2-3 indicates the levels of resiliency and how to interpret these levels.

Table 2-3: Resilience Levels

Resilience Level	Resilience Score	Description
High	>66%	The tunnel has taken reasonable steps to maintain continuity of operations and/or has taken reasonable action to ensure that key functions will not be significantly affected by an event.
Medium	≥33%, ≤66%	The tunnel has taken moderate steps to maintain continuity of operations and/or has taken moderate action to ensure that key functions will not be significantly affected by an event.
Low	<33%	The tunnel has taken few or no steps to maintain continuity of operations and/or has taken little or no action to ensure that key functions will not be significantly affected by an event.

2.7 Other Considerations

2.7.1 Assessing Vehicular Tunnels

Vehicular tunnels are typically shorter than rail tunnels and the conditions surrounding the tunnel typically do not change significantly from portal to portal.

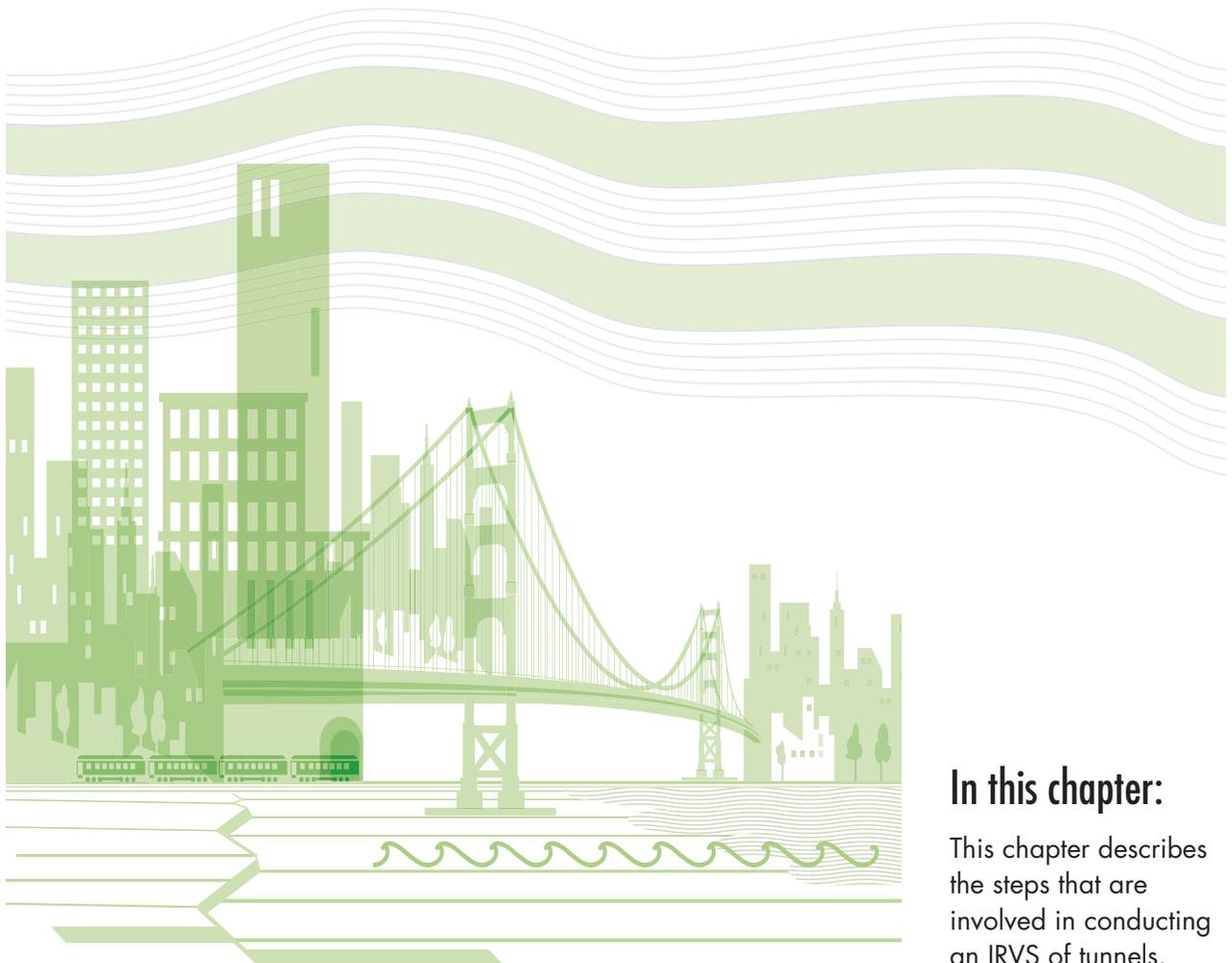
2.7.2 Assessing Rail Tunnels

Depending on the system and city, rail tunnels can span long distances and have many variations in the sections of the tunnel. For example, one section may be under a dense urban area while another section may be underwater. In addition, rail tunnels can have several stations between the tunnel portals. To account for the variations, the screener should:

- Assess rail tunnels in sections
- Assess rail tunnels at the most vulnerable location (e.g., where the tunnel passes under a major downtown area of a city)

3

Conducting an IRVS of Tunnels



In this chapter:

This chapter describes the steps that are involved in conducting an IRVS of tunnels.

This chapter describes the steps that are involved in conducting an IRVS of tunnels (see Table 3-1). The IRVS process can be adjusted as needed.

Chapter 4 describes how to complete the Data Collection Form (DCF).

Table 3-1: Steps in the IRVS of Mass Transit Stations

Pre-Field Activities	<ul style="list-style-type: none"> • Select the tunnels to be assessed • Identify the IRVS team • Train the IRVS team • Identify key objectives of the IRVS • Complete as much of the DCF as possible by reviewing publicly available information and available materials from transit authorities, including operations and security procedures, policies, and construction drawings • Identify the conditions for the field assessment • Set up a meeting with key staff and schedule the tunnel tour • Assemble the equipment that is needed for the field assessment
Field Assessment	<ul style="list-style-type: none"> • Interview and meet with key staff and stakeholders • Tour the exterior and publicly accessible areas of the tunnel • Tour the critical areas of the interior of the tunnel • Record data on the DCF
Post-Field Activities	<ul style="list-style-type: none"> • Transfer data from the paper version of the DCF to the electronic DCF if necessary • Use the scores in a variety of ways including identifying the tunnels that require a more detailed assessment • Summarize the results in a written report

3.1 Pre-Field Activities

The accuracy of the IRVS will be improved if the screeners obtain and review relevant information about the tunnel prior to the field assessment and also review the IRVS methodology. A review of the IRVS methodology by the team of screeners for a group of tunnels prior to the assessments will help ensure consistency among assessments, a high quality of collected data, and uniformity of decisions among screeners.

3.1.1 Selecting Tunnels To Be Assessed

The IRVS can be used to assess a single tunnel or a group of tunnels in a highway or mass transit system or region. The stakeholder typically selects the tunnels that will be assessed (see Section 2.2 for more information on the stakeholder). Budget is often a factor in the selection of tunnels for the IRVS.

3.1.2 Identifying the IRVS Team

The stakeholder or designee appoints the IRVS team leader who is responsible for identifying the IRVS team. The team leader should be familiar with risk assessment and transportation systems. The IRVS team should include members who are knowledgeable about tunnel systems and security concepts and should include at least one individual familiar with structural engineering or construction and operations of a tunnel.

The IRVS was developed so that screeners inside or outside the design community could conduct an IRVS with a reasonable level of certainty after brief training, thus reserving technical experts such as engineers and architects for more in-depth assessments. The more knowledgeable the screeners, the more accurate the assessment and, potentially, the more accurate the results. Training is recommended to ensure that the IRVS team understands the IRVS concepts. At a minimum, the IRVS team should review this manual.

3.1.3 Training the IRVS Team

Training should be required to ensure accuracy and uniformity of decisions among screeners. Training includes reviewing the IRVS methodology. The review should include:

- Tunnel systems (e.g., site design; architectural, mechanical, electrical, plumbing, fire protection, security, and cyber systems)
- How to complete the DCF (see Chapter 4)
- How to use IRVS database (see Section 2.5.6 and Appendix C)
- What screeners should bring to the field assessment (see Section 3.1.9)
- What screeners should look for when performing the field assessment (See Section 3.2.2)
- How to account for uncertainty (see Section 4.2)

The training should also include a desktop exercise, which is a simulated IRVS conducted in a classroom using photographs of tunnels. The desktop exercise can be created by gathering photographs of and information about an actual tunnel.

3.1.4 Identifying the IRVS Objectives

The stakeholders and IRVS team should determine the objectives of the assessment early in the pre-field activities. Examples of objectives are:

- Assessment of a group of tunnels to determine which tunnels require more detailed analysis
- Evaluation of the risk for a tunnel during a period of high threat alert in order to implement protective measures
- Prioritization of a group of tunnels for mitigation
- Preparation of a risk report of tunnels in a system in order to apply for grant funding

Objectives define outcomes and conditions of the assessment. For instance, if the objective is to evaluate the risk of a tunnel during a period of high threat alert, the condition for the assessment will be worst case and the outcome will be to establish immediate protective measures to lower the risk score. Objectives can also help determine the resources, time, and effort that are needed and how the risk and resiliency results will be used. If the objective includes assessing a group of tunnels, more time and effort will be needed than when only a single tunnel is assessed. Objectives may vary across and within transportation systems.

The goal of the IRVS is to enhance protection and resiliency through the implementation of focused risk-reduction strategies.

The goal of the IRVS is to enhance protection and resiliency through the implementation of focused risk-reduction strategies.

3.1.5 Evaluating Target Zones and Density

Two considerations when selecting a tunnel for IRVS are the proximity of the tunnel to other critical facilities and the presence of other high-profile targets near the tunnel. Proximity of targets creates two possible scenarios of concern. In the first scenario, the tunnel itself is the target, and collateral damage to nearby critical facilities will increase damage and the severity of the attack. In the other scenario, the tunnel is not the target, but there are high-profile targets near the tunnel, and the tunnel is subjected to collateral damage that varies in severity depending on the hardiness of the structure, proximity to the target, and magnitude of the

severity depending on the hardness of the structure, proximity to the target, and magnitude of the threat. In the IRVS, the concept of target density is part of the consequences, threat, and vulnerability ratings. The IRVS of tunnels is designed to address both target and non-target tunnels.

The IRVS of mass transit stations is designed to address both target and non-target tunnels.

In the IRVS, the following target zones are considered (see Figure 3-1):

- Zone 1 refers to an attack occurring less than 300 feet from the subject tunnel.
- Zone 2 refers to an attack occurring at least 300 feet but not more than 1,000 feet from the tunnel.

Information regarding the target density is collected on the first page of the DCF (see Section 4.2). The target density can be calculated using open source information such as Google maps or Bing maps. In addition, the IRVS database includes an application for plotting the target density rings in Google Earth (requires installation on a computer) using the coordinates of the tunnel. The target density is calculated using the 18 CIKR Sectors that are identified in HSPD-7.

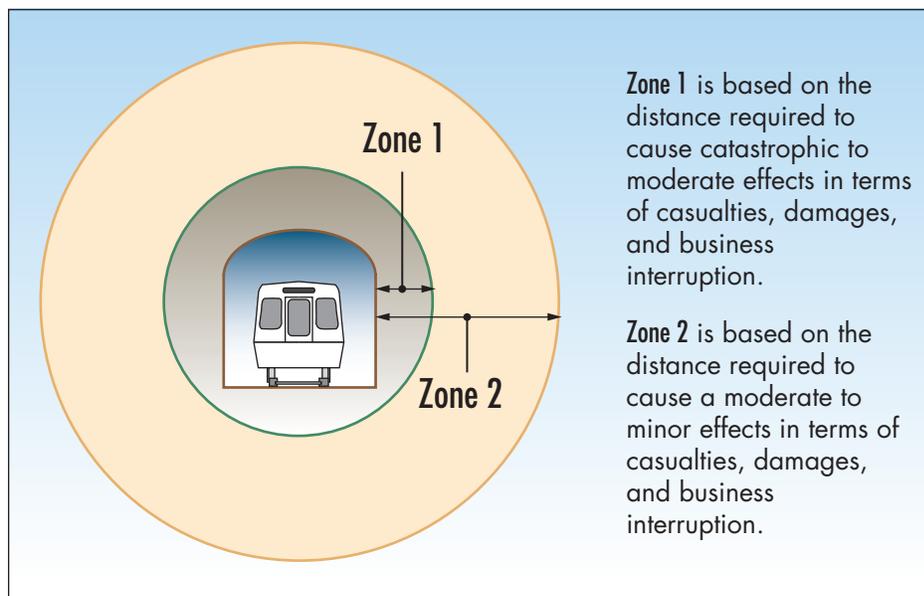


Figure 3-1:
Target Zones 1 and 2

3.1.6 Gathering Pre-Field Data

The IRVS team should complete as much of the DCF as possible before the field assessment by reviewing publicly available information and information that is provided by the transit agency (e.g., operations and security procedures, policies, construction drawings). Electronic documents can be stored in the IRVS database as MS Word files or PDFs. Documents that are not available electronically can be scanned and imported into the database.

Examples of documents that can be useful are:

- Drawings for original design and any implemented modifications
- Prior vulnerability assessment data
- Emergency response and disaster recovery plans
- Security master plan
- Hazardous materials plans
- Site plans of utility and communications system
- Historical reports regarding the tunnel
- Facility systems operational capability
- Reports of incident in the tunnel (e.g., misconduct)

The IRVS team should also review emergency plans, policies, and procedures. These documents are useful in evaluating characteristics related to resilience. Examples of such documents are:

- Emergency notification procedures
- Emergency evacuation procedures
- First responder access and routing
- Shelter-in-place procedures
- Exercise of plans

The screener can also obtain information by conducting phone interviews of transportation system authorities, stakeholders, and key tunnel staff.

3.1.7 Identifying Conditions for the Field Assessment

IRVS results can be affected by the timing of the field assessment. For example, a mass transit tunnel may have low ridership during the work week

but high ridership during a special weekend event at a nearby venue (e.g., sporting event, concert, festival). Ridership is relevant to all three risk components (consequences, threat, and vulnerability).

To avoid variations that can distort the scores, the IRVS team and stakeholders should determine before the field assessment which conditions will be considered. The two conditions are:

- **Current “as-seen” conditions:** The tunnel is assessed for the situation and conditions present at the time of the screening.
- **Worst-case or special event conditions:** The combination of conditions that would make the most harmful results.

Physical conditions should be considered at their most disadvantageous state. Reasonable worst-case conditions are recommended when assessing the risk of a terrorist attack because intelligent adversaries can choose circumstances in which targets are vulnerable and consequences maximized (NIPP, 2009). The concept of worst case should be moderated by reason, however; scenarios should not include numerous unlikely conditions unless the focus of the contingency and other types of planning is on rare or special events. On the other hand, scenarios should not be based simply on average conditions. Each type of tunnel has different characteristics that need to be assessed to accurately describe reasonable worst-case conditions. The IRVS team and stakeholders should establish the conditions that will be considered.

3.1.8 Scheduling a Meeting with Key Staff and Stakeholders and Scheduling the Tunnel Tour

The IRVS team should try to arrange a meeting or interview with key staff and stakeholders before or during the field assessment to review the information that was obtained before the field assessment. The IRVS team leader decides which key staff and stakeholders should be interviewed based on the composition of the team and the familiarity of the tunnel or transportation system. The team should prepare a list of questions before the meeting. Key personnel include:

- Chief of engineering
- Chief of security
- Chief of Information Technology
- Emergency manager

To avoid variations that can distort the scores, the IRVS team and stakeholders should determine before the field assessment which conditions will be considered.

The IRVS team also needs to schedule the tunnel tour. The IRVS team should plan which areas of the tunnel (see Section 3.2.2) need to be viewed and obtain the proper permissions to survey the tunnel.

3.1.9 Assembling the Equipment for the Field Assessment

The screener should take the following to the field assessment:

- A laptop or tablet loaded with the IRVS database, which contains the DCF and catalog. The database user guide is included in this manual as Appendix C.
- The paper version of the DCF if a laptop or tablet is not available. The paper version is included in this manual as Appendix D.
- A digital camera for photographing the tunnel.

3.2 Field Assessment

The field assessment is an onsite visit to the tunnel whose purpose is to record and/or verify information on the DCF. Interviews with key tunnel personnel and stakeholders may be conducted during the field assessment. The visit involves observing exterior and interior areas of the tunnel.

3.2.1 Key Personnel and Stakeholder

The field assessment is an onsite visit to the tunnel to record and/or verify information that has already been recorded on the DCF. The visit includes interviewing key personnel and stakeholders and touring the tunnel.

3.2.2 Touring the Tunnel

The IRVS team should tour the exterior of the tunnel; publicly accessible areas; and internal, secure areas of the tunnel. The locations the screener should tour, if applicable, are:

- **Tunnel exterior**
 - Perimeter of tunnel and area above the tunnel (public areas and infrastructure above)
 - Approaches
 - All points of entry/egress
 - Ventilation structures (if applicable)
 - Connection stations (if applicable)
 - Waterside (if applicable)

■ Tunnel interior

- Tracks or lanes
- Mechanical electrical and plumbing rooms
- Emergency exits
- Security rooms
- Pump rooms or floodgates (if applicable)
- Ventilation equipment (if applicable)

3.3 Post-Field Activities

The following activities are typically conducted after completing the DCF and the field assessment.

3.3.1 Transferring Data to the DCF

If the paper version of the DCF is used, the information must be transferred to the IRVS database in order to generate the risk and resiliency scores. Any photographs taken during the field assessment should be imported into the database.

3.3.2 Using the IRVS Scores

The IRVS of Tunnels is a quick and simple tool for obtaining a preliminary risk and resilience assessment. IRVS results can be used to:

- Identify the tunnels that require a more detailed assessment
- Prioritize tunnels for further evaluation
- Develop emergency preparedness plans for high-threat alerts
- Plan post-event evacuation, rescue, recovery, and safety evaluation efforts
- Prioritize mitigation needs
- Conduct a “what if” exercise by selecting different attributes to see how the scores are affected.
- Compare the scores of various threat scenarios to identify the relative exposure of the tunnels to different threats. Risk scores for different scenarios can be compared.
- Develop tunnel-specific vulnerability information

The IRVS of Tunnels is a quick and simple tool for obtaining a preliminary risk and resilience assessment.

3.3.3 Identifying Tunnels that Require Further Analysis

Depending on the objectives of the IRVS assessment, the IRVS team and stakeholders may identify tunnels requiring further analysis (a more detailed assessment). The IRVS team and stakeholders must determine the level of risk and resiliency that is considered unacceptable and would therefore trigger a more detailed assessment recommendation. Unacceptable risk and resilience may be defined differently for different tunnel systems based on the conditions of the system (e.g., size, locality, number of riders, performance objectives).

Generally, the risk and resilience can be interpreted as unacceptable when the risk score is above 70% and the resilience score is below 30%.

3.3.4 Preparing a Written Report

The IRVS database can be used to generate a generic report for one tunnel or a group of tunnels. The report includes the information that was input into the database and the risk and resiliency scores. The report is generated as an MS Word document and can be edited by the IRVS team.

4

Completing the Data Collection Form



In this chapter:

This chapter provides instructions on completing the DCF and a Catalog of Tunnel Characteristics and attribute options with detailed descriptions and graphics. The attributes are listed in order of increasing risk.

Information that is collected during the IRVS is recorded electronically on the Data Collection Form (DCF) or on paper using the paper version of the DCF. The screener can input data into the DCF using a laptop or tablet computer. If the paper version is used, the information has to be transferred to the electronic version, so using the electronic version is more efficient. The paper version is provided in Appendix D.

This chapter provides instructions on completing the DCF and a catalog of tunnel characteristics and attribute options with detailed descriptions and graphics. The attributes are listed in order of increasing risk.

The DCF is typically completed during the field assessment, but it can also be completed before or after the field assessment.

- **Before the field assessment** – The DCF is completed collectively by the IRVS team and key personnel during a desktop workshop, and the information is verified during the field assessment. Completing the DCF before the field assessment is typically done by screeners who are familiar with the tunnel or when the available information makes it possible.
- **During the field assessment** – The DCF is completed during the field assessment either electronically or using the paper version.
- **After the field assessment** – The IRVS team records observations, conducts interviews, and takes pictures during the field assessment. After returning from the field assessment, the IRVS team collectively completes the DCF.

The DCF should be completed according to the tunnel conditions that have been selected (see Section 3.1.6). Screeners should document the assessment as completely as possible to optimize the accuracy of the risk and resiliency scores.

4.1 Accounting for Uncertainty

The accuracy of the risk and resiliency scores rely on an accurate and thorough completion of the DCF. All characteristics must be evaluated before risk and resiliency scores can be calculated. If a screener is unsure which attribute is correct for a particular characteristic, the screener should document observations using the comments tab and should do one of the following:

- Select “Not Applicable” when available

The accuracy of the risk and resiliency scores rely on an accurate and thorough completion of the DCF.

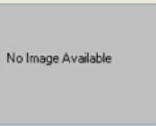
- Make an educated guess based on professional or engineering judgment
- Select the attribute that is most common in other similar tunnels in the system

Where two or more attributes for one characteristic could be selected, the screener should select the dominant attribute. When one attribute is not clearly dominant and an educated guess is not possible because not enough information is available, the screener should select the attribute with the highest risk. The number of times a screener is uncertain about which attribute to select should be minimal.

4.2 Page One of the DCF

The first page of the DCF includes tunnel identification, historical information about the tunnel, and target density. Tunnel identification is especially important when a group of tunnels are assessed. The electronic version of page 1 is shown in Figure 4-1, and the paper version is shown in Figure 4 2.

iRVS Site Record

Facility Name *: Default Facility Image: 

Facility ID#: Facility Descriptive Text:

Org. Name:

Address1:

Address2:

City: St:

Zip: Sector: Facility Importance:

Site Type: Subsector:

Assessment(s) Coordinates:

Assessment Folder Name: C:\RVSv1\Subway\Assessment_01_2011-03-23\

Assessment Number	Assessment Date *	Assessment Comments / Notes	Assessment Folder Name	Entered By
01	3/23/2011		Assessment_01_2011-03-23\	Assess

Create additional [blank] assessment record for this site

Create a duplicate of Assessment [01] including scoring

Record: 1 of 1 No Filter Search

Required Field(s) For Help, Press the F1 Key Close

Figure 4-1:
Data Collection Form, page 1

Pre-Field Information

Complete the information on this page before the field assessment, using additional sheets as needed. The numbers in parentheses refer to the ID number in the catalog. Refer to the catalog for explanations of the information that is requested on this page and for the potential sources of the information.

Tunnel name / identification _____
 Address / intersection _____
 Transportation Authority _____ Mode _____
 Year built _____ Footprint (in square feet) _____
 Overview of the tunnel from the transportation authority (use additional pages if necessary)

Number of tracks / lanes (1.1) _____ Tunnel medium (1.2) _____
 Peak daily use (e.g., vehicles per day, riders per day) (1.3, 2.2) _____
 Replacement value (1.9) _____
 Geology: Soil conditions (3.9) _____
 Terrorist threats against the tunnel (2.3.1) _____

 Terrorist threats against this transportation system (2.3.2) _____

 History of flooding affecting the tunnel since opening (2.11) _____

 Year(s) of major retrofits (5.5) _____
 Retrofit description _____

Target Density. Number of potential high-value / CIKR targets / buildings within 300 feet and between 300 and 1000 feet of any point of the right-of-way (1.7, 2.5).

CIKR Sector	Within 300 feet	From 300 to 1000 feet
Agriculture and Food		
Banking and Finance		
Chemical		
Commercial Facilities		
Communications		
Critical Manufacturing		
Dams		
Defense Industrial Base		
Emergency Services		
Energy		
Government Facilities		
Healthcare and Public Health		
Information Technology		
National Monuments / Icons		
Nuclear Reactors, Materials, and Waste		
Postal and Shipping		
Transportation Systems		
Water		
TOTAL		

Figure 4-2: Data Collection Form (paper version), page 1

4.3 Step One: Consequences Rating

4.3.1 Consequence Ratings Characteristics

Consequences are related primarily to the use, occupancy (the function of the building or infrastructure), and importance of the tunnel from the owner's perspective. Rating consequences involves assessing the following tunnel characteristics:

- Number of tracks / lanes
- Number of levels
- Underwater tunnel
- Peak number of travelers per day
- Tunnel locality

- Nearby or adjacent transportation systems / public assembly facility
- High-value targets / critical infrastructures
 - Within 300 feet
 - Between 300 feet and 1000 feet
- Impact of physical loss / criticality
 - Station
 - Track
- Social impact
- Replacement value
- Operational redundancy
- Estimated down time after a major disaster

Information used to determine the consequence rating typically comes from the owner/operator, government sources, municipalities, and publicly accessible sources. This information should be gathered before the field assessment or during interviews with key personnel (see Section 3.2.1).

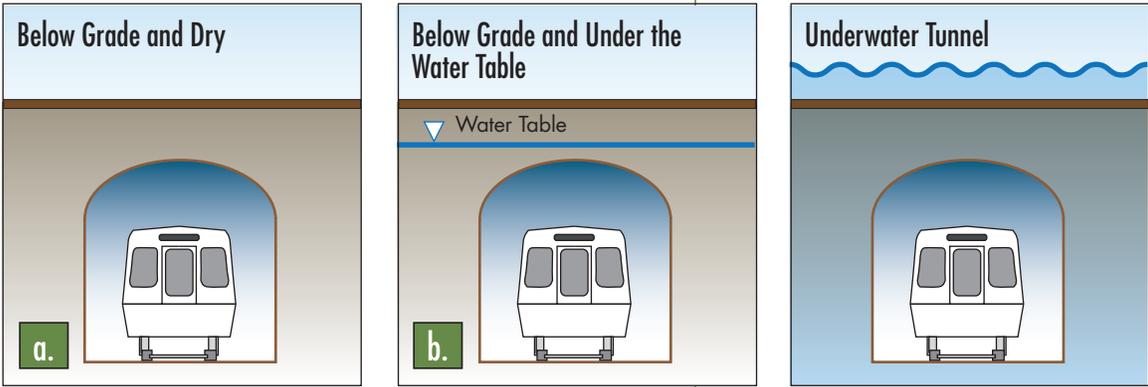


Information used to determine the consequence rating typically comes from the owner/operator, government sources, municipalities, and publicly accessible sources.

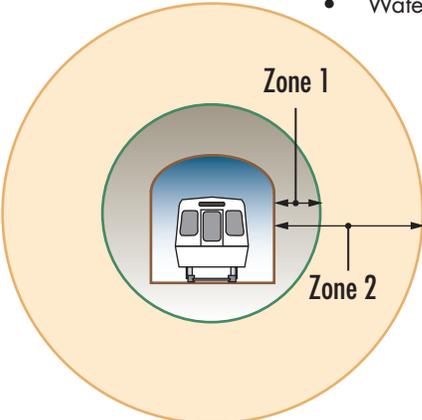
4.3.2 Catalog of Tunnel Characteristics and Attribute Options for the Consequence Rating

The catalog of consequence characteristics and attribute options is provided in Table 4 1. The catalog is also part of the IRVS database. The ID number in the catalog corresponds to the number of the characteristic in the DCF. The screener should use the catalog as a reference, as needed, when evaluating the characteristics.

Table 4-1: Catalog of Tunnel Characteristics and Attribute Options for the Consequences Rating

1. Consequence Rating		
ID	Tunnel Characteristics	Attribute Options
1.1	<p>Number of Tracks or Lanes</p> <p>Number of tracks or lanes in the tunnel including all tubes or bores.</p>	<p>a. 1 b. 2 c. 3 to 4 d. 5 to 8 e. More than 8</p>
	 <p><i>b. Two-track rail tunnel.</i></p>	
1.2	<p>Tunnel Medium</p> <p>The condition surrounding the tunnel (i.e., water or soil).</p> <p>The most common type of tunnel medium is below grade (surrounded by soil). Tunnels below grade can be constructed through dry soil or below the water table. Underwater tunnels provide a passage under a body of water for transportation systems (highways, railroads, and subways). Tunnels built through dry soil are expected to have lower consequences than tunnels surrounded by water. If an underwater tunnel is breached or damaged, the flooding, fire, or smoke consequences in the tube would be significant.</p>	<p>a. Below grade (dry) b. Below grade (under water table) c. Underwater</p>
		

1. Consequence Rating		
ID	Tunnel Characteristics	Attribute Options
1.3	<p>Peak Number of Travelers per Day</p> <p>Number of people who travel through the tunnel on a peak day. Most mass transit authorities provide traveler reports to the public on the Internet. The screener should research this characteristic during the pre-field assessment. When ridership information is not available, the screener will have to estimate the number of riders per day.</p>	<p>Low ridership (in riders per day):</p> <ul style="list-style-type: none"> a. Less than 1,000 b. 1,000 to 2,000 c. 2,000 to 5,000 d. 5,000 to 10,000 e. 10,000 to 20,000 <p>High ridership (in riders per day):</p> <ul style="list-style-type: none"> f. 20,000 to 50,000 g. 50,000 to 100,000 h. 100,000 to 150,000 i. 150,000 to 200,000 j. More than 200,000
1.4	<p>Locality of Tunnel</p> <p>Population density and land use surrounding the tunnel. The screener should consider the time of day the activity in the locality is at its peak. For instance, the peak activity in a business district may occur during the morning rush hour; this location should be described as urban or dense urban.</p> <p>The attribute options are listed from lowest (Option A) to highest risk (Option E). When the tunnel spans more than one type of locality, the screener should select the more conservative option (higher risk).</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>d.</p> </div> <div style="text-align: center;"> <p><i>d. Dense urban neighborhood and street above a mass transit tunnel</i></p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">  <p>e.</p> </div> <div style="text-align: center;"> <p><i>e. Dense urban street over a four-track mass transit tunnel</i></p> </div> </div>	<p>Least Risky</p> <div style="position: relative; height: 300px;">  <ul style="list-style-type: none"> a. Remote. Sparsely populated with very few inhabitants. In major urban areas, remote would describe primarily rights-of-way that travel through parkland or protected areas that are off-limits to development. b. Rural. Low ratio of inhabitants to open land or farmland or an outlying part of a city or town. c. Suburban. Small town or city with low population density or mixed-use office park, warehouse, and manufacturing. d. Urban. Metropolitan area in a city or large town. e. Dense urban. Densely populated area in a major urban corridor where there are clusters of commercial, retail, and residential buildings located on congested streets. In these situations there is a significant chance of collateral consequences to populations, on the streets and in surrounding structures. </div> <p>Most Risky</p>

1. Consequence Rating		
ID	Tunnel Characteristics	Attribute Options
1.5	<p>Adjacent/Nearby Transportation Systems or Public Assembly Venues</p> <p>Any transportation system (tunnels, structures, or modes) or public assembly venue that is above, below, or within 300 feet of the tunnel. Bus stops are not included.</p> <p>Public assembly venues include:</p> <ul style="list-style-type: none"> • Amphitheater • Arena • Convention center • Museum • Performing arts center / auditorium • Shopping mall • Stadium 	<ul style="list-style-type: none"> a. None. No other transportation systems or public assembly venues are within 300 feet of any part of the tunnel. b. Close. Another transportation system or public assembly venue is within 300 feet of the tunnel but is not connected. c. Tightly integrated. The tunnel is connected to either another transportation system or a large public assembly facility through tunnels, passageways, the structure, or other connection.
1.6	<p>High-Value/CIKR Targets</p> <p>A high-value/CIKR target is any structure or asset the incapacitation or destruction of which would have a debilitating impact on the security, economy, public health or safety, and/or environment across any Federal, State, regional, territorial, or local jurisdiction.</p> <p>The 18 Critical Infrastructure and Key Resources (CIKR) sectors defined by DHS for evaluating target density are listed below and are available in the DCF and also in DHS (2009). Subsectors should also be reviewed for this characteristic.</p> <p>CIKR Sectors</p> <ul style="list-style-type: none"> • Agriculture and Food • Banking and Finance • Chemical • Commercial Facilities • Communications • Critical Manufacturing • Dams • Defense Industrial Base • Emergency Services • Energy • Government Facilities • Healthcare and Public Health • Information Technology • National Monuments and Icons • Nuclear Reactors, Materials and Waste • Postal and Shipping • Transportations Systems • Water  <p>Zone 1 – Within 300 feet of the perimeter of the structure</p> <p>Zone 2 – 300 to 1,000 feet of the perimeter of the structure</p>	<p>High-value/CIKR targets are divided into two zones for this characteristic according to the distance of the target from any point of the perimeter of the tunnel. Zone 1 is within 300 feet of any point of the perimeter of the tunnel, and Zone 2 is between 300 feet and 1,000 feet of any point of the perimeter of tunnel. In most cities, 300 feet is equal to approximately 1 block, and 1,000 feet is equal to approximately 3 blocks.</p> <p>Zone 1. Number of targets within 300 feet of any point of the perimeter of the tunnel.</p> <ul style="list-style-type: none"> a. None b. 1 to 6 c. 7 to 12 d. 13 to 19 e. 20 or more <p>Zone 2. Number of targets between 300 feet and 1,000 feet of any point of the perimeter of tunnel.</p> <ul style="list-style-type: none"> a. None b. 1 to 6 c. 7 to 12 d. 13 to 19 e. 20 or more

1. Consequence Rating		
ID	Tunnel Characteristics	Attribute Options
1.7	<p>Impact of Physical Loss/Criticality</p> <p>Extent to which loss of or serious damage to the tunnel would affect the livelihood and resources of individuals and businesses in the local, regional, and national community. Criticality refers to the importance of the tunnel to the system or region. Partial or complete physical loss of a tunnel from a terrorist attack or natural disaster would have direct and/or indirect economic consequences. Direct loss includes the cost to rebuild an asset and cost to respond to and recover from the event. Indirect loss includes the costs resulting from the disruption of a product or service and the long-term costs from environmental damage. The impact of physical loss includes consequences from the loss of a facility above the tunnel. For this characteristic, the economic impact of physical loss should be evaluated for two scenarios:</p> <ul style="list-style-type: none"> • Loss of the tunnel • Loss of the tracks or lanes <p>The difference between the impact of physical loss of the actual tunnel and the tracks or lanes is due to the direct and indirect losses associated with loss of the tunnel. The loss of the tunnel itself is asset-oriented and will have a direct impact. The loss of the tracks or lanes could result in indirect losses if the tracks or lanes are shared by multiple authorities, and a major corridor for multiple systems is interrupted.</p> <p>The attribute options define the geographic limits of the economic impact of the loss of a tunnel.</p> <div style="text-align: center;"> <pre> graph TD A[Economic Impact of Physical Loss] --> B[Direct Losses] A --> C[Indirect Losses] B --- B1[• Cost to rebuild asset] B --- B2[• Cost to respond and recover from an event] B --- B3[• Loss of revenue] C --- C1[• Long-term economic effects on the local, regional, or national community] C --- C2[• Downstream costs resulting from disruption of the service after an event] C --- C3[• Long-term costs due to environmental damage] </pre> </div>	<ul style="list-style-type: none"> a. Local. The tunnel has little, if any, importance to maintaining the transportation system’s service levels, mobility with respect to the regional transportation system, and the local and regional economy. The regional transportation system would be minimally affected, and regional authorities would be able to route passengers around distressed areas easily. b. Regional. Loss of the tunnel would substantially affect the transportation system and force passengers to find alternative transportation, which would result in increased congestion-related environmental and employment costs locally and in the region. c. National. Loss of the tunnel would severely strain the regional transportation system, and movement around the region via other modes would be disrupted significantly, resulting in extreme social and economic costs nationally,

1. Consequence Rating		
ID	Tunnel Characteristics	Attribute Options
1.8	<p>Social Impact</p> <p>Psychological effect on public morale and confidence in the transportation system. Social impacts of loss include the decrease in the public's mobility, lack of confidence in the transportation system, and environmental impacts. Included are changes in the public's sense of safety and well-being after a significant event and possible subsequent aberrant behavior.</p>	<p>a. Low. There will be little or no effect on daily life in the region served by the transportation system.</p> <p>b. Moderate. A substantial number of people will stop using the transportation system.</p> <p>c. High. Transportation use in the affected region will be severely disrupted.</p>
1.9	<p>Replacement Value (Fair Market Value)</p> <p>Current market cost to construct a tunnel. Replacement value depends on the construction costs in the region.</p> <p>Replacement value information is obtained before the field assessment and is on page 1 of the DCF. This information should be obtained from a knowledgeable tunnel representative. If this is not possible, the value must be estimated using qualitative guidance for construction costs.</p>	<p>a. Less than \$1 million (m)</p> <p>b. \$1 m to \$5 m</p> <p>c. \$5 m to \$20 m</p> <p>d. \$20 m to \$50 m</p> <p>e. \$50 m to \$100 m</p> <p>f. \$100 m to \$200 m</p> <p>g. \$200 m to \$350 m</p> <p>h. \$350 m to \$600 m</p> <p>i. \$600 m to \$900 m</p> <p>j. More than \$900 m</p>
1.11	<p>Operational Redundancy</p> <p>The degree to which a transportation system is able to maintain a reasonable service level by routing passengers around a distressed tunnel, either by sharing tracks with other lines, bussing, or some other means of transportation for mass transit tunnels and providing an alternate route for highway tunnels.</p>	<p>a. Very high. Few, if any, disruptions would result from a problem in the tunnel, and transportation services or travelers would easily be re-routed.</p> <p>b. High. Some travelers would be affected, but most transportation operations would be able to continue, with service routed around the troubled tunnel without any disruptions.</p> <p>c. Moderate. Many travelers would be affected, but the transportation system would be functional with few delays for the majority of travelers.</p> <p>d. Low. Few, if any, alternative routes exist; failure of the tunnel would cause system delays, nearly crippling transportation operations.</p> <p>e. Very low. Failure of the tunnel would cripple transportation in the region and cause transportation operations to halt.</p>

1. Consequence Rating		
ID	Tunnel Characteristics	Attribute Options
1.12	<p>Estimated Downtime after a Major Disaster</p> <p>The resiliency of the tunnel to a major disaster is estimated by the amount of time needed for the tunnel to recover fully and be operational after a disaster. A major disaster is considered an incident with the potential of causing catastrophic losses in terms of injuries, casualties, and damage.</p>	<p>a. Very short. Less than a day</p> <p>b. Short. Less than a week</p> <p>c. Moderate. Less than a month</p> <p>d. Long. Less than a year</p> <p>e. Very long. More than a year</p>

4.4 Step Two: Threat Rating

This section contains (1) a description of the tunnel characteristics that are assessed to determine the threat rating and (2) the catalog of threat characteristics and attribute options.

4.4.1 Threat Rating Characteristics

The threat rating is a function of the following tunnel characteristics:

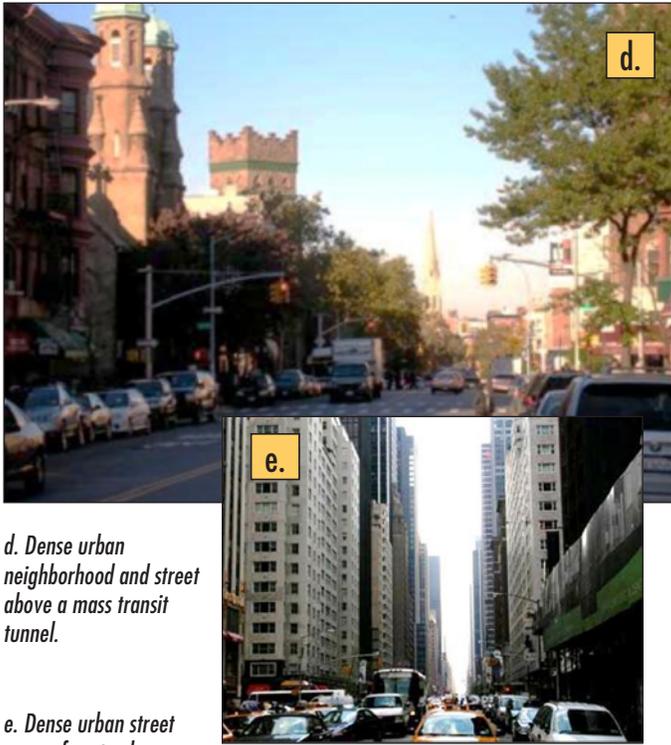
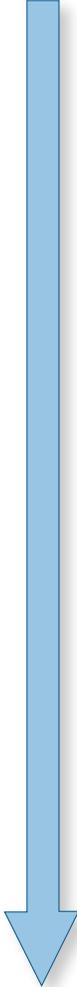
- Tunnel locality
- Number of vehicles / trains per day
- Threats to this tunnel
- Threats to this system
- High-value targets / critical infrastructures
 - Within 300 feet
 - Between 300 feet and 1,000 feet
- Significance of tunnel
- Function criticality (within system / network / region)
- Number of approaches
- Plaza / public areas
- Protective deterrence measures
- Storage of off-duty vehicles and equipment
- Historical flooding

The tunnel characteristics that are the same for the consequence and threat ratings are tunnel locality, peak number of riders/transfers, and high-value targets/CIKR. In the IRVS Database, these characteristics will be automatically selected after they are input in the consequence section of the DCF.

4.4.2 Catalog of Tunnel Characteristics and Attribute Options for the Threat Rating

The catalog of threat characteristics and attribute options is provided in Table 4-2. The catalog is also provided electronically the IRVS database. The ID number in the catalog corresponds to the number of the characteristic in the DCF. The screener should use the catalog as a reference, as needed, when evaluating the characteristics on the DCF.

Table 4-2: Catalog of Tunnel Characteristics and Attribute Options for the Threat Rating

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.1	<p>Locality of Tunnel</p> <p>General population density and land use in the area surrounding the tunnel.</p> <p>The screener should consider the time of day the locality is at its peak activity. For instance, the peak activity in a business district may occur during the morning rush hour; this location should be described as urban or dense urban.</p> <p>When the tunnel spans more than one type of locality, the more conservative option (higher risk) should be selected.</p>  <p><i>d. Dense urban neighborhood and street above a mass transit tunnel.</i></p> <p><i>e. Dense urban street over a four-track mass transit tunnel.</i></p>	<p>Least Risky</p>  <ul style="list-style-type: none"> a. Remote. sparsely populated with very few inhabitants. In major urban areas, remote would describe primarily rights-of-way that travel through parkland or protected areas that are off-limits to development. b. Rural. Low ratio of inhabitants to open land or farm land, or an outlying part of a city or town. c. Suburban. Small town or city with low population density or mixed-use office park, warehouse, and manufacturing. d. Urban. Metropolitan area in a city or large town. e. Dense urban. Densely populated area in a major urban corridor where there are clusters of commercial, retail, and residential buildings located on congested streets. In these situations there is a significant chance of collateral consequences to populations, on the streets and in surrounding structures. <p>Most Risky</p>

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.2	<p>Peak Number of Travelers per Day</p> <p>Number of people who travel through the tunnel on a peak day. Most mass transit authorities provide ridership reports to the public on the Internet. The screener should research this characteristic during the pre-field assessment. When traveler information is not available, the screener will have to estimate the number of riders per day.</p>	<p>Low number of travelers (per day):</p> <ul style="list-style-type: none"> a. Less than 1,000 b. 1,000 to 2,000 c. 2,000 to 5,000 d. 5,000 to 10,000 e. 10,000 to 20,000 <p>High number of travelers (per day):</p> <ul style="list-style-type: none"> f. 20,000 to 50,000 g. 50,000 to 100,000 h. 100,000 to 150,000 i. 150,000 to 200,000 j. More than 200,000
2.3	<p>Terrorist Threats (Credible)</p> <p>A terrorist threat refers to any planned, thwarted, or successful attack against the tunnel or transportation system in the past or present. This characteristic addresses the likelihood of a terrorist attack occurring at the tunnel under consideration. Unsubstantiated threats, such as called-in bomb threats, should not be considered.</p> <p>To determine whether a threat is credible, the screener should obtain the most accurate threat information and talk to a senior security representative for the tunnel or transportation authority. Information may also be available from law enforcement officials in the area, newspapers, and the Internet. The screener may have to use judgment based on the best available information at the time of the screening.</p>	
2.3.1	<p>Terrorist Threats: Tunnel</p> <p>Any credible threat, past or present, to the tunnel.</p>	<ul style="list-style-type: none"> a. No b. Previous c. Current
2.3.2	<p>Terrorist Threats: Transportation System</p> <p>Any credible threat to the transportation system operating the tunnel. If a credible threat has been made to a transportation system (e.g., Washington Metro), but no particular tunnel has been identified, the threat should be counted.</p>	<ul style="list-style-type: none"> a. No b. Previous c. Current

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.4	<p>High-Value/CIKR Targets</p> <p>A high-value/CIKR target is any structure or asset the incapacitation or destruction of which would have a debilitating impact on the security, economy, public health or safety, and/or environment across any Federal, State, regional, territorial, or local jurisdiction.</p> <p>The 18 Critical Infrastructure and Key Resources (CIKR) sectors defined by DHS for evaluating target density are listed below and are available in the DCF and also in DHS (2009).</p> <p>CIKR Sectors</p> <ul style="list-style-type: none"> • Agriculture and Food • Banking and Finance • Chemical • Commercial Facilities • Communications • Critical Manufacturing • Dams • Defense Industrial Base • Emergency Services • Energy • Government Facilities • Healthcare and Public Health • Information Technology • National Monuments and Icons • Nuclear Reactors, Materials and Waste • Postal and Shipping • Transportations Systems • Water 	<p>High-value/CIKR targets are divided into two zones for this characteristic according to the distance of the target from any point of the perimeter of the tunnel. Zone 1 is within 300 feet of any point of the perimeter of the tunnel, and Zone 2 is between 300 feet and 1,000 feet of any point of the perimeter of tunnel. In most cities, 300 feet is equal to approximately 1 block, and 1,000 feet is equal to approximately 3 blocks.</p> <p>Zone 1. Number of targets within 300 feet of any point of the perimeter of the tunnel.</p> <p>a. None b. 1 to 6 c. 7 to 12 d. 13 to 19 e. 20 or more</p> <p>Zone 2. Number of targets between 300 feet and 1,000 feet of any point of the perimeter of tunnel.</p> <p>a. None b. 1 to 6 c. 7 to 12 d. 13 to 19 e. 20 or more</p>
		<p>Zone 1 – Within 300 feet of the perimeter of the structure</p> <p>Zone 2 – 300 feet to 1,000 feet of the perimeter of the structure</p>

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.5	<p>Significance of Tunnel</p> <p>Symbolic nature or landmark status of the tunnel. If the tunnel is on a national, State, local, or nongovernmental historic registry, the screener should select either Option C or Option D.</p> <p>The screener can determine whether the tunnel is on an historic registry by:</p> <ul style="list-style-type: none"> • Consulting with the transit authority or building management • Reviewing the National Register of Historic Places at www.nationalregisterofhistoricplaces.com • Checking with States, local jurisdictions, and nongovernmental organizations for listings of historically significant buildings within a locality • Checking the outside of the station or building in which the station is housed for a plaque indicating its status as an historic property.  <p><i>c. The Holland Tunnel in New York City, which is on the U.S. National Register of Historic Places and a National Historic Landmark. Station with regional significance</i></p>	<ul style="list-style-type: none"> a. Local. The tunnel is recognizable only to locals and can be confused with similar tunnels. The tunnel has no media value or symbolism for the public. b. Regional. The tunnel is recognizable only to people in the State and region. The tunnel is prominent in the local community and is a local landmark. The tunnel has some media value on a regional level. c. National. The tunnel is easily recognizable and is featured in the national mass media. The tunnel is considered a landmark and is located in an architecturally significant structure. d. International. The tunnel is easily recognizable and is featured in international mass media. An example is the Chesapeake Bay Bridge Tunnel, considered one of the seven engineering wonders of the modern world.

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.6	<p>Function Criticality within a Transportation System or Region</p> <p>Function criticality describes the importance of a tunnel to the regional transportation system. When a tunnel is used heavily but has redundancy with other transportation systems, it should be rated lower.</p>	<p>a. Very low. The regional transportation system would barely be affected by loss of the tunnel, and regional authorities would easily be able to route passengers around distressed areas.</p> <p>b. Low. Loss of the tunnel would result in delays in the regional transportation system, and passengers would have longer commutes, but regional transportation mobility would not be severely affected.</p> <p>c. Moderate. Loss of the tunnel would cause significant delays in the regional transportation system, but movement around the region would continue.</p> <p>d. High. Loss of the tunnel would severely strain the regional transportation system, and movement around the region via other modes would be disrupted significantly.</p> <p>e. Very high. The regional transportation system has no redundancy to compensate for the loss of the tunnel; transportation operations around the region would nearly cease, for example, when station is a regional or a multimodal transportation hub.</p>
2.7	<p>Number of Approaches</p> <p>Number of direct tracks or lanes of access by trains and/or vehicles to a tunnel.</p>	<p>a. 1 to 2</p> <p>b. 3 to 4</p> <p>c. 5 to 8</p> <p>d. 9 to 12</p> <p>e. More than 12</p>

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.8	<p>Plaza/Public Area</p> <p>A plaza is an open public space outside the controlled access to the tunnel. The plaza can be at grade or below grade and sometimes has public seating and seating areas. Plaza's provide a pleasant space for people to relax, converse, and enjoy the outdoors in a more spacious setting; however, if not properly designed, plazas can leave the tunnel susceptible to an attack. Barriers and landscape features should be designed to make the plaza impenetrable for a vehicle. Furthermore, the plaza should be under surveillance using cameras and/or patrols.</p>  <p><i>b. Below-grade public plaza leading to a transit entrance with numerous obstacles between traffic and the transit entrance</i></p>	<ul style="list-style-type: none"> a. None. No plaza/public area. b. Well-controlled. Numerous barriers that are well-positioned to obstruct vehicular entry and regular surveillance. c. Moderate control. Some vehicular barriers but several notable security flaws (e.g., temporary or ornamental barriers that can easily be defeated by vehicles). d. Not controlled. No vehicular barriers or surveillance.  <p><i>c. Public plaza with some protection</i></p>  <p><i>d. Public area adjacent to a subway station without limited access management controls</i></p>

2. Threat Rating		
ID	Tunnel Characteristics	Attribute Options
2.9	<p>Protective Deterrence Measures</p> <p>Visibility and/or prominence of protective security measures that discourage an aggressor from attacking the tunnel. Security creates a psychological deterrent for an aggressor who is considering attacking the tunnel. Visibility inhibits criminal behavior because of the fear of being caught. A potential aggressor who perceives a risk of being caught may be deterred from attacking the tunnel.</p> <p>For deterrence to be effective, security measures should be prominent and visible throughout the tunnel (i.e., perimeter, site, and tunnel interior). Combined security measures, such as those listed below, may be used in all areas of the tunnel:</p> <ul style="list-style-type: none"> • Security guards (armed and unarmed) • Law enforcement patrols • Monitoring and surveillance equipment • Dedicated search and screening • Random search and screening • Mobile screening (e.g., canine unit) • Access controls • Public awareness and notification of protective measures 	<p>a. High. Security measures are prominent and visible in all areas of the tunnel (interior and exterior).</p> <p>b. Medium. Security measures are prominent and visible only in one or two areas of the tunnel. For instances, security measures may be prominent inside the tunnels but not at the perimeter.</p> <p>c. Low. Security measures are minimal or not visible enough to discourage an attacker in any area of the tunnel. An attacker would not be discouraged by the security measures from attacking the tunnel.</p>
2.10	<p>Flooding History</p> <p>Flooding refers to an incident in which the tunnel was unable to clear water in a timely manner during a water surge. Service on transportation systems can be disrupted by flooding from both major and minor rainstorms. Flood waters can disrupt signals underground and can require the electrified third rail be shut off. The screener should research historical data of flooding at the station through newspaper and Internet searches prior to the field assessment.</p>	<p>a. None. No record of flooding.</p> <p>b. Limited. Some flooding has occurred, but service was either not disrupted or quickly restored.</p> <p>d. Moderate. Flooding has occurred often, causing disruptions.</p> <p>e. Severe. Flooding has impaired operations for significant periods.</p>

4.5 Step Three: Vulnerability Rating

4.5.1 Vulnerability Rating Characteristics

The vulnerability rating is a function of tunnel characteristics that may be adversely affected by a terrorist attack, natural hazard, or accidental event.

The vulnerability rating characteristics are:

- Site
- Architecture
- Structure
- Ventilation (including HVAC)
- Fire protection
- Operations (e.g., power supply, lighting)
- Nonstructural components
- Physical security
- Cyber infrastructure
- Operational security

4.5.1.1 Site

Site vulnerability refers to the condition of the area between the approaches of the tunnel and the area above and adjacent to the tunnel.

4.5.1.2 Architectural

Architectural considerations involve the tunnel layout and space design. Space design relates to separating public areas of the tunnel from the more secured areas of the facility. Features such as the number of entrances, number of levels, service entrances, lobby/lobbies, retail space, and integrated/adjacent parking garages are key characteristics of architectural vulnerabilities. Furthermore, the number of levels and tracks in the tunnel are critical to the overall vulnerability.

4.5.1.3 Structural

Structural vulnerability is defined as a weakness in a structure's ability to support its own weight and the weight of its contents and to resist loads from wind and earthquake. Structural vulnerabilities can be exploited by an aggressor. Evaluating structural vulnerabilities is limited by the extent to which the structure is covered with finishes. The structural framing in public areas is typically covered for aesthetic purposes making it difficult to determine the materials underneath the finishing.

To identify the structural characteristics as accurately as possible, the following steps should be taken before the field assessment:

- Review the structural as-built drawings, including renovations/retrofits. Drawings provide the most detailed structural information.
- Make arrangements to talk to the tunnel engineer during the field assessment.
- Request permission to tour areas without interior finishes or areas not accessible by the public.

Reviewing the drawings and questioning the tunnel engineer may be the most efficient way to assess the structural vulnerability. Site observation can be more time-consuming but is necessary when the drawings are not available.

The structural characteristics that are evaluated have a strong influence on a tunnel's performance in a terrorist attack or natural disaster. Structural vulnerability to an explosive event is dependent on the magnitude of the air blast shock wave as it loads walls, columns, and floor/framing.

4.5.1.4 Ventilation

Ventilation refers to any system that permits air intake or exhaust to control temperature or remove moisture, odors, smoke, heat, dust, and airborne bacteria. Ventilation systems are also referred to as HVAC systems. Ventilation systems are required in tunnels because of heat from the railway tunnels, fire hazards, exhaust from vehicles, and the potential for CBR threats. All building structures that are served by the ventilation systems in the tunnel are included in the IRVS.

Vulnerability is dependent on the exposure, protection, and redundancy of HVAC systems. The likelihood of a CBR contaminant being introduced in the tunnel is greatly influenced by the accessibility of the air vents to the public.

Ventilation systems are more applicable to vehicle tunnels than rail tunnels because of the high concentration of contaminants in vehicular tunnels. Rail tunnels often have ventilation systems in the stations or at intermediate fan shafts but during normal operating hours rely on the piston effect of trains pushing air through the tunnel to remove stagnant air. Many rail tunnels have emergency mechanical ventilation that works only in the event of fire (FHWA, 2005).

Ventilation system characteristics are given significant weight in the vulnerability rating for CBR threat scenarios.

4.5.1.5 Fire Protection System

A fire protection system in the tunnel serves the functions of preventing, suppressing, and protecting against the hazards of a fire. Fire protection systems include fire and smoke-detection and alarm as well as fire suppression. Life safety in the transit station is supported by the fire protection system which initiates evacuation, allows for safe evacuation, and suppresses the fire prior to the arrival of fire fighters.

There are eight subsystems that need to operate in order to have a functional fire safety system in a tunnel.

- Detection
- Alarm
- Verification
- Incident location
- Communications
- Response plan
- Personnel evacuation
- Smoke control (ventilation)

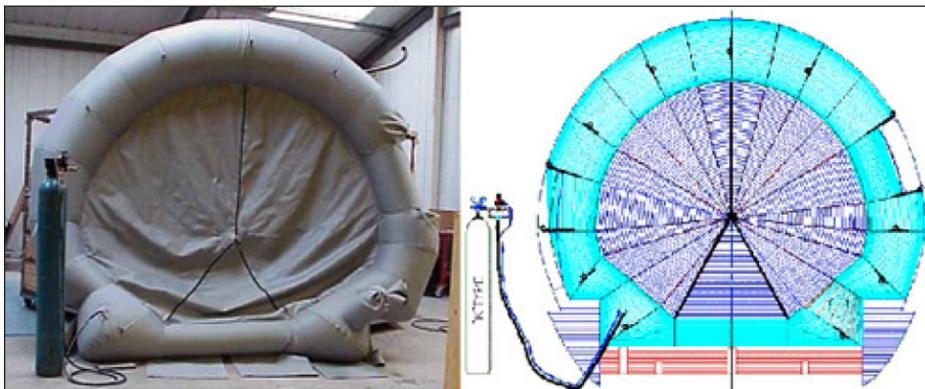


Figure 4-3:
The “Tunnel Plug” is an example of an innovative fire suppression system under development for tunnels. Funded by DHS S&T, the plug is designed to drop from the ceiling and inflate inside the tunnel, essentially sealing off the passageway and preventing smoke or fire from spreading.

4.5.1.6 Operational Systems

Operations refer to the critical utility and control functions required for the transit station to operate safely and efficiently (e.g., power supply, lighting, monitoring, surveillance).

4.5.1.7 Nonstructural

Nonstructural vulnerabilities are vulnerabilities in non-load-bearing features (e.g., wall and ceiling finishes, fixture attachments, police booths, barriers).

4.6.1.8 Physical Security

Physical security refers to any method or system whose purpose is to detect, prevent, and protect against any threat or hazard. The availability and effectiveness of security-related detection systems are the key concerns in physical security vulnerabilities.

The evaluation of the physical security vulnerability consists of two sections in the data collection form.

1. **Security System Checklist.** The vulnerability assessment of physical security begins by reviewing the available security systems in the tunnel. The screener evaluates the available security systems by completing the checklist of general security systems that can be used to detect and/or interdict against a threats to the tunnel.
2. **Security System Evaluation.** The second portion of the physical security evaluates the security measures in relation to the specific threats. For each threat scenario, the screener evaluates the number of systems (from the security system checklist) and the effectiveness of the collective systems to protect against the specific threat scenario. The purpose is to assess the ability of a given security system to prevent a threat from being carried out.

Security personnel should be interviewed before or during the field assessment. Reviewing security system documentation is also recommended. If no interview is conducted, at least one screener on the IRVS team should have a basic understanding of security principles.

4.5.1.9 Cyber Infrastructure

Cyber infrastructure includes electronic information, control systems, and/or communication systems needed for daily operations. Cyber infrastructure is critical to the functions and services of a tunnel. Because cyber infrastructure is interconnected, attacks using cyber tools can spread quickly and have debilitating effects. Cyber vulnerabilities are addressed through evaluation of communication and control systems of the tunnel.

Security and information technology personnel should be interviewed during the field assessment. Review cyber-security system documentation is also recommended.

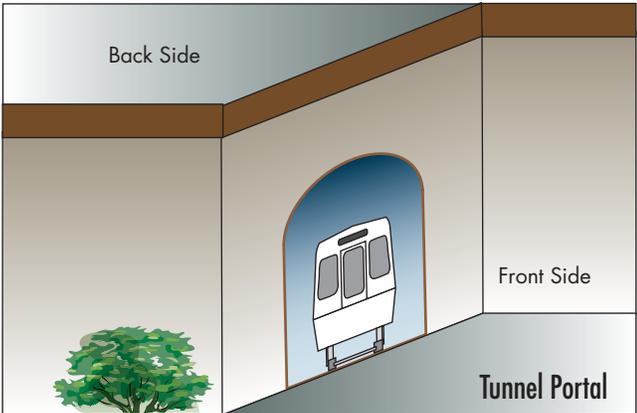
4.5.1.10 Operational Security

Operational security refers to the transit agency's emergency preparedness and planning for the tunnel. Operational security vulnerabilities are assessed by evaluating emergency and security response plans, mass evacuation plans, and training of emergency response personnel.

4.5.2 Catalog of Tunnel Characteristics and Attribute Options for the Vulnerability Rating

The catalog of vulnerability characteristics and attribute options is provided in Tables 4 3a through 4 3j. The catalog is also provided electronically in the IRVS database. The ID number in the catalog corresponds to the number of the characteristic in the DCF. The screener should use the catalog as a reference, as needed, when completing the DCF.

Table 4-3a: Catalog of Tunnel Characteristics and Attribute Options for Site Vulnerabilities

3. Vulnerability Rating: Site Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
3.1	<p>Tunnel Maintenance/Service Facility</p> <p>This facility controls all electrical feeds (both high- and low-voltage supplies) into the tunnel or section of tunnel (single or redundant) and other vital equipment to maintain tunnel operations (such as ventilation and fire suppression systems). The tunnel may have more than one of these facilities depending on its size (area). If the tunnel service building is seriously damaged, the tunnel would be unsafe and would be closed for a considerable period, causing major disruption.</p> <p>Most major highway tunnels have more than one of maintenance/service facility. In a subway tunnel, the system's tunnels normally serve as the maintenance/service facilities.</p>	<ul style="list-style-type: none"> a. Available/redundant b. Some availability/some redundancy c. Available/not redundant d. Not available/not redundant 
3.2	<p>Portals</p> <p>Any point at which a tunnel transitions from tunnel to open air.</p> 	 <ul style="list-style-type: none"> c. Exposed back d. Underwater <p><i>a. Portal protected by buildings and cladding</i></p>

3. Vulnerability Rating: Site Vulnerabilities

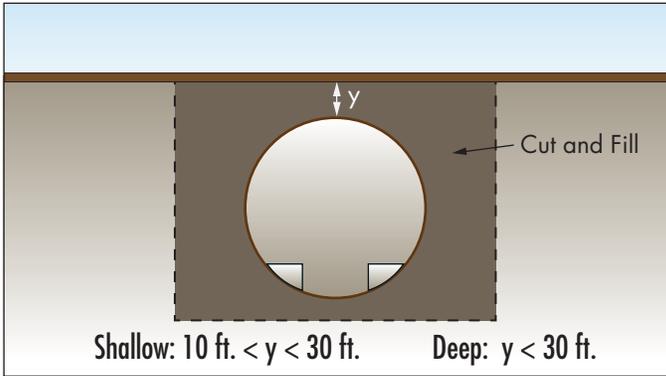
ID	Tunnel Characteristics	Attribute Options
3.2	<p>Portals (continued)</p>  <p><i>a. Back of portal protected by bollards, fencing, and barbed wire</i></p>	 <p><i>b. Front of portal exposed to both intentional and accidental impacts.</i></p>  <p><i>c. Back of a portal exposed to both intentional and accidental impacts</i></p>
3.3	<p>Tunnel Approaches</p> <p>Direct tracks and lanes of tunnel access and egress for trains and/or vehicles.</p>  <p><i>a. Approach to a highway tunnel</i></p>	<p>a. More than 3 b. 2 to 3 c. Only 1</p>  <p><i>b. Approach to a railway tunnel</i></p>

3. Vulnerability Rating: Site Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
3.4	<p>Presence of Stand Pipes / Fire Hydrants (Water Supply)</p> <p>A standpipe is a type of rigid water piping that is built into a tunnel in a vertical or horizontal position. Fire hoses can be connected to the piping, allowing manual application of water to the fire. Some tunnels may have fire hydrants near the approaches. The presence of standpipes and/or fire hydrants in the tunnel should be used to evaluate the adequacy of water supply to the tunnel. The availability and sufficiency of water provided to the tunnel is critical for general operations such as fire protection.</p>	<p>a. Yes b. No</p>  <p><i>a. Standpipe at the portal of the tunnel where fire hoses can be connected</i></p>
3.5	<p>Water Drainage</p> <p>Adequate water drainage allows the tunnel to clear water in a timely manner during a water surge. Service on a transportation tunnel may be disrupted by flooding of only a few inches. Water drainage should be evaluated by inspection of the drainage structures, pump room (when present), and research of historical data of flooding in the tunnel.</p>  <p><i>c. A poor drain clogged with debris that can limit the tunnel's ability to clear water in a timely manner.</i></p>	<p>a. Excellent. The tunnel controls water inflow well, and flooding does not impede transit operations.</p> <p>b. Moderate. Some flooding has occurred, but service was either not disrupted or quickly restored.</p> <p>c. Limited. Flooding has impaired operations for limited periods.</p> <p>d. Deficient. Flooding has impaired operations for significant periods.</p>

3. Vulnerability Rating: Site Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
3.6	<p>Natural Protective Barriers</p> <p>Natural protective barriers are terrain elements such as grassy knolls, hills, ditches, boulders, shrubs, trees, or water bodies that make traversing a site difficult or may at least delay an aggressor. Assess the degree to which natural barriers shield the transit station from vehicles that can intentionally or accidentally damage the station.</p>	<p>a. Not applicable</p> <p>b. High. Tunnel portals and assets are surrounded by natural features that make a close approach by unwarranted vehicles or aggressors nearly impossible. The tunnel's designers have incorporated the principles of Crime Protection Through Environmental Design.</p> <p>c. Medium. Tunnel portals and assets have natural features that create obstacles to approaching vehicles or aggressors. Approaching the tunnel by vehicle or on foot is difficult but not impossible.</p> <p>d. Low. The tunnel and assets have little or no protection from aggressors or vehicular attack, either accidental or intentional.</p>
3.7	<p>Manmade Barriers</p> <p>Manmade barriers such as bollards, fencing, walls, floors, roofs, bars, and roadblocks that are used to restrict, channel, or impede access and provide standoff distance between the tunnel and the public/vehicles. These barriers are designed to deter threats and delay the undeterred aggressor. Assess the degree to which manmade barriers shield the transit station from vehicles that can intentionally or accidentally damage the station. The screener evaluates this characteristic by assessing the presence and effectiveness of bollards/barriers and fencing at the site.</p>	
3.7.1	<p>Barriers/Bollards</p> <p>Physical wall or bollard to prevent intrusion of vehicles.</p>  <p><i>Site partially protected by a brick wall, but without standoff or any other protective barriers, the site is fundamentally exposed.</i></p>	<p>a. Not applicable</p> <p>b. High. Permanent barrier resistance to a 15,000-pound vehicle traveling at 50 mph with penetration of less than 3 feet.</p> <p>c. Medium. Permanent barrier resistance to a 15,000 pound vehicle traveling at 40 mph with penetration of less than 20 feet.</p> <p>d. Low. Fixed or movable barrier designed to limit or redirect vehicular access.</p>

3. Vulnerability Rating: Site Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
3.7.2	<p>Fencing</p> <p>Common means of establishing a physical protective barrier to protect a controlled area.</p>  <p><i>Crash-rated fence (Ameristar Fence Products, Inc.)</i></p>	<p>a. Not applicable</p> <p>b. High. Fence designed to provide optimal restriction or delay to pedestrian-based attacks. Vehicle and pedestrian gates are designed to continue the structural integrity of the fence line.</p> <ul style="list-style-type: none"> • Double buried fence line • Height of 10 feet • Anti-climb/anti-cut fencing vertical bars with horizontal supports designed to make climbing difficult. • Top guard an overhang of barbed wire or tape along the top of the fence, facing outward and upward at an approximately 45-degree angle. • Hardened posts • Counter-sunk into concrete <p>c. Medium. Fence designed to restrict or delay pedestrian-based attacks. Vehicle and pedestrian gates are designed to continue the structural integrity of the fence line.</p> <ul style="list-style-type: none"> • Single buried fence line • Height of 10 feet • Hardened posts • Counter-sunk into concrete <p>d. Low. Fence provides minimal delay to a pedestrian-based assault.</p> <ul style="list-style-type: none"> • 7-foot chain-link fence
3.8	<p>Tunnel Medium</p> <p>The conditions surrounding the tunnel (water or soil). Underwater tunnels provide a passage beneath a body of water for mass transit systems (highway, railroads, and subways). If an underwater tunnel is breached or damaged by an attack, the flooding, fire, or smoke consequences in the tube would be significant.</p>	<p>a. Below grade (above water table). Below the street level or prevailing natural features.</p> <p>b. Below grade (under water table)</p> <p>c. Underwater. Tunnel that is under a body of water.</p>

3. Vulnerability Rating: Site Vulnerabilities

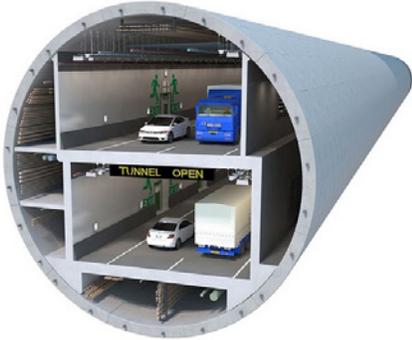
ID	Tunnel Characteristics	Attribute Options
3.8	<p>Tunnel Medium (continued)</p>  <p><i>a. Busy street above a below-grade mass transit tunnel</i></p>	 <p><i>c. Vent shaft marking the site of an underwater tunnel</i></p>
3.9	<p>Depth of Cut and Cover above Tunnel</p> <p>Depth of below-grade tunnel.</p>  <p><i>Cross section illustrating the depth of cut and cover.</i></p>	<ul style="list-style-type: none"> a. Not applicable. Not constructed using cut and cover construction (e.g., drilled rock, immersed tube tunnels). b. Deep. More than 30 feet below grade. c. Shallow. 10 to 30 feet below grade. d. Exposed. 0 to 10 feet below grade with an open cut.

3. Vulnerability Rating: Site Vulnerabilities																
ID	Tunnel Characteristics	Attribute Options														
3-10	<p>Geology (Soil Condition)</p> <p>Geology, or soil condition, describes the type of soil/Geology, or soil condition, describes the type of soil/rock that a transit tunnel is built on or under. The geology surrounding the tunnels is critical to the framing and structure because it provides a substantial percentage of the load carrying capacity for underground structures. If the type of soil is not easy to identify, the screener should ask the transit authority.</p> <table border="1"> <thead> <tr> <th>Soil Type</th> <th>Suitability</th> </tr> </thead> <tbody> <tr> <td>Hard Rock</td> <td>Best</td> </tr> <tr> <td>Sand and Gravel</td> <td>Medium</td> </tr> <tr> <td>Medium and Hard Clays</td> <td>Medium</td> </tr> <tr> <td>Silts and Soft Clays</td> <td>Poor</td> </tr> <tr> <td>Organic Silt and Clays</td> <td>Poor</td> </tr> <tr> <td>Peat</td> <td>Poor</td> </tr> </tbody> </table>	Soil Type	Suitability	Hard Rock	Best	Sand and Gravel	Medium	Medium and Hard Clays	Medium	Silts and Soft Clays	Poor	Organic Silt and Clays	Poor	Peat	Poor	<p>a. Hard rock</p> <p>b. Medium</p> <p>c. Poor</p> <p>Note the following red flags in the DCF by checking the red flag and adding comments.</p> <ul style="list-style-type: none"> • High water table • Presence of soft soils • Cut and fill • Evidence of slides or subsidence
Soil Type	Suitability															
Hard Rock	Best															
Sand and Gravel	Medium															
Medium and Hard Clays	Medium															
Silts and Soft Clays	Poor															
Organic Silt and Clays	Poor															
Peat	Poor															
3.11	<p>Adjacent Buildings</p> <p>Applicable to any inhabited commercial, residential, institutional, or industrial structure within 300 feet of the tunnel. Buildings that are used to support transportation operations, such as maintenance facilities and or transit parking garages, are not counted.</p>  <p><i>c. Four-track mass transit tunnel below a street in a dense central business district with numerous buildings</i></p>	<p>a. None. No adjacent buildings. Typical of this category are suburban locations with large commuter parking facilities and rural locations.</p> <p>b. Some. Some adjacent buildings. Typical of this category are urban and suburban neighborhoods with one- and two-story structures nearby.</p> <p>c. Numerous. Numerous adjacent buildings. Typical of this category are stations in dense urban neighborhoods, such as central cities or dense urban settings.</p>														

3. Vulnerability Rating: Site Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
3.12	<p>Hazardous Materials Storage</p> <p>Storage of hazardous materials in the tunnel or in surrounding areas poses a high risk to staff and riders because of the potential for combustion or release of lethal materials.</p> <p>Abundant open-source information on hazardous materials storage is available on Web sites such as the Environmental Protection Agency (EPA), State office of emergency management, and local fire department.</p>	<p>a. No</p> <p>b. Yes</p>

Table 4-3b: Catalog of Tunnel Characteristics and Attribute Options for Architectural Vulnerabilities

4. Vulnerability Rating: Architectural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
4.1	<p>Number of Tubes</p> <p>Number of distinct openings (circular or square) or bores that vehicles or trains pass through.</p>  <p><i>c. Tunnel with more than two tubes</i></p>	<p>a. 1</p> <p>b. 2</p> <p>c. More than 2</p>
4.2	<p>Services Entrance</p> <p>Any entrance used by the transit organization's personnel that is not open to the general public and not used for emergency evacuation.</p> 	<p>a. Not Applicable</p> <p>b. No. Service entrance not present.</p> <p>c. Yes. Service entrance present</p>

4. Vulnerability Rating: Architectural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
4.3	<p>Crowding/Congestion</p> <p>Potential for traffic tie-ups in the tunnel.</p>	<ul style="list-style-type: none"> a. Never crowded b. Sometimes c. Rush hour only d. Always crowded
4.4	<p>Emergency Exits</p> <p>Emergency exits are egresses that facilitate the evacuation of riders and emergency personnel operations during an incident. Emergency exits should be clearly designated with the proper signage. The screener should count the number of independent (separate from public exits) emergency exits in the tunnel.</p> 	<ul style="list-style-type: none"> a. More than 4 b. 3 to 4 c. 2 d. 1 e. None
4.5	<p>Number of Levels</p> <p>Number of levels open to the public, including platforms, lobbies, concourses/mezzanines, fare control areas, transfer passageways, service, and other areas in the tunnel. For below-grade tunnels, the street level should not be considered unless the tunnel has features that make it an attractive target at this level.</p> <p><i>b. Two-level highway tunnel (courtesy, Washington State Department of Transportation)</i></p> 	<ul style="list-style-type: none"> a. 1 b. 2 to 3 c. More than 3

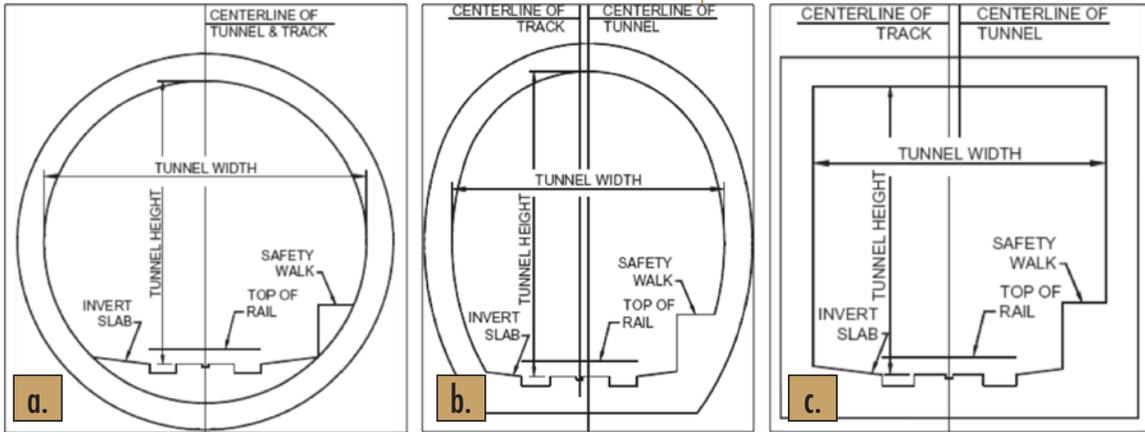
4. Vulnerability Rating: Architectural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
4.6	<p>Ease of Egress from Vehicle/Trains to Tunnel</p> <p>Ability for an aggressor to exit the train or vehicle into the tunnel in non-emergency situations.</p>	<p>a. Difficult</p> <p>b. Moderate</p> <p>c. Easy</p>
4.7	<p>Flood Gates</p> <p>Adjustable gates used to control or stop water flow in a water surge.</p> <div data-bbox="261 667 932 1163" data-label="Image"> </div> <p><i>b. Floodgate on the right lining of a subway tunnel</i></p>	<p>a. Yes</p> <p>b. No</p>

4. Vulnerability Rating: Architectural Vulnerabilities

ID	Tunnel Characteristics	Attribute Options
4.8	<p>Plaza/Public Areas</p> <p>Open public space outside the controlled access to the tunnel. The plaza can be at grade or below grade and sometimes has public seating and seating areas. Plazas provide a pleasant space for people to relax, converse, and enjoy the outdoors in a more spacious setting; however, if not properly designed, plazas can leave the tunnel susceptible to an attack. Barriers and landscape features should be designed to make the plaza impenetrable to a vehicle. Furthermore, the plaza should be under surveillance using cameras and/or patrols.</p> <div data-bbox="331 646 751 1144" data-label="Image"> </div> <p data-bbox="781 646 1008 793">b. Below-grade public plaza leading to a transit entrance with numerous obstacles between traffic and the transit entrance</p> <div data-bbox="331 1184 1002 1598" data-label="Image"> </div> <p data-bbox="331 1625 626 1656">c. Public plaza with some protection.</p>	<ul style="list-style-type: none"> a. None. No plaza/public area. b. Well-controlled. Public plaza has numerous barriers that are well-positioned to obstruct vehicular entry and surveillance is conducted. c. Medium control. Public plaza has some vehicular barriers but has several notable security flaws (e.g., temporary or ornamental barriers that can easily be defeated by vehicles). d. Not controlled. Public plaza has no vehicular barriers or surveillance. <div data-bbox="1045 1184 1466 1404" data-label="Image"> </div> <p data-bbox="1045 1432 1466 1493">d. Public area adjacent to a subway station without limited-access management controls</p>

Table 4-3c: Catalog of Tunnel Characteristics and Attribute Options for Structural Vulnerabilities

5. Vulnerability Rating: Structural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
5.1	<p>Method of Construction</p> <p>Technique used to build the tunnel.</p>	<ul style="list-style-type: none"> a. Drilled rock. Built through rock. b. Drilled soil. Built through dirt or other soft materials such as sand. c. Cut-cover. Built by uncovering the street or ground, building the necessary tunnel shells, and rebuilding the area above d. Immersed. Assembled in large sections, moved to the proper area, and assembled with other sections onsite.
5.2	<p>Liner Cross Section</p> <p>Shape of a tunnel from the onlooker's view.</p>	<ul style="list-style-type: none"> a. Circular b. Oval c. Rectangular/square

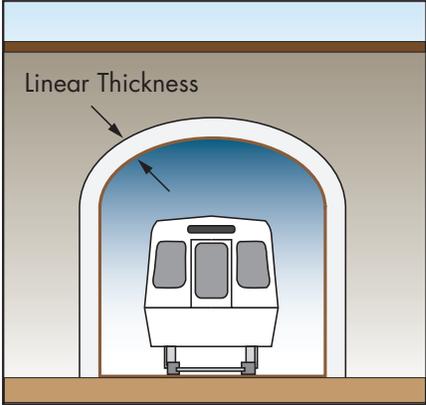


a. Circular liner cross section (FHWA, 2005)

b. Oval liner cross section (FHWA, 2005)

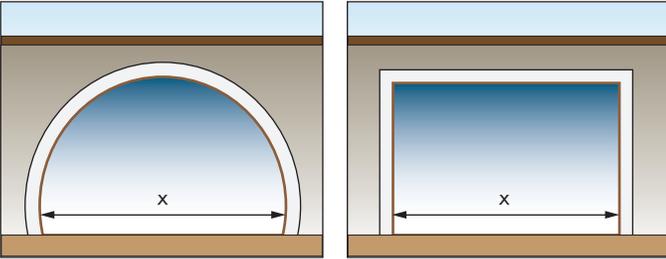
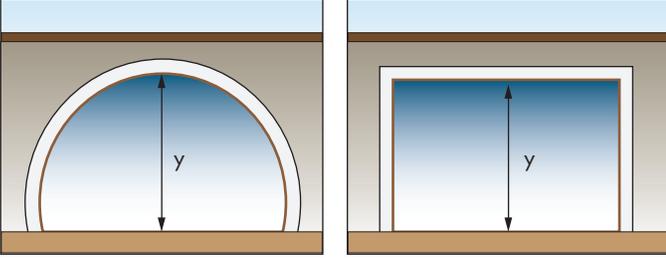
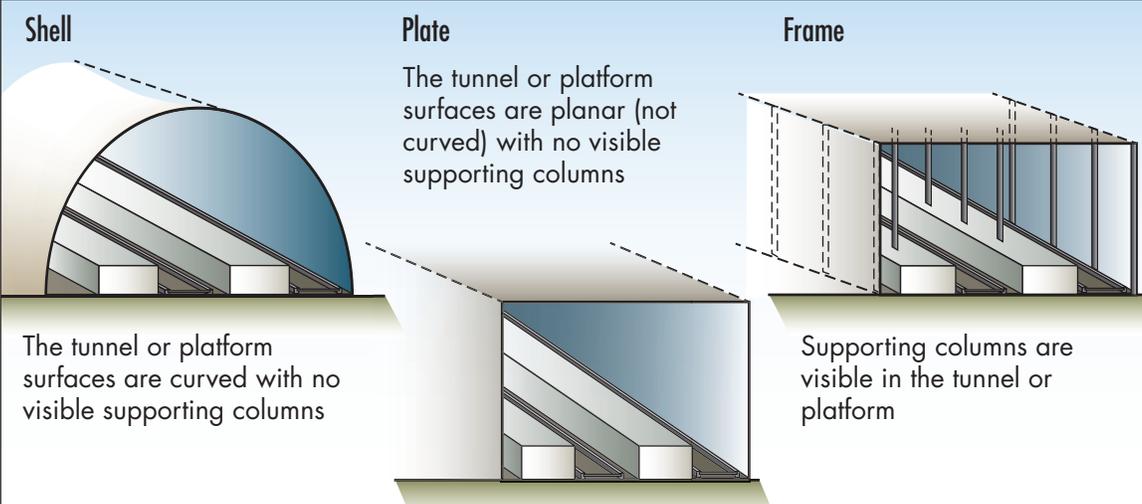
c. Single box liner cross section (FHWA, 2005)

5. Vulnerability Rating: Structural Vulnerabilities

ID	Tunnel Characteristics	Attribute Options																						
5.3	<p>Liner Relative Thickness</p> <p>Liner (or roof/wall) relative thickness refers to the thickness of the structural roof, wall, or envelope outlining the tunnel. A tunnel that has a thin liner that spans a long distance tends to be more vulnerable than one with a thicker liner and shorter span. In general, the relative liner thickness can be found in structural drawings of the tunnel. Such information is difficult to ascertain visually, especially by the nonprofessional screener. For an approximate evaluation of this characteristic, the construction material of the liner can provide some clues to the relative liner thickness. The table below provides general guidelines for relationships between construction materials and relative liner thickness.</p> <table border="1"> <thead> <tr> <th>Construction Material/Visible Structural Details</th> <th>Relative Liner Thickness</th> </tr> </thead> <tbody> <tr> <td>Non-Reinforced Masonry</td> <td>Thick</td> </tr> <tr> <td>Reinforced Masonry</td> <td>Thick</td> </tr> <tr> <td>Other types of brick, stone, or rock based materials</td> <td>Thick</td> </tr> <tr> <td>Non-Reinforced Concrete</td> <td>Thick</td> </tr> <tr> <td>Reinforced Concrete</td> <td>Medium</td> </tr> <tr> <td>Iron (usually non-ductile older construction)</td> <td>Thin Note: Watch for stiffeners (ribs); if not closely spaced or not visible, categorize as 'medium'</td> </tr> <tr> <td>Steel</td> <td>Thin (older construction) Very thin (newer construction)</td> </tr> <tr> <td>Pre-stressed/post-tensioned concrete</td> <td>Thin</td> </tr> <tr> <td>High strength concrete</td> <td>Thin</td> </tr> <tr> <td>High strength steel</td> <td>Very thin</td> </tr> </tbody> </table>	Construction Material/Visible Structural Details	Relative Liner Thickness	Non-Reinforced Masonry	Thick	Reinforced Masonry	Thick	Other types of brick, stone, or rock based materials	Thick	Non-Reinforced Concrete	Thick	Reinforced Concrete	Medium	Iron (usually non-ductile older construction)	Thin Note: Watch for stiffeners (ribs); if not closely spaced or not visible, categorize as 'medium'	Steel	Thin (older construction) Very thin (newer construction)	Pre-stressed/post-tensioned concrete	Thin	High strength concrete	Thin	High strength steel	Very thin	<ul style="list-style-type: none"> a. Not applicable. Station is above grade b. Thick c. Medium d. Thin e. Very thin  <p><i>Liner thickness</i></p>  <p><i>b. Relatively thick stone liner</i></p>
Construction Material/Visible Structural Details	Relative Liner Thickness																							
Non-Reinforced Masonry	Thick																							
Reinforced Masonry	Thick																							
Other types of brick, stone, or rock based materials	Thick																							
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Pre-stressed/post-tensioned concrete	Thin																							
High strength concrete	Thin																							
High strength steel	Very thin																							
5.4	<p>Construction Material</p> <p>Primary material used to construct the tunnel's structural framework and envelope.</p>	<ul style="list-style-type: none"> a. High-strength concrete or steel. Modern high-strength material is found primarily in recent retrofits and new construction and is extremely strong and blast-resistant. b. Steel/concrete/pre-stressed concrete c. Wrought iron d. Brick or masonry. Brick, stone, and cinderblock materials used as the primary means of construction 																						

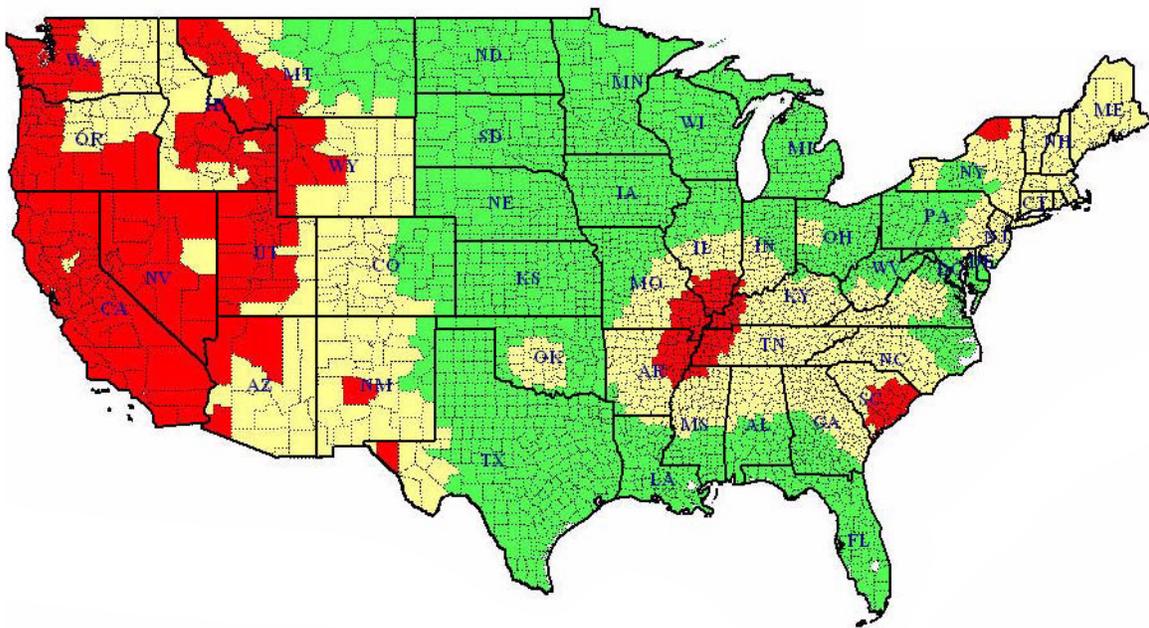
5. Vulnerability Rating: Structural Vulnerabilities

ID	Tunnel Characteristics	Attribute Options
5.4	<p>Construction Material (continued)</p>  <p>b. Steel/concrete/pre-stressed concrete</p>	 <p>c. Wrought iron</p>  <p>d. Brick or masonry</p>
5.5	<p>Known Retrofits</p> <p>Recent structural upgrades to the tunnel including any addition of new technology or features to the existing system to increase the strength, durability, and/or service life of the structure. The screener should not give credit for simple "patch and repair" work to improve the aesthetics of the station.</p>	<p>a. Yes</p> <p>b. No</p>
5.6	<p>Longest Span</p> <p>Greatest distance between columns or other supporting structures.</p>	<p>a. Not Applicable</p> <p>b. 15 to 25 feet</p> <p>c. 25 to 40 feet</p> <p>d. 40 to 50 feet</p> <p>e. 50 feet or more</p>

5. Vulnerability Rating: Structural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
5.6	<p>Longest Span (continued)</p>  <p><i>Cross section illustrating the span of a circular tunnel</i></p> <p><i>Cross section illustrating the span of a Rectangular tunnel</i></p>	
5.7	<p>Controlling Height Average distance from floor to roof or ceiling.</p>  <p><i>Cross section illustrating the height of a circular tunnel</i></p> <p><i>Cross section illustrating the height of a Rectangular tunnel</i></p>	<ul style="list-style-type: none"> a. Not applicable b. Less than 25 feet c. 25 to 40 feet d. 40 to 50 feet e. 50 feet or more
5.8	<p>Type of Framing Type of structural frame or "skeleton" to which the interior and exterior envelopes of the tunnel are attached.</p>  <p>Shell The tunnel or platform surfaces are curved with no visible supporting columns</p> <p>Plate The tunnel or platform surfaces are planar (not curved) with no visible supporting columns</p> <p>Frame Supporting columns are visible in the tunnel or platform</p> <p><i>Shell, plate, and frame framing</i></p>	<ul style="list-style-type: none"> a. Shell b. Plate c. Frame

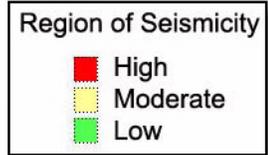
5. Vulnerability Rating: Structural Vulnerabilities

ID	Tunnel Characteristics	Attribute Options
5.9	<p>Seismic Design</p> <p>Tunnels in active fault or earthquake zones that were built with or retrofitted with seismic design to be resistant to earthquakes.</p>	<p>a. Not applicable. Not in a high seismic zone and does not require seismic design</p> <p>b. Yes. In an seismic zone and incorporates seismic design</p> <p>c. No. In an seismic zone and does not incorporate seismic design elements</p>



Note:

- (1) Based on NEHRP B-C soil type.
- (2) The seismicity at any site is calculated based on the highest seismicity at any point in a county. More accurate information on any site can be obtained from the USGS site.



5. Vulnerability Rating: Structural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
5.10	<p>Overall Structural Condition</p> <p>State of tunnel maintenance, basic upkeep, and relative deterioration of important structural elements. Indicators of poor structural condition include aging members, discoloration, cracks, deflection, excessive vibrations, spalled or delaminated concrete, and corrosion. New materials, retrofitting, and lack of visual flaws may be taken as a sign of healthy structural condition</p>	<ul style="list-style-type: none"> a. Excellent. Recently built or retrofitted. b. Good. Well maintained with few structural flaws. c. Average. A few major structural flaws, but none of them will impede safe transit operations or pedestrian movement. d. Below average. Major flaws in critical structural components that have the potential, without proper maintenance/repair, of impeding transit operations or pedestrian movement. e. Poor. Nearly unusable from lack of maintenance or other problems that have caused structural deterioration.

Table 4-3d: Catalog of Tunnel Characteristics and Attribute Options for Ventilation Vulnerabilities

6. Vulnerability Rating: Ventilation Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
6.1	<p>Protection of Ventilation Shafts</p> <p>Degree of protection and security features of the tunnel’s ventilation shafts. Ventilation shafts are typically small openings in the ground that permit air intake or exhaust and rarely have significant above-ground structural components (for larger structures, see ID 6.2).</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>c.</p> </div> <div style="text-align: center;">  </div> </div> <p><i>c. Vent shaft partly protected from traffic and pedestrians behind a wall and fencing.</i></p>	<ul style="list-style-type: none"> a. Not applicable b. Well-protected. Vent is well shielded or is not visible to passers-by c. Somewhat protected. Vent has limited protection but is still vulnerable. d. Not protected. Vent is completely exposed; no attempt has been made to shield the vent from any hazard <p><i>d. Ventilation shaft exposed at the street level with no protection</i></p>

6. Vulnerability Rating: Ventilation Vulnerabilities

ID	Tunnel Characteristics	Attribute Options
6.2	<p>Protection of Ventilation Structures</p> <p>The degree to which major vent structures are shielded from vehicular attacks, accidents, or natural events. Certain tunnels (mainly vehicular tunnels) require ventilation buildings to provide the tunnel with essential ventilation.</p> <div data-bbox="261 512 932 984">  <p data-bbox="277 533 321 575">b.</p> </div> <p data-bbox="261 1010 870 1066"><i>b. Vent building protected from maritime attack by fencing, standoff, and a manned guard booth</i></p> <div data-bbox="261 1115 797 1766">  <p data-bbox="277 1136 321 1178">c.</p> </div> <p data-bbox="261 1791 932 1827"><i>c. Vent tower with partial protection from jersey barriers but little standoff distance</i></p>	<ul style="list-style-type: none"> a. Not applicable b. Well-protected. Protected from failure in the event of an attack, accident, or natural disaster c. Somewhat protected. Has features, either manmade or natural, so that it is shielded but not completely protected from an attack, accident, or natural disaster d. Not protected. No standoff distance from vehicles or exposed to natural hazards or another structural feature could cause ventilation functions to be compromised <div data-bbox="976 856 1393 1171">  <p data-bbox="1333 877 1377 919">b.</p> </div> <p data-bbox="976 1197 1382 1283"><i>b. Vent buildings protected from vehicular impact by a double row of trees and decorative masonry and iron structures</i></p> <div data-bbox="976 1318 1393 1766">  <p data-bbox="1333 1339 1377 1381">d.</p> </div> <p data-bbox="976 1791 1373 1848"><i>d. Vent structure clearly labeled and without any barriers protecting it from vehicular impact</i></p>

6. Vulnerability Rating: Ventilation Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
6.3	<p>Redundancy of Ventilation Systems</p> <p>Reliability of the ventilation system if one or more components of the tunnel’s system fail. Redundant ventilation systems provide an alternative or fail-safe by allowing connection to a backup system.</p>	<p>a. Not applicable</p> <p>b. Yes</p> <p>c. No</p>
6.4	<p>Ventilation Hardware Exposure</p> <p>Degree to which ventilation systems are visible and accessible to the general public.</p>  <p><i>b. Hardened enclosure</i></p>	<p>a. Not applicable</p> <p>b. Hardened enclosure. HVAC system is behind secured doors and vents where it is neither visible nor accessible to the general public.</p> <p>c. Covered, not hardened. HVAC system is not visible to the general public but is accessible through unsecured doors, vents, or other access points.</p> <p>d. Visible. HVAC system is exposed and unprotected.</p>

Table 4-3e: Catalog of Tunnel Characteristics and Attribute Options for Fire Protection System Vulnerabilities

7. Vulnerability Rating: Fire Systems Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
7.1	<p>Protection of Fire Control Equipment</p> <p>Fire extinguishers, hoses, and other fire control equipment should be kept in a secure enclosure that allows them to be accessed in case of emergency.</p>  <p><i>a. Fire control panel in a locked enclosure.</i></p>	<p>a. Yes</p> <p>b. No</p>

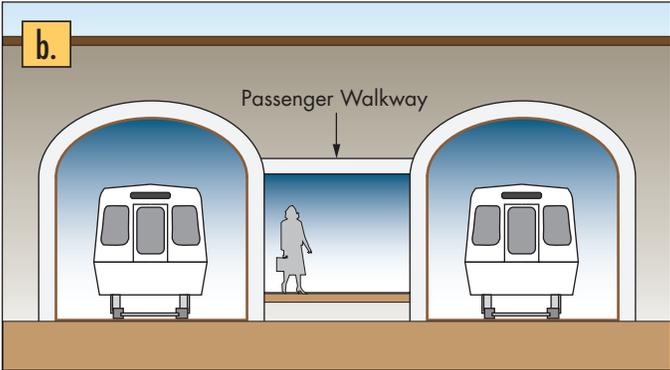
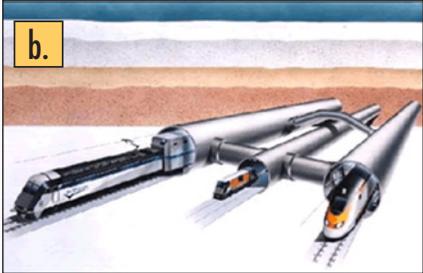
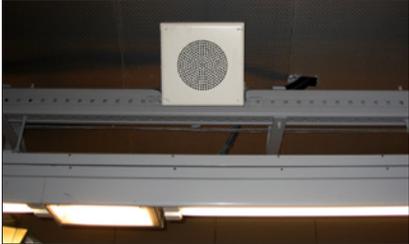
7. Vulnerability Rating: Fire Systems Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
7.2	<p>Effectiveness of Protection of Fire Control Equipment</p> <p>Ability of enclosures to protect fire control equipment from unauthorized personnel and from other hazards.</p>	<p>a. Not applicable</p> <p>b. High</p> <p>c. Medium</p> <p>d. Low</p> <p>e. None</p>
7.3	<p>First Responder Awareness of and Accessibility to Fire Equipment</p> <p>First responder awareness of the location of the fire control equipment and whether this equipment is easily accessed.</p>	<p>a. Yes</p> <p>b. No</p>
7.4	<p>Emergency Lighting</p> <p>Illuminates the tunnel in a fire or other emergency situation or if the normal lighting system ceases to function. Emergency lighting includes having a clearly lit evacuation path and emergency exit signage.</p>	<p>a. Yes</p> <p>b. No</p>
7.5	<p>Presence and Adequacy of Tunnel Cross Passageways</p> <p>Cross passageways between parallel tunnels allow the movement of people from one tunnel to the other in an emergency. For example, if there is a fire in one tunnel, riders can be evacuated off the trains and through the cross passageway to the parallel</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p><i>b. A double tube tunnel with an adequate pedestrian cross passageway</i></p> </div> <div style="text-align: center;">  <p><i>b. Three tunnel tubes with a pedestrian cross passageway between all three</i></p> </div> </div>	<p>a. Single tube</p> <p>b. Double-tube adequate connector</p> <p>c. Double-tube not adequate</p>

Table 4-3f: Catalog of Tunnel Characteristics and Attribute Options for Operations Vulnerabilities

8. Vulnerability Rating: Operations Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
8.1	<p>Power Supply and Distribution: Enclosures</p> <p>Enclosures of power supplies include any covering of electrical equipment, generators, and other supporting infrastructure necessary for facility operations.</p>  <p><i>a. Secure entrance to a power supply area with a hardened door and electronic key pad entry</i></p>  <p><i>c. Power supply system, with only a chain link fence for protection, exposed to the public and subject to tampering</i></p>	<p>a. Well protected. Power supplies are behind hardened enclosures with secure access points.</p> <p>b. Marginally protected. Power supply systems are concealed but not sufficiently hardened to withstand intentional tampering or a natural disaster.</p> <p>c. Not protected. Power supplies are exposed and easily accessible to the general public.</p>  <p><i>b. Power supply system behind a non-hardened door with a traditional lock and key entry system</i></p>

8. Vulnerability Rating: Operations Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
8.2	Surveillance and Control	
8.2.1	<p>Coverage of Control Systems</p> <p>The number of surveillance, intrusion detection, and access management/control systems in operation describes the total number of security systems in place that are designed to allow facility personnel to monitor public behavior. Security systems can be simple or as complex as a comprehensive integrated intrusion detection system that includes a closed circuit television (CCTV) network.</p>  <p><i>Two security systems, a CCTV camera and a mirror, are each different types of surveillance systems with differing qualities and deterrence values</i></p>	<ul style="list-style-type: none"> a. Complete. The traveling public is under surveillance from the time they enter the station until the time they board the train. b. Partial. The traveling public is under surveillance from the station entrance through fare collection area, or from the collection area to the platform. c. None. There are no control systems in operation to cover the traveling public from the time they enter the station until they board the train.
8.2.2	<p>Quality of Control Systems</p> <p>The operational quality of surveillance and control systems in operation based on the age of the equipment.</p>	<ul style="list-style-type: none"> a. High b. Medium c. Low

8. Vulnerability Rating: Operations Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
8.3	Public Address and Communication:	
8.3.1	<p>Public Notification (Alerts and Signage for Public Awareness)</p> <p>Efforts by the transit agency to implement focused public awareness campaigns for transit agency employees and the traveling public, placing emphasis on public security and emergency awareness. Public awareness programs consist of security and emergency preparedness information materials prominently displayed throughout the system by signage, notifications, alerts, and public announcements.</p> <p>Attribute options are divided into small tunnels and large tunnels There are a total of 10 options for this characteristic. Only one attribute option should be selected.</p> <p>Classification of Public Awareness</p> <p>Class 1. Public awareness is a limited effort consisting of:</p> <ul style="list-style-type: none"> • Signage • Posters • Public telephones. <p>Class 2. Public awareness is a heightened effort. In addition to Class 1, Class 2 public awareness consists of:</p> <ul style="list-style-type: none"> • Panic alarms (one-way communication) • Audible alerts through public address systems <p>Class 3. The transit system has a dedicated public awareness campaign. In addition to Class 1 and Class 2, Class 3 public awareness consists of:</p> <ul style="list-style-type: none"> • Real-time updates • Visual alert system • Emergency call boxes with two-way communication 	<p>Small tunnels</p> <ol style="list-style-type: none"> Class 3 Class 2 Class 1 Present (non-operational) None <p>Large tunnels</p> <ol style="list-style-type: none"> Class 3 Class 2 Class 1 Present (non-operational) None
	 <p><i>Electronic message board</i></p>	 <p><i>Audible public address system</i></p>  <p><i>Emergency call box</i></p>
8.3.2	<p>Effectiveness of Public Awareness</p> <p>Ability and success of the public awareness program to accomplish the following (through public notification, alerts, and signage):</p> <ul style="list-style-type: none"> • Declare a state of an emergency • Urge passengers to report unattended property, suspicious behavior, and security concerns • Display security awareness and emergency preparedness information • Inform passengers of the means to evacuate safely from transit vehicles and/or facilities • Designate restricted areas <p>All signage should be prominently displayed and legible to the public. Public address systems should be audible.</p>	<ol style="list-style-type: none"> High Moderate Limited

8. Vulnerability Rating: Operations Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
8.3.3	<p>Asset-Related Communications</p> <p>Systems available at the tunnel to facilitate rapid information gathering, decision-making, and response (action taking).</p> <p>Classification of Communications Systems:</p> <p>Class 1. Basic interdiction-related communications system that alerts the public to potential threats and provides a means for the public and staff personnel to report suspicious activity. Communications consist of:</p> <ul style="list-style-type: none"> • Hand-held radios • Emergency notification alarm • Cell phones • Telephones <p>Class 2. Enhanced interdiction-related communications system that provides appropriate modes of communication capabilities to security, staff personnel, and public. In addition to Class 1, Class 2 communications consists of:</p> <ul style="list-style-type: none"> • Multi-channeled hand-held radios • GPS • Pagers <p>Class 3. Optimal interdiction-related communications system that provides secure, interoperable, and redundant modes of communication capabilities to security, staff personnel, and appropriate communications for the public. In addition to Class 1 and Class 2, Class 3 communications consist of:</p> <ul style="list-style-type: none"> • Secure communications with multiple channels, frequencies, and additional means should primary means fail • Communications channeled through a dedicated proprietary communications center 	<p>Small tunnels</p> <ul style="list-style-type: none"> a. Class 3 b. Class 2 c. Class 1 d. Present (non-operational) e. None <p>Large tunnels</p> <ul style="list-style-type: none"> f. Class 3 g. Class 2 h. Class 1 i. Present (non-operational) j. None
8.3.4	<p>Effectiveness of Asset-Related Communications</p> <p>Ability and success of the asset-related communications to accomplish the following through hand-held radio, emergency alarms, telephones, and emergency callback boxes:</p> <ul style="list-style-type: none"> • Facilitate rapid information gathering • Facilitate decision-making • Facilitate response and action taking 	<ul style="list-style-type: none"> a. High b. Moderate c. Limited

8. Vulnerability Rating: Operations Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
8.4	<p>Quality of Lighting</p> <p>Lighting in tunnels is crucial for motorists and train operators. It has both safety and security purposes. In conjunction with the lighting system, a highly reflective surface on the walls and ceiling, such as tile or metal panels, may be used.</p>	
8.4.1	<p>Effectiveness of Exterior Lighting</p> <p>The effectiveness of illumination at the approaches to the tunnel. Security lighting should be provided for the overall site to allow security personnel to maintain visual assessment during hours of darkness. Continuous or periodic observation may provide both a real and psychological deterrent because it facilitates detection of unauthorized personnel and makes the job of an attacker more difficult.</p>	<p>a. High. Approaches are well lit, and lighting is well maintained.</p> <p>b. Medium. Tunnel approaches have areas where lighting should be improved or where lighting is not well maintained.</p> <p>c. Low. Tunnel exterior lighting is ineffectual or nonexistent.</p>
8.4.2	<p>Sufficiency of Interior Lighting</p> <p>Sufficiency of illumination inside the main functioning areas of the tunnel.</p> <div data-bbox="334 961 1005 1461" data-label="Image"> </div> <p>a. <i>Tunnel with effective interior lighting</i></p>	<p>a. High. Lighting for standard operations, such as regular vehicular movement, is sufficient.</p> <p>b. Medium. Lighting systems either need replacement, basic maintenance, or minor upgrades.</p> <p>c. Low. Facility lighting systems are either nonexistent or of such poor quality that the facility interior is barely passable and other sources of light, such as flashlights, are needed to operate in the tunnel.</p>

Table 4-3g: Catalog of Tunnel Characteristics and Attribute Options for Nonstructural Vulnerabilities

9. Vulnerability Rating: Nonstructural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
9.1	<p>Wall and Ceiling Finish</p> <p>Coverings that are attached to the structural framing and are not intended or designed to resist loads but are important to the overall tunnel function. finishes can provide the following:</p> <ul style="list-style-type: none"> Enhanced tunnel lighting Fire resistance Noise attenuation Aesthetics <p>Finishes include:</p> <ul style="list-style-type: none"> Ceramic tiles Porcelain-enameled metal panels Epoxy-coated concrete Coated cemented-board panels Precast concrete panels Metal tiles 	<p>a. High. Well-maintained and securely attached to the structure. There have been no recent reports or signs of falling debris from the wall or ceiling.</p> <p>b. Medium. Need basic maintenance, parts have recently fallen, and/or there are some missing sections. Issues with wall and/or ceiling finishes have not significantly affected tunnel operations.</p> <p>c. Low. Finishes have caused operational issues in the tunnel; there is a significant backlog of maintenance, and/or there are large missing sections of tile on walls.</p>
9.2	<p>Pavement Driving/Track Quality</p> <p>Overall condition and defects of the pavement or rail tracks in the tunnel.</p>	<p>a. High. Few if any potholes and other obstructions and in a good state of repair.</p> <p>b. Medium. Some potholes and other obstructions and needs some repair. Overall the tunnel is passable.</p> <p>c. Low. Full of potholes and/or other obstacles, making passage nearly impossible</p>
9.3	<p>Quality of Security Personnel Booths</p> <p>Provide information on the existence and rating for any law enforcement installations inside or immediately adjacent to the tunnel that act to directly support public safety in the facility.</p>  <p>a. <i>Example of high-quality modern security personnel booth facility</i></p>	<p>a. High. Modern facility with command and control equipment, intrusion detection, access management controls, permanent structural components, and other features that enable public safety officials to monitor the station complex.</p> <p>b. Medium. Police booths without significant surveillance capabilities and little or no major structural components.</p> <p>c. Low. Temporary or poorly made structure without station surveillance equipment.</p> <p>d. None</p>

9. Vulnerability Rating: Nonstructural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
9.3	<p>Quality of Security Personnel Booths (continued)</p>  <p><i>b. Example of medium-quality security personnel booth</i></p>	 <p><i>c. Example of low-quality security personnel booth</i></p>
9.4	<p>Fixture Attachments</p> <p>Lighting, wiring, piping, and other exposed components.</p>  <p><i>a. Example of secure fixture attachments.</i></p>	<p>a. Secured. Fixture attachments are secure from accidental incidents, vandalism, and other acts that might disrupt operations.</p> <p>b. Not secured. Fixture attachments are exposed to accidental events, vandalism, or other acts that might cause a disruption of service.</p>  <p><i>b. Example of fixture attachments that are not secure</i></p>

9. Vulnerability Rating: Nonstructural Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
9.5	<p>Quality of Barriers/Curbs</p> <p>Existence and effectiveness of barriers and curbs in preventing vehicles from damaging the tunnel complex.</p>	<p>a. High. Existing barriers or curbs are of good quality and sufficient to stop a vehicle from entering the station.</p> <p>b. Medium. Existing barriers or curbs are sufficient to stop an accidental impact at the station but would not stop an intentional vehicular attack at the station.</p> <p>c. Low. Barriers or curbs would not stop even an accidental vehicular impact at the station.</p> <p>d. None present</p>

Table 4-3h: Catalog of Security Systems for Physical Security Vulnerabilities

10a. Vulnerability Rating: Physical Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
10.1a	<p>Access Control</p> <p>Any combination of equipment and/or guards that can deny entry to unauthorized personnel or vehicles to certain areas of the tunnel. The function of access control is to ensure that only authorized personnel are permitted into or out of a controlled area. Entry can be controlled by locked fence gates, locked doors to a building or rooms in a building, or specially designed portals. The means can be applied manually by guards or automatically by using entry control devices .</p> <p>Examples of access control systems:</p> <ul style="list-style-type: none"> • Fare collection gates • Electronic keypad • Magnetic-stripe card • Proximity card • Smart card • Biometric devices 	<p>a. Yes</p> <p>b. No</p>

10a. Vulnerability Rating: Physical Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
10.2a	<p>Intrusion Detection Systems (IDS)</p> <p>The combination of components, including sensors, control units, transmission lines, and monitor units, integrated to operate in a specific manner. The purpose is to detect an aggressor crossing the boundary of a protected area. The sensors initiate alarm signals by sensing the stimulus, change, or condition for which it was designed.</p> <p>Examples of exterior intrusion detection sensors:</p> <ul style="list-style-type: none"> • Fence • Buried line • Microwave • Infrared <p>Examples of interior intrusion detection sensors:</p> <ul style="list-style-type: none"> • Boundary penetration • Volumetric motion • Video analytics 	<p>a. Yes</p> <p>b. No</p>
10.3a	<p>Video and Surveillance Assessment – Monitored CCTV</p> <p>An electronic system of cameras, control equipment, recorders, and related apparatus used for surveillance or alarm assessment. The system may include event-activated software. Effectiveness of the system depends on proper monitoring, the resolution, and coverage of the cameras.</p>	<p>a. Yes</p> <p>b. No</p>
10.4a	<p>Chemical, Biological, Radiological, Nuclear, Explosive (CBRNE) Detection Equipment</p> <p>A variety of technologies and techniques that are in a fixed location to detect the presence or use of CBRNE weapons in real-time.</p> <p>Examples of CBRNE detection equipment:</p> <ul style="list-style-type: none"> • Trace detection equipment • Vapor sampling • CBR identifiers and classifiers • Integrated system 	<p>a. Yes</p> <p>b. No</p> <div data-bbox="1036 1297 1458 1619" data-label="Image"> </div> <p><i>Fixed CBR identifier</i></p>
10.5a	<p>Personnel/Baggage CBRNE Screening</p> <p>Search and screening are conducted at a fixed check point. Anomalies are verified with K-9 and other CBRNE detection devices.</p>	<p>a. Yes</p> <p>b. No</p>

10a. Vulnerability Rating: Physical Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
10.6a	<p>Vehicular CBRNE Screening</p> <p>Vehicles are searched and screened at fixed checkpoints. Anomalies are verified with K-9 and other CBRNE detection devices.</p>	<p>a. Yes</p> <p>b. No</p>
10.7a	<p>Mobile Personnel/Baggage CBRNE Screening</p> <p>Random searches are conducted of personnel and baggage, typically by a roving team of personnel with appropriate equipment and an explosive K-9 Unit.</p>	<p>a. Yes</p> <p>b. No</p>
10.8a	<p>Unarmed Guards/Patrol</p> <p>Security guards at the tunnel carry no firearms and are responsible for detecting, deterring, observing, and reporting malicious behavior.</p>	<p>a. Yes</p> <p>b. No</p>
10.9a	<p>Armed Guards/Patrols</p> <p>Security guards patrolling at the tunnel are armed and meet all appropriate jurisdiction standards. The guard/patrol is responsible for reporting incidents and has a limited interdiction capability.</p>	<p>a. Yes</p> <p>b. No</p>
10.10a	<p>Law Enforcement Patrols (Landside)</p> <p>Sworn law enforcement personnel patrol during specified hours or randomly patrol the tunnel.</p>	<p>a. Yes</p> <p>b. No</p>
10.11a	<p>Asset/Interdiction-related Communications</p> <p>Security communication systems that facilitate rapid information gathering, decision-making, and actions (response).</p> <p>Examples:</p> <ul style="list-style-type: none"> • Pagers • GPS • Multi-channeled hand-held radios • Two-way radio • Direct ring-down intercoms • Standard telephone landlines • Wireless phones • Emergency notification alarm 	<p>a. Yes</p> <p>b. No</p>
10.12a	<p>Special Weapons and Tactics (SWAT) Teams</p> <p>A special tactical unit trained for multiple special operations that is either full-time to the transit system or provided by the local law enforcement. The SWAT team is trained in counterterrorism and possesses specialized skills in explosive breaching, sharpshooter capability, hostage rescue, etc.</p>	<p>a. Yes</p> <p>b. No</p>

10a. Vulnerability Rating: Physical Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
10.13a	<p>Explosion ordinance disposal (EDO) teams</p> <p>A special team either full-time dedicated to the transit system or provided by the local law enforcement who are trained to be used as a bomb squad when needed.</p>	<p>a. Yes</p> <p>b. No</p>
10.14a	<p>Interdiction-related Communications</p> <p>Security communication systems that facilitate rapid information gathering, decision-making, and actions (response) to interdict a threat</p>	<p>a. Yes</p> <p>b. No</p>

10b. Vulnerability Rating: Security, Waterside Security Systems (Applicable to Underwater Tunnels)		
ID	Tunnel Characteristics	Attribute Options
10.1b	<p>Water Intrusion Detection Systems (IDS)</p> <p>Appropriate detection technologies capable of detecting smaller water craft, swimmers, divers, or objects at varying distances and depths from the tunnel (DHS, 2002).</p>	<p>a. Yes</p> <p>b. No</p>
10.2b.	<p>Vessel Boarding Teams</p> <p>Team with the ability to board vessels near the tunnel in security or emergency situations .</p>	<p>a. Yes</p> <p>b. No</p>
10.3b	<p>Dive Teams</p> <p>Team with the capability to dive into the water surrounding the tunnel for security purposes.</p>	<p>a. Yes</p> <p>b. No</p>
10.4b	<p>Patrol Boats</p> <p>Vessels used for emergency response at the tunnel</p>	<p>a. Yes</p> <p>b. No</p>
10.5b	<p>Transit/Maritime Domain Command and Control</p> <p>A form of command and control that handles the interaction between detection and interdiction prior to an incident. Usually consists of a communications center, operations control center, or security operations center, staffed by appropriately trained and equipped personnel who coordinate activities that take place between detection to interdiction (DHS, 2002).</p>	<p>a. Yes</p> <p>b. No</p>
10.6b	<p>Unarmed Guards (Waterside)</p> <p>Security guards at the station waterside carry no firearms and are responsible for detecting, deterring, observing, and reporting malicious behavior.</p>	<p>a. Yes</p> <p>b. No</p>

10b. Vulnerability Rating: Security, Waterside Security Systems (Applicable to Underwater Tunnels)		
ID	Tunnel Characteristics	Attribute Options
10.7b	<p>Armed Guards (Waterside)</p> <p>Security guards patrolling at the station waterside are armed and meet all appropriate jurisdiction standards. The guard/patrol is responsible for reporting incidents and has a limited interdiction capability.</p>	<p>a. Yes</p> <p>b. No</p>
10.8b	<p>Law Enforcement Patrols (Waterside)</p> <p>Sworn law enforcement personnel patrol during specified hours or randomly patrol the station waterside.</p>	<p>a. Yes</p> <p>b. No</p>

10c. Vulnerability Rating: Security System Evaluation		
ID	Tunnel Characteristics	Attribute Options
10.1c	<p>Blast Threat: Internal</p> <p>Intrusion into the transit tunnel by a person or persons with the intent to attack the transit tunnel with an explosive device.</p>	
10.1.1c	<p>Number of Systems</p> <p>Number of security systems available to protect against the threat of an explosion inside the subway tunnel.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<p>a. 8 or more</p> <p>b. 4 to 7</p> <p>c. 1 to 3</p> <p>d. None</p>
10.1.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect against the threat of an explosion inside the transit tunnel. The number of detection systems available will have little impact if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>
10.2c	<p>Blast Threat: External (Direct)</p> <p>Use of an explosive device to attack the transit tunnel from the exterior. In this case, the transit tunnel is the primary target.</p>	
10.2.1c	<p>Number of Systems</p> <p>Number of security systems available to protect against an explosion outside the transit tunnel.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<p>a. 5 or more</p> <p>b. 3 to 4</p> <p>c. 1 to 2</p> <p>d. None</p>
10.2.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect against the threat of an explosion directed at the transit tunnel from the exterior. The number of detection systems available will have little impact if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>

10c. Vulnerability Rating: Security System Evaluation		
ID	Tunnel Characteristics	Attribute Options
10.3c	<p>Blast Threat: External (Collateral)</p> <p>An attack with explosive devices on a target within a 300-foot radius of the transit tunnel e.g., a bomb explosion in a plaza adjacent to a transit tunnel.. The transit tunnel is not the primary target but would be susceptible to collateral effects.</p>	
10.3.1c	<p>Number of Systems</p> <p>Number of security systems available to detect the threat of an explosive attack on a target within 300-feet of the transit tunnel. The tunnel is not the primary target but would be susceptible to collateral effects. The detection systems may be separate from security operations of the tunnel. Redundant systems are highly desirable.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<ul style="list-style-type: none"> a. 5 or more b. 3 to 4 c. 1 to 2 d. None
10.3.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of collective security systems to protect the transit tunnel against the collateral effects of an explosive attack on another target within 300 feet. The number of detection systems available will have little effect if the systems are not effective in thwarting attacks.</p>	<ul style="list-style-type: none"> a. High b. Effective c. Minimal d. Ineffective e. No security
10.4c	<p>CBR Threat: Tunnel</p> <p>The release of a CBR agent inside the tunnel.</p>	
10.4.1c	<p>Number of Systems</p> <p>Number of security systems available to detect the threat of a CBR release inside the tunnel. Detection systems include access control, screening systems, sensors, video surveillance and assessment, security lighting, and security guards. Redundant systems are desirable.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<ul style="list-style-type: none"> a. 5 or more b. 3 to 4 c. 1 to 2 d. None
10.4.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect against the threat of a CBR release inside the tunnel. The number of detection systems available will have little effect if the systems are not effective in thwarting attacks.</p>	<ul style="list-style-type: none"> a. High b. Effective c. Minimal d. Ineffective e. No security
10.5c	<p>CBR Threat: External</p> <p>The release of a CBR agent outside the tunnel.</p>	
10.5.1c	<p>Number of Systems</p> <p>Number of systems available detect the threat of a CBR release inside the tunnel of the tunnel. Detection systems include access control, screening systems, sensors, video surveillance and assessment, security lighting, and security guards. Redundant systems are highly desirable.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<ul style="list-style-type: none"> a. 5 or more b. 3 to 4 c. 1 to 2 d. None

10c. Vulnerability Rating: Security System Evaluation		
ID	Tunnel Characteristics	Attribute Options
10.5.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect against the threat of a CBR release inside the tunnel of the tunnel. The number of detection systems available will have little effect if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>
10.6	<p>Fire Threat: Internal</p> <p>Fire threat inside the tunnel that threatens the life safety of vehicular passengers and riders and the operations of the tunnel itself.</p>	
10.6.1c	<p>Number of Systems</p> <p>Number of detection systems available for security purposes that can also serve as protection against the threat of a fire inside the tunnel</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<p>a. 5 or more</p> <p>b. 3 to 4</p> <p>c. 1 to 2</p> <p>d. None</p>
10.6.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect the tunnel against the threat of a CBR release outside the transit tunnel. The number of detection systems available will have little effect if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>
10.7c	<p>Fire Threat: Tunnel/Track/Smoke</p> <p>Fire or smoke in the tube of the tunnel that threatens life safety, operations, and structure of the tunnel.</p>	
10.7.1c	<p>Number of Systems</p> <p>Number of security systems available for security purposes that can also serve as protection against the threat of a smoke inside the tunnel.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<p>a. 5 or more</p> <p>b. 3 to 4</p> <p>c. 1 to 2</p> <p>d. None</p>
10.7.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect (detect and interdict) against the threat of a smoke inside the tunnel. The number of detection systems available will have little impact if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>
10.8c	<p>Other Threats: Flood/Flooding</p> <p>Event causing the tunnel to be submerged in water, threatening the operations and users of the tunnel.</p>	
10.8.1c	<p>Number of Systems</p> <p>Number of detection systems available to protect against the threat flooding in the tunnel.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<p>a. 5 or more</p> <p>b. 3 to 4</p> <p>c. 1 to 2</p> <p>d. None</p>

10c. Vulnerability Rating: Security System Evaluation		
ID	Tunnel Characteristics	Attribute Options
10.8.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect (detect and interdict) against the threat of a flood inside the tunnel. The number of detection systems available will have little impact if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>
10.9c	<p>Other Threats: Cyber</p> <p>An attack on the transit tunnel through any combination of facilities, equipment, personnel, procedures, and communications integrated through cyber networks or control systems.</p>	
10.12.1c	<p>Number of Systems</p> <p>Number of detection systems available to protect against the threat of a cyber attack on the tunnel.</p> <p>This characteristic is automatically summed in the IRVS Database using the general security system checklist.</p>	<p>a. 5 or more</p> <p>b. 3 to 4</p> <p>c. 1 to 2</p> <p>d. None</p>
10.12.2c	<p>Overall Security Effectiveness</p> <p>Ability and success of the collective security systems to protect the tunnel against the threat of a cyber attack on the tunnel. The number of detection systems available will have little effect if the systems are not effective in thwarting attacks.</p>	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p> <p>e. No security</p>

Table 4-3i: Catalog of Tunnel Characteristics and Attribute Options for Cyber Vulnerabilities

11. Vulnerability Rating: Cyber Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
11.1	<p>Effectiveness of Cyber Security Plan</p> <p>How well the security in place to protect systems, such as the supervisory control and data acquisition (SCADA) or utility monitoring and control systems (UMCS), which provide monitoring and control of utilities within buildings or the electronic security system. Many tunnel operation systems use the Internet to perform these functions, so cyber security must be a priority because the systems are accessible to all attackers with a computer and access to the Internet. The best protection for these systems is to remove them from the Internet; when that is not feasible, other protective features must be put in place.</p>	<p>a. High</p> <p>b. Medium</p> <p>c. Low</p> <p>d. None</p>
11.2	<p>Effectiveness of Training Programs</p> <p>Effectiveness of the programs in place to train transit tunnel employees on the cyber security measures in place.</p>	<p>a. High</p> <p>b. Medium</p> <p>c. Low</p> <p>d. None</p>

11. Vulnerability Rating: Cyber Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
11.3	<p>Security of Communication, Signal, and Power Systems</p> <p>Measures in place to protect the communication system, signal system, and power supply to the tunnel.</p>	<p>a. Secured</p> <p>b. Medium</p> <p>c. Marginal</p> <p>d. No security</p>
11.4	<p>Redundancy of Communication Systems</p> <p>The tunnel's ability to operate communications systems if the primary system is compromised.</p>	<p>a. Yes</p> <p>b. No</p>
11.5	<p>Security of Power Supply</p> <p>Measures in place to protect the power supply to the tunnel. The power supply ensures that all communications and security measures are functioning.</p>	<p>a. Secured</p> <p>b. Medium</p> <p>c. Marginal</p> <p>d. No security</p>
11.6	<p>Effectiveness of Wireless, Radio, or Satellite Systems During Emergencies</p> <p>Whether these communication modes can function effectively to deliver important messages to the tunnel if other systems are compromised.</p>	<p>a. High (regional)</p> <p>b. Medium (within jurisdiction)</p> <p>c. Low (system only)</p>

Table 4-3j: Catalog of Tunnel Characteristics and Attribute Options for Operational Security Vulnerabilities

12. Vulnerability Rating: Operational Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
12.1	<p>Emergency Plan</p> <p>Emergency plans are procedures and protocols the transit agency is prepared to use when a disaster occurs. The purpose of emergency plans is to reduce the impact of disasters. By implementing the emergency plan, a transit agency can enhance its capability to respond to, recover from, and to mitigate against an act of terrorism or natural disaster.</p>	<p>a. Yes</p> <p>b. No</p>
12.2	<p>Emergency Response Exercises</p> <p>A well-rehearsed emergency plan enables efficient coordination of rescue and response operations. Drills and training can improve how people function during emergencies.</p>	<p>a. Full scale</p> <p>b. Table top</p> <p>c. Workshop</p> <p>d. None</p>

12. Vulnerability Rating: Operational Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
12.3	<p>Effectiveness of Emergency Plans</p> <p>Ability and success of the emergency/security response plans implemented by the tunnel. Just having a plan does not protect the tunnel; if the plan is not effective, the tunnel will not be prepared to respond to an emergency.</p> <p>Characteristics of an effective emergency/security response plan are:</p> <ul style="list-style-type: none"> • Communication plans with easily understandable terminology and methods • Development and exercise of warnings combined with planned areas of refuge and evacuation plans • Development of organizations of trained volunteers among civilian populations such as, Community Emergency Response Teams 	<p>a. High</p> <p>b. Effective</p> <p>c. Minimal</p> <p>d. Ineffective</p>
12.4	<p>Security Plan</p> <p>Plan for the protective system, continuity of operations, and other emergencies. The plan includes details on how a system or process will be handled and often include general plans for system redundancy, continuity of operations, Memoranda of Understanding for response force support, and notification requirements.</p>	<p>a. Yes</p> <p>b. No</p>
12.5	<p>Security Plan Update Status</p> <p>Length of time since security plans were last updated. Security plans should be reviewed and updated annually to incorporate changes in threat intelligence.</p>	<p>a. Within 12 months</p> <p>b. 1 to 2 years</p> <p>c. 2 to 5 years</p> <p>d. More than 5 years</p> <p>e. None</p>
12.6	<p>Transit Agency Mass Evacuation Plan</p> <p>Procedure for immediately and rapidly move people out of the tunnel because of a threat or hazard. Mass evacuation plans are developed to ensure the safest and most efficient evacuation time for all of the people in the tunnel in the event of an emergency.</p> <p>The significance of having an evacuation plan depends on the size and expected use of the tunnel.</p>	<p>a. Both tunnel and train (if rail tunnel)</p> <p>b. Train only (if rail tunnel)</p> <p>c. None</p> <p>For vehicle tunnels, the answer will be either attribute option (a.) or (c.).</p>

12. Vulnerability Rating: Operational Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
12.7	<p>Effective of Mass Evacuation Plan</p> <p>Ability and success of the mass evacuation plan. An effective evacuation plan uses multiple exits and technologies to ensure full and complete evacuation. The transit agency should post procedures for safe evacuation prominently in the tunnel.</p> <p>The screener should consider the phases of evacuation when determining the effectiveness of the evacuation plan.</p> <ol style="list-style-type: none"> 1. Detection 2. Decision 3. Alarm 4. Reaction 5. Movement to area of refuge or assembly tunnel 6. Transportation 	<ol style="list-style-type: none"> a. High b. Effective c. Minimal d. Ineffective
12.8	<p>Continuity of Security</p> <p>If security and protective measures are not maintained during off-peak or closing hours, the tunnel is more vulnerable.</p>	<ol style="list-style-type: none"> a. Yes b. No
12.9	<p>Report/Exchange Threat Information</p> <p>How often the transit agency receives and exchanges threat information with local, State, and Federal law enforcement officials.</p>	<ol style="list-style-type: none"> a. Frequent b. Seldom/infrequent c. None
12.10	<p>Training Programs</p> <p>Training should be provided to all transit employees regarding security awareness and emergency response.</p> <p>Training and education for transit personnel (security, maintenance, and operations) are essential because it is the engagement and decision-making of these individuals, operating in their own areas of expertise and responsibility, that will determine the success of emergency preparedness and response. Objectives for training are:</p> <ul style="list-style-type: none"> • Develop employee awareness of potential threats or hazards. Employees should be able to recognize, report, and respond appropriately to suspicious items. • Develop an understanding of responses and protective actions and what to do for each of the possible emergency situations. 	<ol style="list-style-type: none"> a. Well established b. Marginal c. None

12. Vulnerability Rating: Operational Security Vulnerabilities		
ID	Tunnel Characteristics	Attribute Options
12.11	<p>Coordinated Efforts of Local/Regional First Responders</p> <p>A mutual-aid agreement should be established between the transit agency and entities in the area that would be called upon to supplement the agency's resources during an emergency. The collaboration should include:</p> <ul style="list-style-type: none"> • Coordinated exercises with both entities for emergency preparedness and response • Sharing of emergency response and security protocols • Information sharing capabilities (e.g., contacts, procedures, resource inventories) • Interoperable communications systems with first responders (<ul style="list-style-type: none"> a. Well established b. Marginal c. None

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Acronyms

BIPS	Buildings and Infrastructure Protection Series
C	consequences
CBR	chemical, biological, and radiological
CBRNE	chemical, biological, radiological, nuclear, explosive
CCTV	closed circuit television
CIKR	Critical Infrastructure and Key Resources
DCF	Data Collection Form
DHS	Department of Homeland Security
EOD	explosive ordinance disposal teams
FEMA	Federal Emergency Management Agency
HSPD	Homeland Security Presidential Directorate
HVAC	heating, ventilation, and air conditioning



ACRONYMS

IDD	Infrastructure Protection and Disaster Management Division
IDS	intrusion detection system
IRVS	integrated rapid visual screening for mass transit stations
MBTA	Massachusetts Bay Transportation Authority
MS	Microsoft
MTS	mass transit station
NIPP	National Infrastructure Protection Plan
PANYNJ	Port Authority of New York & New Jersey
RMS	Risk Management Series
S&T	Science and Technology Directorate
SCADA	supervisory control and data acquisition
SWAT	special weapons and tactics teams
T	threat
TSA	Transportation Security Administration
UMCS	utility monitoring and control systems
V	vulnerabilities

Glossary

Access control. Any combination of barriers, gates, electronic security equipment, and/or guards that can deny entry to unauthorized personnel or vehicles.

Aggressor. Any person seeking to compromise a function or structure.

Assessment. The evaluation and interpretation of measurements and other information to provide a basis for decision-making.

Asset. Person, structure, facility, information, material, or process that has value.

Asset-related communications. Systems available to facilitate rapid information gathering, decision-making, and response (action taking).

Attack. Hostile action resulting in the destruction, injury, or death to the civilian population or damage or destruction to public and private property.

Attribute. Subcategory of characteristic. For example, station elevation is a characteristic, and a below-grade elevation is the attribute. Attributes are presented in the electronic software in a dropdown menu. In paper version of the data collection form, attribute options are presented in columns “a” to “e.”

Biological agent. Living organisms or the materials derived from them that cause disease or harm to humans, animals, or plants or cause deterioration of material. Biological agents may be in liquid droplets, aerosols, or dry powders.

Business continuity. Ability of an organization to continue to function during and after a disaster.

Catalog. List of station characteristics and attributes that are assessed in the IRVS of mass transit stations. The catalog includes guidance on selecting attributes.

Catenary. System of overhead trolley wires that carry electric current, in which the contact wire is hung from another wire that hangs in a catenary curve; also, any or all of the overhead trolley wire system.

Characteristic. Physical component, functionality, or operation of a mass transit station that is evaluated in the IRVS procedure and listed on the Data Collection Form.

Chemical agent. Chemical substance that is intended to kill, seriously injure, or incapacitate people through physiological effects.

Closed circuit television. Electronic system of cameras, control equipment, recorders, and related apparatus used for surveillance or alarm assessment.

Collateral damage. Injury or damage to assets that are not the primary target of an attack.

Concourse. Open space that accommodates large crowds and allows for efficient distribution of people between locations.

Consequence. Effect of an event, incident, or occurrence. Consequences are divided into four categories: public health and safety, economic, psychological, and governance impacts.

Consequences rating. Degree of debilitation that would be caused by the incapacity or destruction of an asset.

Control center. Centrally located room or facility staffed by personnel charged with the oversight of specific situations and/or equipment.

Control system. Computer-based system used in many types of infrastructure and in many industries to monitor and control sensitive processes or physical functions.

Controlled area. Area into which access is controlled or limited; portion of a restricted area that is usually near or surrounding a limited or exclusion area.

Critical Infrastructure. Vital system or asset, either physical or virtual, that the incapacity or destruction of which may have a debilitating impact on the security, economy, public health or safety, environment, or any combination, across a Federal, State, regional, territorial, or local jurisdiction.

Cyber security. Protection that is intended to prevent damage to, unauthorized use of, or exploitation of, and if needed, restoration of electronic information and communications systems. Includes protection of information networks and wireline, wireless, satellite, public safety answering points, and communication and control systems.

Data Collection Form. Form containing the station characteristics and attribute options that is used in the IRVS of mass transit stations.

Deterrence. Inhibition of criminal behavior by fear especially of punishment.

Direct loss. Cost to rebuild, respond, and recover from an event.

Disaster. Natural catastrophe, technological accident, or human-caused event that results in severe property damage, deaths, and/or multiple injuries.

Downtime. Disruption of a service that is the result of an event, incident, or occurrence.

Emergency. Any natural or human-caused situation that results in or may result in substantial injury or harm to the population or substantial damage to or loss of property.

First responder. Local police, fire, and emergency medical personnel who arrive first on the scene of an incident and take action to save lives, protect property, and meet basic human needs.

Flood. Temporary, partial or complete inundation of normally dry land areas from overflow of inland or tidal waters, unusual or rapid

accumulation or runoff of surface waters, or mudslides/mudflows caused by accumulation of water.

Hazard. Natural or manmade source or cause of harm or difficulty.

Hazardous material. Any substance or material that, when involved in an accident and released in sufficient quantities, poses a risk to people's health, safety, and/or property. Includes explosives, radioactive materials, flammable liquids or solids, combustible liquids or solids, poisons, oxidizers, toxins, and corrosive materials.

Heavy rail. Electric railway with the capacity to handle a heavy volume of passengers.

Highway. A public road, especially a major road connecting two or more destinations. Any interconnected set of highways can be variously referred to as a "highway system", a "highway network", or a "highway transportation system".

Indirect loss. Downstream costs resulting from disruption of the service after an event.

Integrated rapid visual screening. Quick and simple procedure to assess the risk and resiliency of a mass transit station.

Intermodal. More than one mode of transportation (e.g., rail, bus, air).

Intrusion detection system. Combination of sensors, control units, transmission lines, and monitor units, integrated to operate in a specified manner.

IRVS Tier 1 assessment. Screening that identifies the primary facility vulnerabilities and.

IRVS Tier 2 assessment. Onsite evaluation by assessment specialists that provides a robust evaluation of system interdependencies, vulnerabilities, and mitigation options.

Key Resource. Publicly or privately controlled resource essential to the minimal operation of the economy and government.

Light rail. System characterized by vehicles that require an operator and are powered by overhead electric catenary or trolley wires. Often some portion of the route runs in the streets of cities or towns (as opposed to

a heavy rail system in which vehicles operate on a private right-of-way). Modern equivalent of a trolley or interurban.

Liner. Roof/wall of underground stations or tunnels.

Liner relative thickness. Thickness of the structural roof/wall outlining an underground station to tunnel.

Line. Transportation route that is typically distinguished by numbering, name, or color.

Lobby. Area with station attendants and fair collection machines.

Mass transit station. Structure acting as a terminal, typically underground or elevated, serving a mode of transportation for a mass transit system.

Mezzanine. Intermediate story in a station that projects in the form of a balcony.

Mitigation. Ongoing and sustained action to reduce the probability of or lessen the impact of an adverse incident.

Natural protective barrier. Mountains, deserts, cliffs, ditches, water obstacles, or other terrain feature that is difficult to traverse.

Owner/operator. Entity responsible for day-to-day operation and investment in a particular asset or system.

Physical security. Measures/concepts designed to safeguard personnel; prevent unauthorized access to equipment, installations, material, and documents; and safeguard them against espionage, sabotage, damage, and theft.

Platform. Section of pathway, along rail tracks at a train station, metro station, or tram stop, at which passengers may board or alight from.

Prioritization. Process of using risk assessment results to identify where risk reduction or mitigation efforts are most needed and determination of which protective actions should be instituted in order to have the greatest effect.

Progressive collapse. A chain reaction failure of structural members to an extent disproportionate to the original localized damage. Such damage may result in upper floors collapsing onto lower floors.

Rapid transit. Electric railway characterized by high speed and rapid acceleration. Uses passenger railcars operating singly or in multiple unit trains on fixed rails, operates on separate rights-of-way from which all other vehicular and foot traffic are excluded, and uses sophisticated signaling systems and high platform loading.

Replacement value. Current market cost to construct the asset.

Resilience. Ability to resist, absorb, recover from, or successfully adapt to adversity or a change in conditions.

Resilience Score. A numeric value that describes the ability of a mass transit station to resist, absorb, and recover from a potentially disruptive event at a mass transit station.

Risk. Potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood and the associated consequences.

Risk score. Numerical value obtained from the IRVS that describes the risk to a station for a terrorist attack or natural disaster

Sector. Logical collection of assets, systems, or networks that provide a common function to the economy, government, or society.

Signal. Provides information to the train driver about the line ahead.

Signal box. Building or room that houses signal levers or a control panel.

Social impact. Psychological effect on public morale and confidence as a result of an event.

Stand-off distance. Distance maintained between a building and the potential location for an explosive detonation or other threat.

Subway. Underground railroad, generally in a large city. Considered heavy rail because it operates on a dedicated track.

Target density. Number of potential high-value targets surrounding a mass transit station.

Terrorism. Unlawful use of force and violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof in furtherance of political or social objectives.

Third rail. Rail running parallel to one of the two running rails of a track; carries a supply of electricity used to power electric cars or locomotives.

Threat. Natural or manmade occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/or property.

Threat rating. Likelihood or potential of the occurrence of manmade or natural hazard.

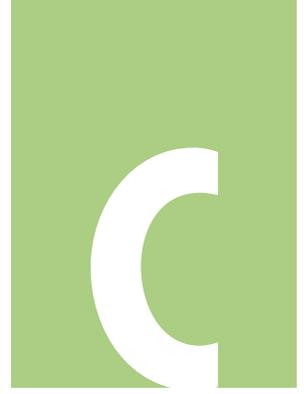
Transportation hub. Place where passengers and cargo are exchanged between vehicles or transport modes. Includes train stations, mass transit stations, bus stops, tram stops, airports, and ferry slips.

Tunnel. A passageway through or under an obstruction such as a city, mountain, river, or harbor. A tunnel may be used for pedestrian traffic, vehicular road traffic, or rail traffic or as a canal. Tunnels are typically completely enclosed except for openings for egress, commonly at each end.

Vulnerability. Physical feature or operational attribute that renders an entity open to exploitation or susceptible to a given hazard.

Vulnerability rating. Weakness of functions, systems, and sites in regard to a particular threat/hazard.

Yard. System or grouping of tracks connected to, but not part of, a main line; used for switching or storing cars, or making up trains.



Integrated Rapid Visual Screening (IRVS) Database User Guide





IRVS Database User Guide

Table of Contents

1. Introduction	C-4
2. Field Database and Master Database	C-5
Field Database	C-6
Master Database	C-6
3. System Requirements	C-7
4. Installation	C-7
5. Logging On	C-10
6. Creating and Editing Screening Records	C-13
7. Conducting a Screening	C-19
7.1 Entering the Pre-Field Data	C-20
7.1.1 Hazards Tab (Building Site Type Only)	C-22
7.1.2 Pre-Field Questions Tab (All Site Types)	C-24
7.1.3 Structure Type Tab (Building Site Type Only)	C-26
7.2 Conducting the Onsite Evaluation	C-26
7.3 Generating the Risk and Resiliency Scores.....	C-27
7.4 Creating an Executive Summary.....	C-29
7.5 Adding Points of Contact.....	C-30
7.6 Adding Assessment Team Members	C-31
7.7 Adding Photos, Setting the Default Image, Deleting Photos, and Viewing Photos.....	C-32
7.7.1 Adding Photos	C-32
7.7.2 Setting the Default Image.....	C-33
7.7.3 Deleting Photos	C-34
7.7.4 Viewing Photos	C-34

7.8	Adding GIS Images.....	C-34
7.8.1	Deleting GIS Images.....	C-35
7.8.2	Viewing GIS Portfolio Images.....	C-35
7.9	Adding and Deleting Miscellaneous Information	C-35
7.9.1	Adding Miscellaneous Information.....	C-35
7.9.2	Deleting Miscellaneous Files.....	C-36
7.10	Exporting Screening Data.....	C-36
7.11	Emptying the Database.....	C-36
8.	Filtering Records	C-36
8.1	Viewing All Summaries.....	C-37
8.2	Plotting a Filtered List.....	C-38
9.	Generating and Printing Reports	C-39
10.	Administrative Functions.....	C-40
10.1	Exporting Screening Data from the Field Database to Transfer Media	C-41
10.2	Importing Screening Data into the Master Database from Transfer Media.....	C-42
10.3	Importing Screening Data Directly into the Master Database from the Field Database	C-44
10.4	Deleting a Single Screening Record.....	C-44
10.5	Deleting All Screening Records from the Field Database	10-45
10.6	Managing User Accounts	C-46
10.6.1	User Groups.....	C-46
10.6.2	Add a User	C-47
10.6.3	Delete a User	C-47
10.6.4	Change the User Level.....	C-48
10.7	Customizing Report Handling Markings	C-48



Section 1

1. Introduction

The Integrated Rapid Visual Screening (IRVS) Database is part of the IRVS methodology for screening mass transit stations, buildings, and tunnels.

The IRVS Database is a standalone application that can be used to record, store, and manage data. The types of data that can be stored include screening data, digital photos, site plans, floor plans, emergency plans, and GIS products. The database can also be used to generate risk and resilience scores. Managers can use the database to store, search, and analyze data from multiple screenings and generate a variety of reports.

The IRVS Database is a standalone application that is both a data collection tool and a data management tool.

This user guide provides instructions on installing the database, using the database to conduct screenings, and performing administrative functions.

The user guide or a catalog reference can be opened by pressing the F1 key on the keyboard or by selecting **Help [F1]** or **Current Question Help [F1]** (the help function will open up the catalog to the exact location of the characteristics that are being evaluated).



2. Field Database and Master Database

The IRVS Database that is used in the field by the screening team is referred to as the Field Database. The data that are collected during the screening and stored temporarily in the Field Database are later transferred to the Master Database at an organization's headquarters. The instructions in this user guide apply to both the Field Database and Master Database unless otherwise indicated.

The Field Database, which is on a laptop, can be used to perform the following functions:

- Create a screening record, which includes site identification, address, sector and subsector identification, facility importance, and geographical coordinates
- Plot and display screening sites using a mapping program
- Enter the pre-field data: hazards, answers to pre-field questions, and structure type
- Enter site evaluation data
- Display the site's risk and resilience scores
- Create an Executive Summary of the screening
- Record the site points of contact (POCs)
- Record the members of the screening team
- Add digital photos, site plans, floor plans, emergency plans, and GIS products
- Transfer the collected screening data to the organization's Master Database
- Purge the collected data from the Field Database and prepare the database for subsequent screenings

The Master Database can be used by managers to store, search, print, display, and analyze data collected from multiple screenings. The Master Database can be used to perform the following functions:

- Import screening data and relevant information (e.g., photos) from Field Databases
- Plot and display screening sites using a mapping program

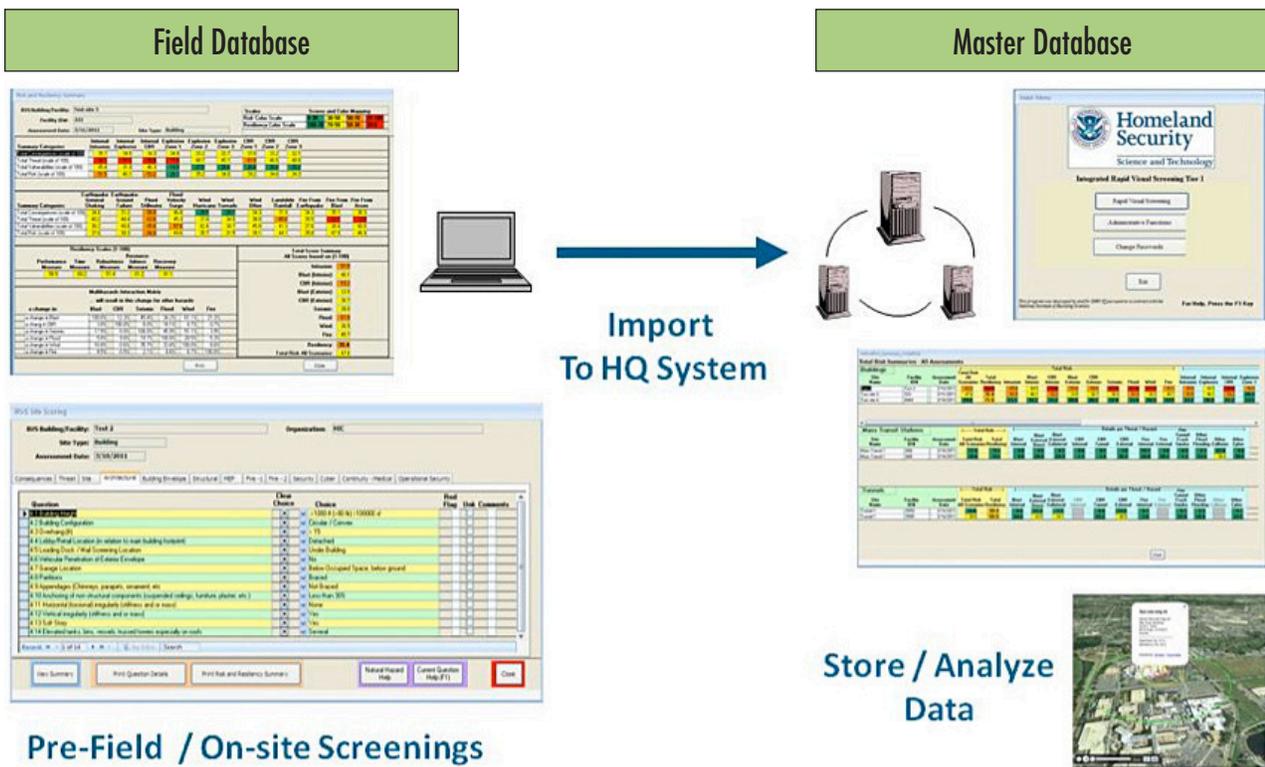


Section 2



The Master Database can be used by managers to store, search, print, display, and analyze data collected from multiple screenings.

- Store, search, and analyze data on multiple screenings
- Display and print a variety of reports
- Create a duplicate of an IRVS record for mitigation analysis or “what if” impacts resulting from changes to consequences, threats, vulnerabilities, or resilience
- Generate reports
- Export reports as MS Word documents or PDFs for editing or formatting
- Export screening risk data to MS Excel spreadsheets for editing
- Filter or sort screening records by site identification, address, sector or subsector identification, or facility importance
- Display the total risk summary for one or more sites
- Store, display, and print digital photos, site plans, floor plans, emergency plans, GIS products, and miscellaneous information collected during screenings
- Perform administrative functions



3. System Requirements

The system requirements for the IRVS Database are as follows:

- Pentium 4 or equivalent processor
- Windows XP or later
- MS Access Runtime or MS Access 2007 or later
- MS Excel 2007 or later
- 256 MB of RAM
- Adobe Reader

The database has a plotting function that displays site coordinates and IRVS information on a digital map if the computer has an external mapping program that is capable of displaying a Keyhole Markup Language (KML) file. KML is an XML-based language that is used to display three-dimensional spatial data in mapping programs such as Google Earth.



Section 3

4. Installation

The database should be installed on a computer at the organization's headquarters (this copy will become the Master Database) and also on a laptop that will be used in the field (this copy will become the Field Database).

The installation steps are as follows:

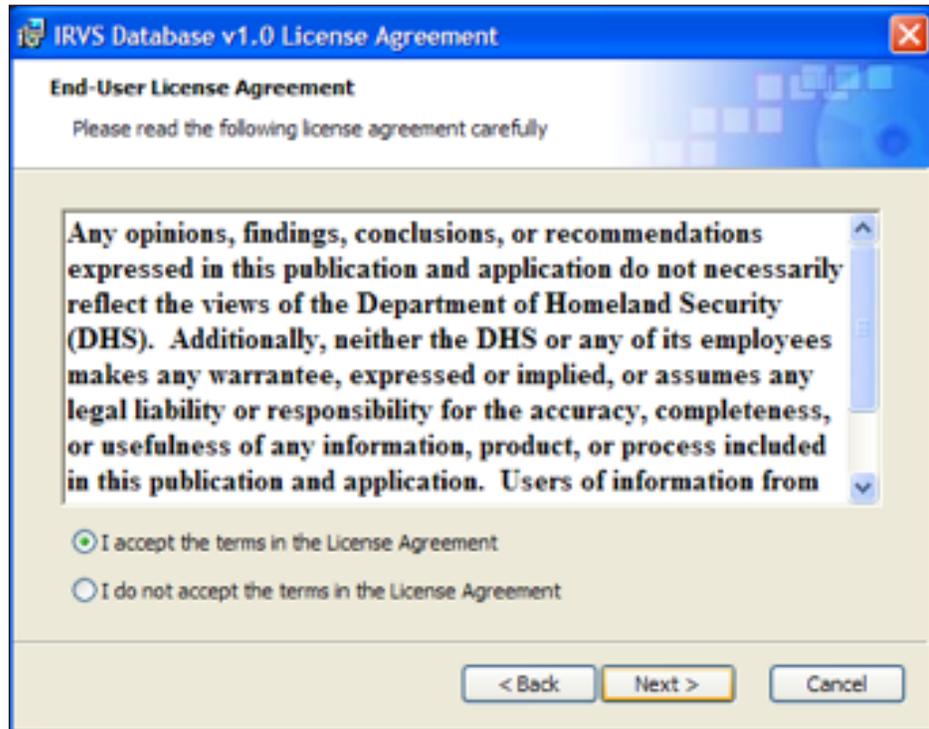
1. If you have already downloaded the software, find the SETUP.EXE file by selecting **Start** at the bottom left of the Windows screen, then selecting **Run**, and then typing the location of the SETUP.EXE file (i.e., CD, C:/Temp, or another location on the hard drive). When you have found the SETUP.EXE file, skip to Step #3. If you have not downloaded the program, go to Step #2.
2. Go to the DHS Web site at <http://www.dhs.gov/files/programs/scitech-bips-tools.shtm> and follow the instructions for downloading the software.
3. **Close** all other programs and double click on the SETUP.EXE file.
4. The IRVS Database Setup Wizard will appear. Select **Next**.



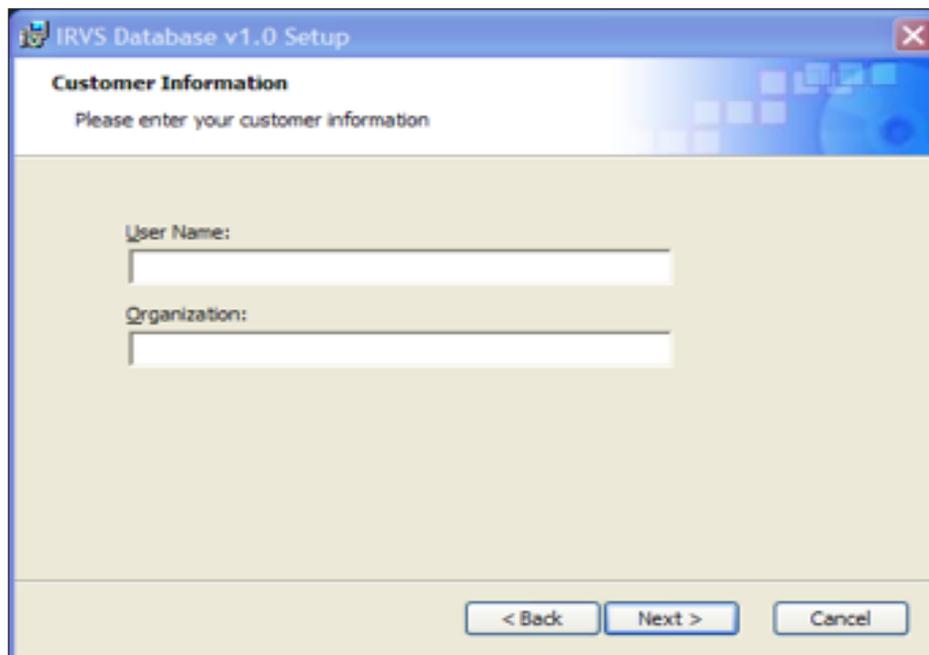
Section 4



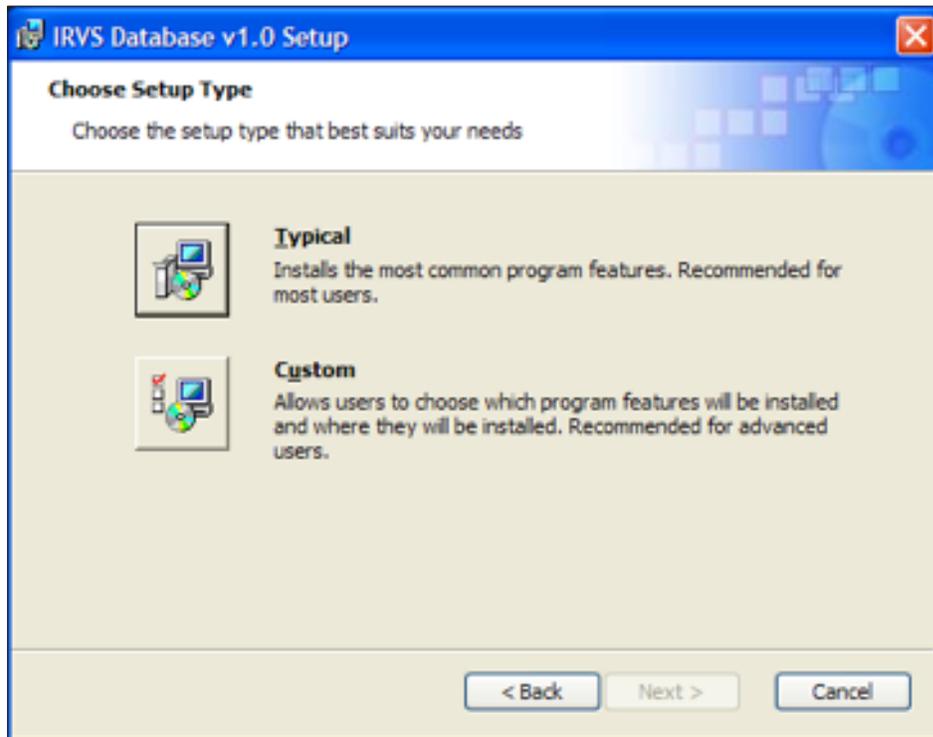
5. A screen showing the End User License Agreement will appear. Read the agreement, select **I Accept the terms of the License Agreement** and **Next**.



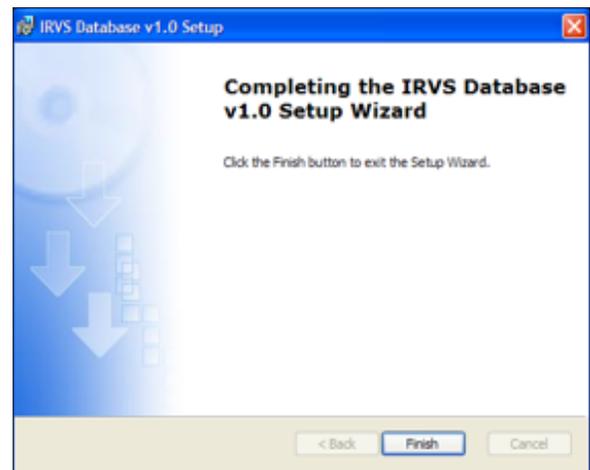
6. The Customer Information menu will appear. Fill in the user name and organization. Select **Next**.



- The Choose Setup Type menu will appear. In most cases you should follow the Typical Installation. The Custom Installation allows the user to change the file name and/or file location. This may be a requirement under an organization's security policy. Check with your System Administrator as needed. Select **Typical** or on Custom, as directed by your system administrator, which will make Next selectable, and then select **Next**.



- The Ready to **Install** menu will appear. Select Install. The amount of time required for the installation depends on the computer.
- When the installation is complete, the screen below will appear. Select **Finish**.



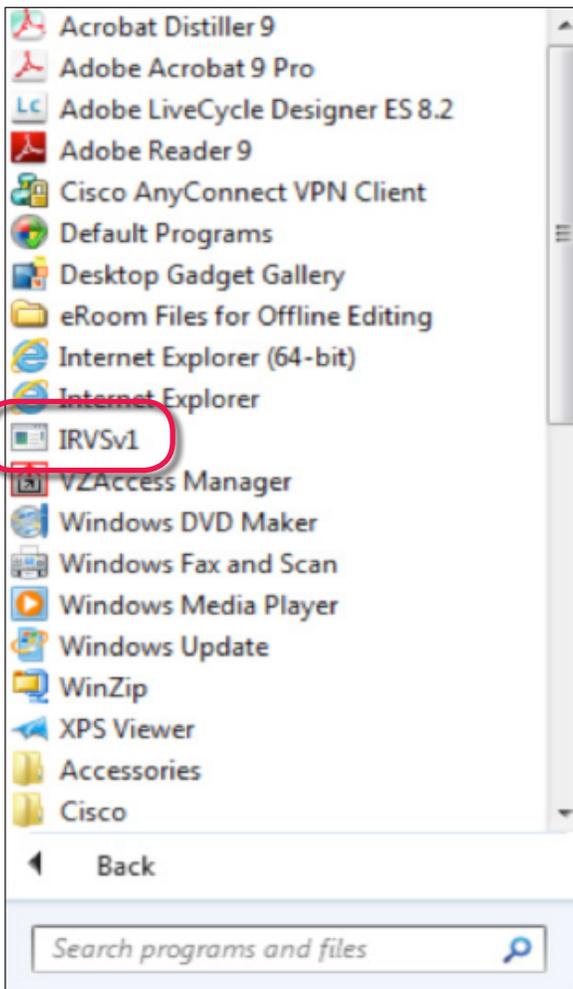


Section 5

5. Logging On

This section explains how to log on using a preloaded or assigned user name and password. Assigning user names is an administrative function that is available only to those with permission to access administrative functions. See Section 10.6.2 for instructions on assigning user names.

1. Double click on the desktop icon for the IRVS Database that was created during the installation or click the **Start button** and then **All Programs/IRVS Database**. The database may also be opened by double clicking the database file (file name: iRVSV1b.accdr) in the newly



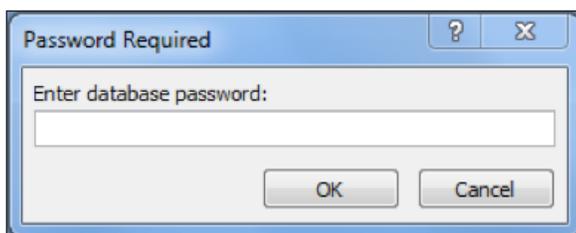
created IRVS folder. Note: this is a MS Runtime file so it cannot be opened after starting MS Access.

2. The database may also be opened by double clicking the database file (file name: **iRVSV1b.accdr**) in the newly created IRVS folder. Note: this is a MS Runtime file so it cannot be opened after starting MS Access.

Reminder: the generic database password is: **IRVS2011**.

After entering the database password select **OK.**, and the Login Screen displays.

3. In the **Logon** menu, if you don't have an assigned user name, skip to Step #4. If you have an assigned user name, enter it. Leave the password blank. Select OK. You will be asked to create a password. Follow the instructions in Steps #5 and #6 below). Create the password and skip to Section 7.
4. If you don't have an assigned user name, use one of the following preloaded user names and passwords:



User Name	Password
Administrator	Administrator
Assessor	Assessor
Editor	Editor
Reader	Reader

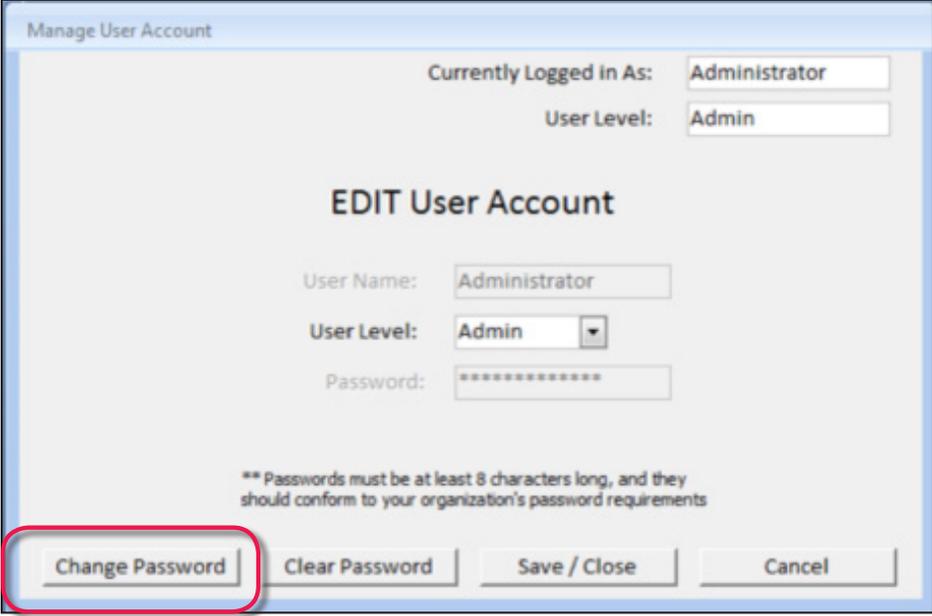


The Administrator user name/password allows you to access the administrative functions, which include establishing new user accounts and passwords. See Section 9 for information on administrative functions. You must have permission to log on as an Administrator.

5. Select **Continue**.
6. The **Main Menu** of the database will appear. Select **Change Passwords**, and the **EDIT User Account** screen will appear.

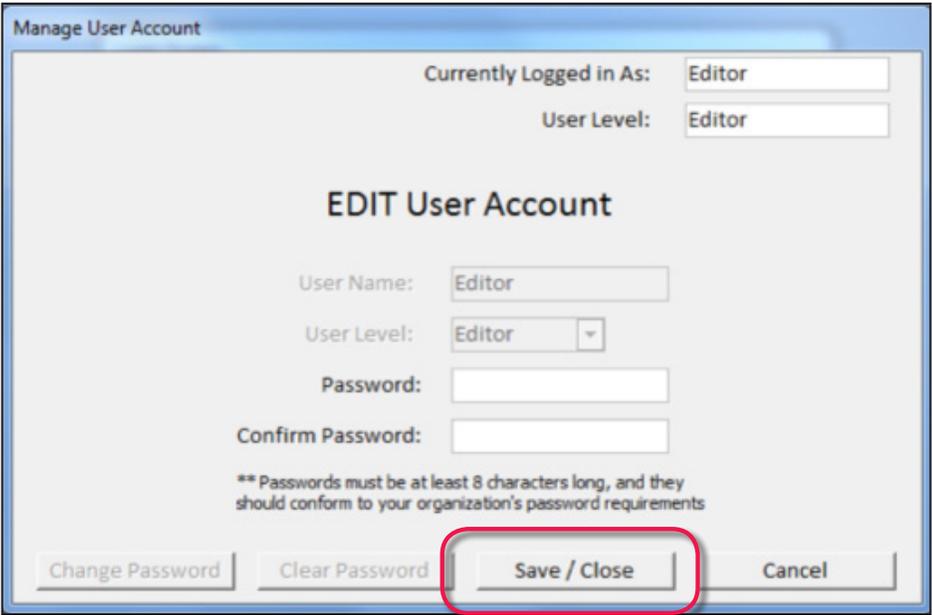


7. In the **EDIT User Account** screen, the user name you used will be populated in the **Currently Logged in AS:** field. Also displayed will be your user level. Select **Change Password**.



The screenshot shows a window titled "Manage User Account" with a sub-header "EDIT User Account". At the top right, there are two fields: "Currently Logged in As:" with the value "Administrator" and "User Level:" with the value "Admin". Below these, the "EDIT User Account" section contains three fields: "User Name:" with "Administrator", "User Level:" with a dropdown menu showing "Admin", and "Password:" with a masked field of asterisks. A note at the bottom states: "** Passwords must be at least 8 characters long, and they should conform to your organization's password requirements". At the bottom of the window, there are four buttons: "Change Password", "Clear Password", "Save / Close", and "Cancel". The "Change Password" button is highlighted with a red circle.

8. In the new **EDIT User Account** screen, enter a new password in the **Password** field, following the instructions at the bottom of the screen. Retype the new password in the **Confirm Password** field. To cancel, select **Cancel**. To set the password, select **Save / Close**. After setting the password, you will be prompted to login using the new password.



The screenshot shows a window titled "Manage User Account" with a sub-header "EDIT User Account". At the top right, there are two fields: "Currently Logged in As:" with the value "Editor" and "User Level:" with the value "Editor". Below these, the "EDIT User Account" section contains four fields: "User Name:" with "Editor", "User Level:" with a dropdown menu showing "Editor", "Password:" with an empty field, and "Confirm Password:" with an empty field. A note at the bottom states: "** Passwords must be at least 8 characters long, and they should conform to your organization's password requirements". At the bottom of the window, there are four buttons: "Change Password", "Clear Password", "Save / Close", and "Cancel". The "Save / Close" button is highlighted with a red circle.

6. Creating and Editing Screening Records

1. From the **Main Menu**, select **Rapid Visual Screening**.

The **IRVS Record Listing** screen will appear (shown on next page). The screening records that are already in the database, if any, will be listed. You can use the **IRVS Record Listing** screen to create an IRVS screening record and review or edit existing records. Screening records can be deleted only by users with access to administrative functions (see Section 9.2).

A screening record includes the facility name, facility identification, address, site type, sector and subsector, facility importance, and geographical coordinates.



Section 6



The screenshot shows the 'IRVS Record Listing' interface. At the top, there is a search bar with fields for Facility Name, Facility ID#, Screening No. / Date, Screening Comments, City, State, Site Type, Sector, and Subsector. Below the search bar is a table with columns for Facility Name, Facility ID#, Screening No. / Date, Screening Comments, City, State, Site Type, Sector, Subsector, Facility Importance, and Summary Computed. The first row contains the following data: HIC, 00023, 01, 6/15/2011, Springfield, VA, Building, Defense Industrial Base, Information Technology Indus, High, and a checked box. Below the table is a row of buttons: Add New Site, Site ID, Address, Coordinates, Pre-field Questions, Site Evaluation, Site Summary, Exec Sum/POC/Photos/GIS, and Help. Below that is another row of buttons: View All Summaries (Filtered List), Plot (Filtered List), Print Question Details (Filtered List), Print Question Details (Selected Assessment), Print All Details (Selected Assessment), Print Risk Summary (Selected Assessment), and Close. The 'Close' button is highlighted with a red box. At the bottom, there is a status bar showing 'Record: 1 of 1' and a search filter.

- To create a screening record, select **Add New Site**, which will bring up the **IRVS Site Record** screen.

This screenshot is identical to the previous one, showing the 'IRVS Record Listing' interface. In this version, the 'View All Summaries (Filtered List)' button in the bottom row of buttons is highlighted with a red box. The 'Close' button remains highlighted with a red box as well.

- In the **IRVS Site Record** screen, complete the following fields: **Facility Name** (required), **Facility ID#** (if applicable), **Org. Name** (name of the organization that owns the facility), **Address**, **City**, and **Zip**. For **State**, select the two-letter abbreviation from the dropdown menu or type in the two-letter abbreviation.

The screenshot shows the 'IRVS Site Record' form. The 'Facility Name' field is filled with 'Building ABC'. Other fields include 'Facility ID#', 'Org. Name', 'Address1', 'Address2', 'City', 'State', 'Zip', 'Site Type' (Building), 'Subsector', 'Default Facility Image' (No Image Available), and 'Facility Importance'. Below the form is a table for 'Assessment(s)' with columns for Assessment Number, Assessment Date, Assessment Comments / Notes, Assessment Folder Name, and Enter By. The first row contains the following data: 01, [blank], [blank], [blank], and [blank]. Below the table are two buttons: 'Create additional (blank) assessment record for this site' and 'Create a duplicate of Screening [01] including scoring'. At the bottom, there is a status bar showing 'Record: 1 of 1' and a search filter. A 'Required Field(s)' button and a 'Close' button are also visible.

4. For the **Default Facility Image**, select a photo from the dropdown list of photos in the database for this site, if any. The photo will display on this screen when the record is opened. See Section 7.7 for instructions on adding photos.
5. Describe the facility under **Facility Descriptive Text** (e.g., Building ABC is a three-story commercial office property. The first floor has a lobby and offices for building management. The second and third floors have office space that is leased to several organizations.).
6. Select a **Sector** and **Subsector** from the dropdown lists.
7. Select the **Facility Importance** from the dropdown list (High, Medium, Low). There are no predefined criteria for this ranking. This field simply provides an additional way to filter screening records.
8. Select the **Site Type** (required) from the dropdown list (Building, Mass Transit Station, Tunnel).
9. Type in the **Assessment Date** (required) and assessments notes as needed.
10. Select **Create additional (blank) assessment record for this site** to create a new blank record for this site.
11. Select **Create a duplicate of Assessment [number] including scoring** to create a duplicate record that includes evaluation data for use in analysis or a “what if” investigation. For example, an organization may conduct a screening and based on the results, want to decide whether to implement protective measures. The duplicate assessment can be used to predict how the protective measures would affect the risk scores by changing the relevant attributes.

IRVS Site Record

Facility Name *: Default Facility Image: 

Facility ID#: Facility Descriptive Text:

Org. Name:

Address1:

Address2:

City: St:

Zip: Sector: Facility Importance:

Site Type*: Subsector:

Assessment(s) Coordinates

Assessment Folder Name:

Assessment Number	Assessment Date *	Assessment Comments / Notes	Assessment Folder Name	Enter By
▶ 01	3/10/2011	Primary site	Assessment_01_2011-03-10\	assessc

Record:

* Required Field(s) For Help, Press the F1 Key

- Select **Coordinates** to record the coordinates of the screening site and to plot them on a mapping program. Your computer must have an installed mapping program that can read KML files, such as Google Earth, to plot the coordinates on a map. The mapping tool not only enhances the screening evaluation process but also supports risk analysis and post-screening mitigation planning.

The screenshot shows the 'IRVS Site Record' form. The 'Facility Name' is 'Test 2', 'Facility ID#' is 'Test 2', 'Org. Name' is 'HIC', 'Address1' is '1111', 'Address2' is '1111', 'City' is 'Springfield', 'St.' is 'VA', 'Zip' is '11111', 'Sector' is 'Healthcare and Public Health', 'Facility Importance' is 'Primary', 'Site Type' is 'Building', and 'Subsector' is 'Direct Patient Healthcare'. The 'Assessment(s)' section has 'Coordinates' selected. Below this is a table with one row: '01' | '3/10/2011' | 'Primary site' | 'Assessment_01_2011-03-10\' | 'assessc'. There are buttons for 'Create additional (blank) assessment record for this site' and 'Create a duplicate of Assessment [01] including scoring'. At the bottom, there are navigation controls and a 'Close' button.

- Enter the site's latitude and longitude coordinates, as explained below. You can add multiple plot points by selecting **Add coordinates for this site**. The database automatically assigns a point number to each plot.

The screenshot shows the 'IRVS Site Record' form with the 'Coordinates' tab selected. A red box highlights the instructions: '* Enter coordinates in either DD:MM:SS.##-x format or in: Decimal Degrees ###.####'. Below this is a table with columns: 'Point Number', 'Lat DD:MM:SS.##-N', 'Long DDD:MM:SS.##-W', 'Lat Dec. Deg.', 'Long Dec. Deg.', and 'Comment'. The first row contains: '1' | '38:55:42.79-N' | '077:00:40.18-W' | '38.92855' | '-77.01116' | 'West side'. Below the table are buttons for 'Add coordinates for this site', 'Plot These', and 'Lat/Long Help'. At the bottom, there are navigation controls and a 'Close' button.

Enter the coordinates in one of the following formats:

- Degrees-minutes-seconds (first two boxes). The decimal-degree equivalents will automatically populate the second two boxes. Values in the decimal-degree format are used to create the KML file for display in Google Earth or other visualization program.
- Decimal-degree values (second two boxes).

14. Select **Plot These** to create a map showing the location of the screening site. As noted above, the map can be created only if your computer has an installed mapping program that can read KML files.

IRVS Site Record

Facility Name *: Test 2 Default Facility Image: bldg1.jpg

Facility ID#: Test 2 Facility Descriptive Text:

Org. Name: HIC

Address1: 1111

Address2: 1111

City: Springfield St: VA

Zip: 11111 Sector: Healthcare and Public Health Facility Importance: Primary

Site Type*: Building Subsector: Direct Patient Healthcare

Assessment(s) Coordinates

* Enter coordinates in either **DD:MM:SS.##-x** format or in: **Decimal Degrees ###.####**

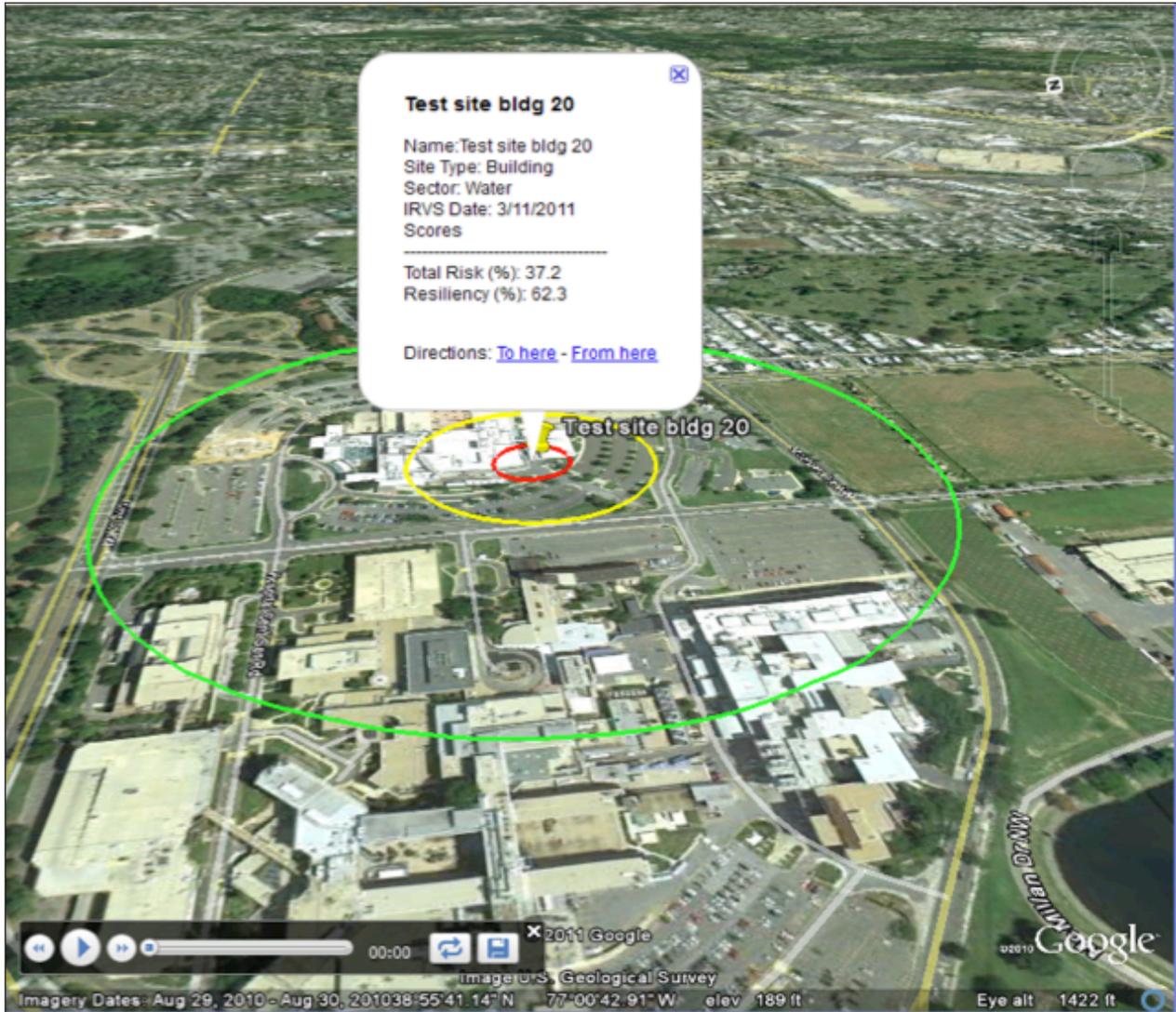
Point Number	Lat DD:MM:SS.##-N	Long DDD:MM:SS.##-W	Lat Dec. Deg.	Long Dec. Deg.	Comment
1	38:55:42.79-N	077:00:40.18-W	38.92855	-77.01116	West side

Add coordinates for this site **Plot These** Lat/Long Help

Record: 1 of 1 Search

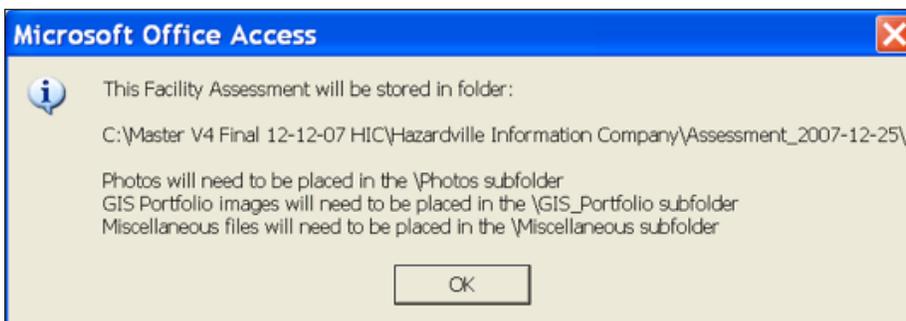
* Required Field(s) For Help, Press the F1 Key Close

The map will display 100-foot, 300-foot, and 1,000-foot rings (to visualize the target zones) around the site and the screening information that is shown in the map below. Mass transit stations and tunnels are evaluated using only 300-foot and 1000-foot target zones. Risk and resiliency scores will not display until the scores have been calculated.



15. When you have finished entering the information for the screening record, select **Close** on the bottom right of the **IRSV Site Record** screen. Information about where the record will be stored will appear in the message box shown below. Note the information about the three subfolders (Photos, GIS_Portfolio, and Miscellaneous).

If you changed the program's location using Custom Installation, note the file path of these subfolders because you will need the file path to load and link the contents of the subfolders to other copies of the database.



16. Select **OK**. The file path will be listed in the **Assessment Folder Name** field, which you will see the next time you open the record.

The screenshot shows the 'IRVS Site Record' form. The 'Assessment(s)' tab is active. The 'Assessment Folder Name' field is highlighted with a red circle, containing the path 'C:\IRVSv1\Test 2\Assessment_01_2011-03-10\'.

Assessment Number	Assessment Date *	Assessment Comments / Notes	Assessment Folder Name	Entered By
01	3/10/2011	Primary site	Assessment_01_2011-03-10\	assessac

17. Select **Close** to return to the previous screen.

7. Conducting a Screening

After you have created an IRVS site record, you are ready to start the screening. The steps in the screening are as follows:

- Entering the pre-field data
- Conducting the onsite evaluation
- Generating the risk and resiliency scores
- Creating an executive summary
- Adding points of contact
- Adding the Assessment Team Members
- Adding GIS images (optional)
- Adding miscellaneous information (optional)
- Exporting the screening data to transfer media from the Field Database
- Erasing the screening record from the Field Database

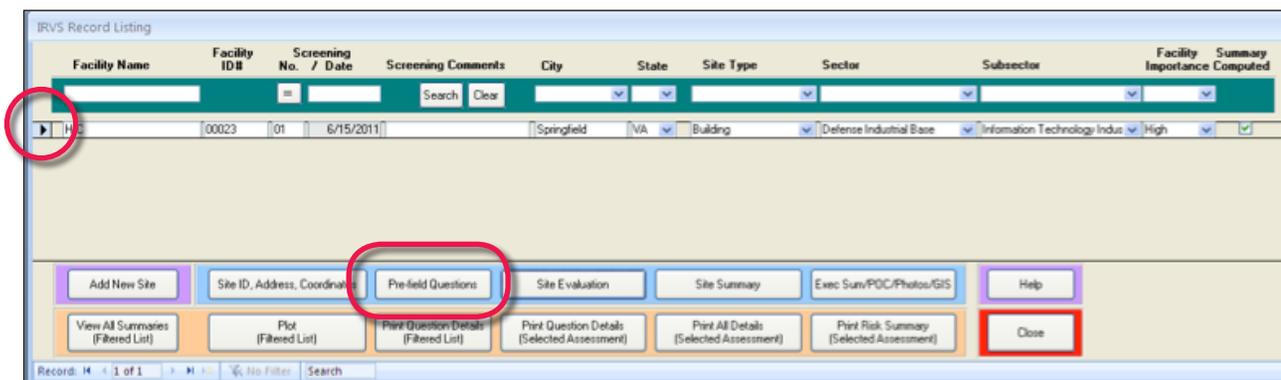


Section 7

7.1 Entering the Pre-Field Data

Pre-field data include basic information about the site and its target density. Screeners should try to obtain as much pre-field data as possible to ensure that the risk and resiliency scores are as accurate possible. Pre-field data can be obtained on the Internet and from various private sources.

1. In the **IRVS Record Listing** screen, select the record of the site to be screened by clicking the far left column in the row with the record.
2. Select **Pre-Field Questions** to open the **IRVS Site Scoring** screen.



Pre-field data differ according to the site type, as follows:

- For buildings, the **Pre-Field Questions** screen has questions under three tabs: **Hazards**, **Pre-Field Questions**, and **Structure Type** (as shown below). For more information about these tabs, see Sections 7.1.1, 7.1.2, and 7.1.3.
 - For mass transit stations and tunnels, the **Pre-Field Questions** screen has only one tab: the **Pre-Field Questions** tab. For more information about the **Pre-Field Questions** tab, see Section 7.1.1.
3. For each question in the **Question** column, select the appropriate choice by selecting one of the choices in the dropdown list in the **Choice** column. If you want to change your answer, select **X** in the **Clear Choice** column to clear your answer. Clearing an answer will not affect the **Red Flag**, **Unk** (unknown), or **Comments** columns.
 4. If you need more information about a question, select **Current Question Help [F1]** on the bottom right of the screen, and for more information about a natural hazard, select **Natural Hazard Help** on the bottom right of screen.

iRVS Site Scoring

RVS Building/Facility: Organization:

Site Type:

Assessment Date:

Hazards | Pre-Field Questions | Structure Type

Question	Clear Choice	Choice	Red Flag	Unk	Comments
<input checked="" type="checkbox"/> Hazard: Blast	<input checked="" type="checkbox"/>	<input type="text" value="Blast"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
<input checked="" type="checkbox"/> Hazard: CBR	<input checked="" type="checkbox"/>	<input type="text" value="CBR"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
<input checked="" type="checkbox"/> Hazard: Seismic	<input checked="" type="checkbox"/>	<input type="text" value="Seismic"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
<input checked="" type="checkbox"/> Hazard: Flood	<input checked="" type="checkbox"/>	<input type="text" value="Flood"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
<input checked="" type="checkbox"/> Hazard: Wind	<input checked="" type="checkbox"/>	<input type="text" value="Wind"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
<input checked="" type="checkbox"/> Hazard: Fire	<input checked="" type="checkbox"/>	<input type="text" value="Fire"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
<input checked="" type="checkbox"/> Resiliency Computations (Required Question)	<input checked="" type="checkbox"/>	<input type="text" value="Medical"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>

Record:

5. If you think there's a concern that requires immediate attention, click the box under the **Red Flag** column. You will be asked to enter a comment that supports your decision to red flag the item. Type in the comment and select **Save**. To remove a red flag, select the red flag.
6. If you don't know the answer, click the box under the **Unk** (unknown) column. You can add the information when you obtain it. To remove a checkmark, select the checkmark.
7. If you want to add information (e.g., about an unusual circumstance), select the box in the **Comment** column to add information. When you select the box, a comment box will appear. Enter your comments and select **Save**. To remove a comment, select the box in the Comment column. Delete the comment and select **Save**. The box will no longer be marked.
8. Answer as many questions as possible. For buildings, answer the questions under all three tabs (**Hazards, Pre-Field Questions, and Structure Type**). For more information about the tabs, see Sections 7.1.1, 7.1.2, and 7.1.3.
9. For a printable version of the answers to the pre-field data questions, select **Print Question Details**. Select **Print** at the top left to print the answers and **Close Print Preview** at the top right to return to the previous menu.
10. Select **Close** to return to the previous menu.

iRVS Site Scoring

RVS Building/Facility: Organization:

Site Type:

Assessment Date:

Hazards Pre-Field Questions Structure Type

Question	Clear Choice	Choice	Red Flag	Unk	Comments
<input checked="" type="checkbox"/> Hazard: Blast	<input checked="" type="checkbox"/>	<input type="text" value="Blast"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: CBR	<input checked="" type="checkbox"/>	<input type="text" value="CBR"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Seismic	<input checked="" type="checkbox"/>	<input type="text" value="Seismic"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Flood	<input checked="" type="checkbox"/>	<input type="text" value="Flood"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Wind	<input checked="" type="checkbox"/>	<input type="text" value="Wind"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Fire	<input checked="" type="checkbox"/>	<input type="text" value="Fire"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Resiliency Computations (Required Question)	<input checked="" type="checkbox"/>	<input type="text" value="Medical"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Record: 1 of 7 No Filter Search

View Summary Print Question Details Print Risk and Resiliency Summary Natural Hazard Help Current Question Help (F1) Close

7.1.1 Hazards Tab (Building Site Type Only)

The hazards that you select for a building affect the questions in the **Pre-Field Questions** tab and the hazards that included in the risk analysis. Complete the questions in the Hazards tab before completing the other two tabs for a building site type.

For information about natural hazards, select **Natural Hazard Help** at the bottom of the **IRVS Site Scoring** screen and select the hazard you need information about in the dialog box that appears.

iRVS Site Scoring

RVS Building/Facility: Organization:

Facility ID#: Screening#:

Site Type:

Screening Date:

Hazards Pre-Field Questions Structure Type

Question	Clear Choice	Choice	Red Flag	Unk	Comments
<input type="checkbox"/> Hazard: Blast	<input checked="" type="checkbox"/>	<input type="text" value="Blast"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/> Hazard: CBR	<input checked="" type="checkbox"/>	<input type="text" value="CBR"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Seismic	<input checked="" type="checkbox"/>	<input type="text" value="Seismic"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Flood	<input checked="" type="checkbox"/>	<input type="text" value="Flood"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Wind	<input checked="" type="checkbox"/>	<input type="text" value="Wind"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Hazard: Fire	<input checked="" type="checkbox"/>	<input type="text" value="Short fire vulnerabilities checklist"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Resiliency Computations (Required Question)	<input checked="" type="checkbox"/>	<input type="text" value="Business / Financial"/>	<input type="checkbox"/>	<input type="checkbox"/>	

View Summary Print Question Details Print Risk and Resiliency Summary Natural Hazard Help Current Question Help (F1) Close

- In the **IRVS Site Scoring** screen, select the **Hazards** tab and select the hazards that may affect the building you are screening by selecting the hazard from the dropdown menu in the Choice column. The possible hazards are blast; chemical, biological, and radiological (CBR); seismic; flood; wind; and fire. Under the question column, left click on the row of a Hazard you want to use in the process and the arrowhead on the left side of the form moves to that row and the row is designated for change. Then select the down arrowhead in the Choice column to produce a drop down list of possible answers. Select the name of the hazard to include it in the screening or select on the blank row to not include it in the screening. The IRVS screening is adjusted based on which Hazards are selected. At the completion of this form, the database automatically tailors the IRVS question set and grays out un-needed questions. Only those hazards selected are included in the risk analysis.



The sixth hazard listed, **Hazard: Fire** has additional choices to tailor the IRVS screening. The three choices for this hazard are listed below:

- **Short fire vulnerabilities checklist.** Fire Tab 1, which has a few fire-related questions, will be displayed in the site evaluation if this is selected.
 - **Fire marshal's list – Longer list – includes all short list attributes.** Fire Tab 2 will be displayed in the site evaluation if this is selected and has more fire-related questions than the short fire vulnerabilities checklist. Choose this selection if you want the longer list of questions.
 - **Blank space.** Choose this selection if you do not want to include the fire hazard in the screening.
- For **Resiliency Computations (Required Question)**, select one of the options listed below, which refer to the type of facility being screened. Each option provides a form in the site evaluation for Continuity of Operations.
 - **No resiliency computations are needed.** If you select this answer, resiliency will not be scored. Choose this if stakeholders are not concerned about the continuity of operations after a disaster.

- **General.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen general facilities such as commercial, agricultural, educational, and industrial. A Continuity – General tab will appear during the scoring.
- **Government.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen government facilities such as offices, police stations, fire stations, and emergency operations centers. A Continuity – Government tab will appear during the scoring.
- **Medical.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen medical facilities. A Continuity – Medical tab will appear during the scoring.
- **Schools (K-12).** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen school facilities. A Continuity – School (K-12) tab will appear during the scoring.
- **Business/Financial.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen business/financial facilities. A Continuity – Finance/Business tab will appear during the scoring.
- **Retail.** If you select this answer, the resilience section (Continuity of Operations) will be tailored to screen retail facilities. A Continuity – Retail tab will appear during the scoring.

7.1.2 Pre-Field Questions Tab (All Site Types)

1. In the **IRVS Site Scoring** screen, select the **Pre-Field Questions** tab. A list of questions based on the site type (mass transit station, building, or tunnel) will appear. For the building site type only, pre-field questions depend on which hazards were selected under the Hazards tab. The pre-field questions that are not needed will be grayed out and will not be included in the risk analysis.
2. The Pre-Field Tab contains a special Help button labeled **Target Density Worksheet** at the top of the question list. This Help button is specific to three questions on the Tab
 - Pre-Field Question 5: Target Density Zone I (<100ft)
 - Pre-Field Question 5: Target Density Zone II (100 to 300ft)
 - Pre-Field Question 5: Target Density Zone III (300 to 1,000ft)

IRVS Site Scoring

RVS Building/Facility: Organization:

Facility ID#: Screening#:

Site Type:

Screening Date:

Hazards: Pre-Field Questions Structure Type

Question	Target Density Worksheet	See Plotted Coord.	Clear Choice	Choice	Red Flag	Unk	Comments
PF-1: Number of Occupants			X	100 - 500			
PF-2: Replacement Value			X	\$1M - \$5M			
PF-3: Registered Historic Site			X	No			
PF-4: Occupancy Use			X	Occupancy Group II			
PF-5 Target Density: Zone I (<100 ft) [See Target Density Worksheet at Top]			X	> 4			
PF-5 Target Density: Zone II (100 to 300 ft) [See Target Density Worksheet at Top]			X	4-6			
PF-5 Target Density: Zone III (300 to 1,000 ft) [See Target Density Worksheet at Top]			X	13-19			
PF-6: Target Potential: Facility			X	Yes			
PF-6: Target Potential: Sector			X	Yes			
PF-7: Seismic Zone			X	Medium			
PF-8: Geology (Nearby Seismic Faults)			X	Near Fault			
PF-9: Floodplain			X	Yes			
PF-10: Maximum Previous Flood Depth			X	Never in the past			
PF-11: Duration of Previous Flood			X	Never in the past			

Record: 1 of 20 | No Filter | Search

View Summary | Print Question Details | Print Risk and Resiliency Summary | Natural Hazard Help | Current Question Help (F1) | Close

Responses to these three questions can either be entered from the drop-down menu of each question or the assessor can use the Target Density Zone Worksheet to answer the questions.

IRVS Site Scoring

RVS Building/Facility: Organization:

Facility ID#: Screening#:

Site Type:

Screening Date:

Hazards: Pre-Field Questions Structure Type

Question	Target Density Worksheet	See Plotted Coord.	Clear Choice	Choice	Red Flag	Unk	Comments
PF-1: Number of Occupants			X	100 - 500			
PF-2: Replacement Value			X	\$1M - \$5M			
PF-3: Registered Historic Site			X	No			
PF-4: Occupancy Use			X	Occupancy Group II			
PF-5 Target Density: Zone I (<100 ft) [See Target Density Worksheet at Top]			X	> 4			
PF-5 Target Density: Zone II (100 to 300 ft) [See Target Density Worksheet at Top]			X	4-6			
PF-5 Target Density: Zone III (300 to 1,000 ft) [See Target Density Worksheet at Top]			X	13-19			
PF-6: Target Potential: Facility			X	Yes			
PF-6: Target Potential: Sector			X	Yes			
PF-7: Seismic Zone			X	Medium			
PF-8: Geology (Nearby Seismic Faults)			X	Near Fault			
PF-9: Floodplain			X	Yes			
PF-10: Maximum Previous Flood Depth			X	Never in the past			
PF-11: Duration of Previous Flood			X	Never in the past			

Record: 1 of 20 | No Filter | Search

View Summary | Print Question Details | Print Risk and Resiliency Summary | Natural Hazard Help | Current Question Help (F1) | Close

2.5. Target Density

You can use this worksheet to calculate the proper selections for questions PF 5.1, 5.2, 5.3

Facility Type	Question 5.1	Question 5.1	Question 5.1
	Zone I < 100 feet	Zone II 100 - 300 feet	Zone III 301 - 1000 feet
▶ Agriculture and Food			
Banking and Finance			
Chemical and Hazardous Materials			
Commercial Facilities			
Communications			
Critical Manufacturing			
Dams			
Defense Industrial Base			
Emergency Services			
Energy			
Government Facilities			
Healthcare and Public Health			
Information Technology			
National Monuments and Icons			
Nuclear Reactors, Materials and W			
Postal and Shipping			
Transportation			
Totals:			

Clear Cancel Use

Record: 1 of 18 Filtered Search

Select the **Target Density Worksheet** button at the top of the question list and a table labeled Target Density will pop-up. The assessor can use the worksheet to calculate the proper selections for questions PF-5, and enter the exact number of facilities for each category and zone into the table. After completing the table, select the **Use** button to automatically populate the answers to the three questions.

- Complete the answers to the pre-field questions.

7.1.3 Structure Type Tab (Building Site Type Only)

- In the **IRVS Site Scoring** screen, select the **Structure Type** tab. This tab will appear only when screening a building. This tab has only one question, **Building Type**, and it is a critical question for the IRVS methodology.

- Answer the question by selecting one of the choices from the drop-down menu. For help, refer to the catalog, which can be accessed by selecting **Current Question Help [F1]** on the bottom right of the screen.

7.2 Conducting the Onsite Evaluation

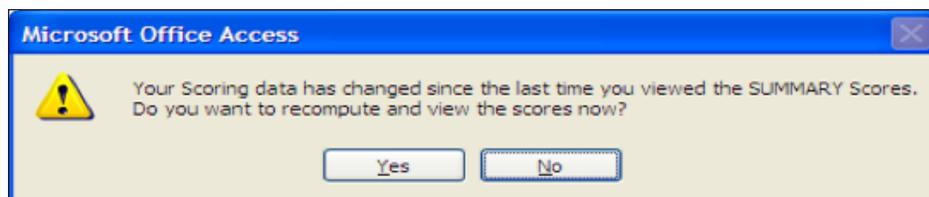
After you have answered the **Pre-Field Questions**, you are ready to record the onsite evaluation data.

- In the **IRVS Recording Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
- Select **Site Evaluation** to open the **IRVS Site Scoring** screen. The screen will have 11 to 14 tabs, depending on the site type, hazards, and resiliency selection. Questions that are not needed will be grayed out and will not be included in the risk analysis.
- Answer the questions under each tab, using the procedure that you followed to enter the pre-field data (see Section 7.1). For help with any of the questions, select **Current Question Help [F1]** on the bottom right of the screen.
- Select each of the Vulnerability tab (e.g., **Site, Architectural, Building Enclosure, Structural...**) and answer the questions.

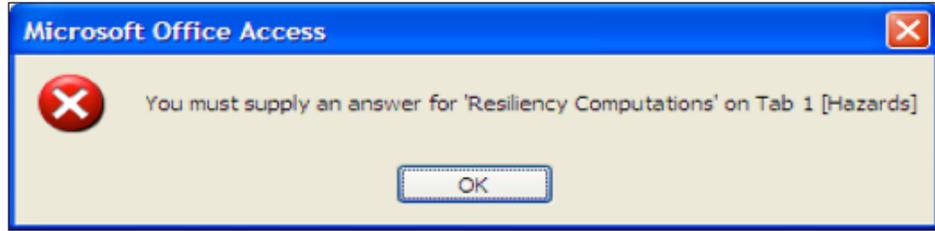
7.3 Generating the Risk and Resiliency Scores

After completing the **Pre-Field Questions** and **Site Evaluation**, you are ready to generate the risk and resiliency scores. Resilience scores will not be generated if you selected **No resiliency computations are needed** in the **Hazards** tab.

1. In the **IRVS Recording Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Pre-Field Questions** tab or **Site Evaluation** tab to open the **IRVS Site Scoring** screen.
3. Select **View Summary** to open the Risk and **Resiliency Summary** screen. If data have changed since the last time you opened **View Summary**, the message below will appear. Select **Yes**.



4. If required answers are missing, the risk and resiliency scores cannot be calculated, and a message such as the one below will appear. Select **Yes** and fill in the missing answers.



- If MS Excel is open on your computer, the risk and resiliency scores cannot be calculated, and you will be prompted to close Excel.
- If you have answered all required questions and MS Excel is not open, the database will generate the **Risk and Resiliency Summary**, as shown below. The time required to generate the summary will depend on your computer.

Risk and Resiliency Summary

RVS Building/Facility: Scales Scores and Color Mapping
 Facility ID#: Risk Color Scale 0-30 30-50 50-70 70-100
 Assessment Date: Site Type: Resiliency Color Scale 100-70 70-50 50-30 30-0

Summary Categories	Internal Intrusion	Internal Explosive	Internal CBR	Explosive Zone 1	Explosive Zone 2	Explosive Zone 3	CBR Zone 1	CBR Zone 2	CBR Zone 3
Total Consequences (scale of 100)	38.3	41.0	45.6	37.5	38.2	37.3	39.3	39.9	38.3
Total Threat (scale of 100)	85.2	52.1	53.6	32.9	22.3	37.4	18.3	24.0	35.5
Total Vulnerabilities (scale of 100)	29.0	56.8	55.3	44.2	50.0	56.7	7.6	11.1	17.1
Total Risk (scale of 100)	34.2	44.4	48.8	34.9	28.6	37.5	15.5	18.7	24.1

Summary Categories	Earthquake General Shaking	Earthquake Ground Failure	Flood Stillwater	Flood Velocity Surge	Wind Hurricane	Wind Tornado	Wind Other	Landslide Rainfall	Fire From Earthquake	Fire From Blast	Fire From Arson
Total Consequences (scale of 100)	19.6	19.9	19.3	19.3	32.1	28.1	39.8	18.7	0.0	36.0	38.3
Total Threat (scale of 100)	5.9	10.8	2.4	3.1	37.8	34.5	38.0	23.8	0.8	48.7	62.7
Total Vulnerabilities (scale of 100)	58.8	49.2	10.6	12.6	49.7	57.9	53.5	18.9	8.4	8.9	6.5
Total Risk (scale of 100)	16.2	18.5	8.4	9.3	34.4	31.4	38.8	19.7	0.0	20.2	19.9

Resiliency Scales (1-100)					Total Score Summary All Scores based on (1-100)	
Performance Measure	Time Measure	Robustness Measure	Resourcefulness Measure	Recovery Measure	Intrusion:	
81.3	82.6	56.3	86.8	87.2	Intrusion:	34.2
					Blast (Interior):	44.4
					CBR (Interior):	48.8
					Blast (Exterior):	35.2
					CBR (Exterior):	21.8
					Seismic:	17.6
					Flood:	9.0
					Wind:	36.0
					Fire:	19.3
					Resiliency:	67.2
					Total Risk All Scenarios:	42.6

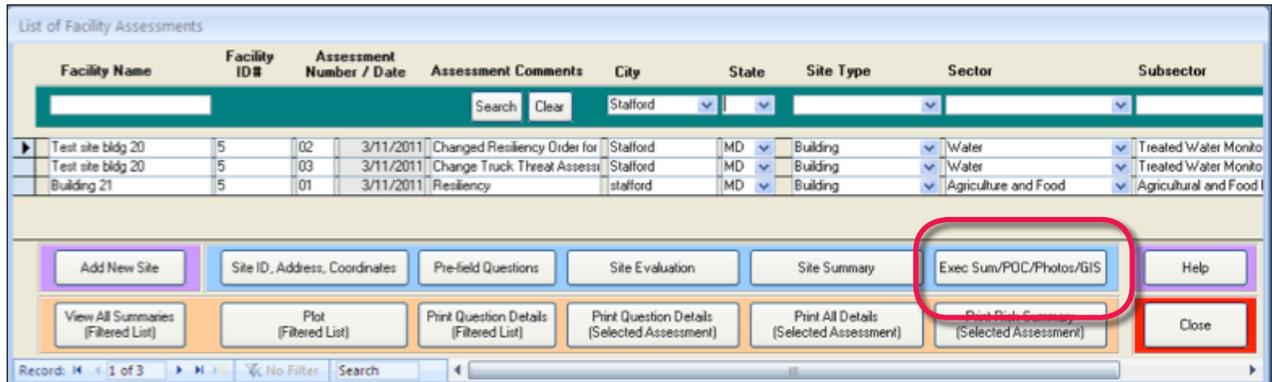
Multihazards Interaction Matrix						
... will result in this change for other hazards:						
a change in:	Blast	CBR	Seismic	Flood	Wind	Fire
a change in Blast	100.0%	16.5%	53.3%	8.8%	48.2%	9.8%
a change in CBR	10.1%	100.0%	0.0%	0.9%	0.0%	0.0%
a change in Seismic	25.8%	0.0%	100.0%	26.2%	49.4%	3.7%
a change in Flood	5.7%	1.0%	35.4%	100.0%	14.1%	7.0%
a change in Wind	27.3%	0.0%	57.8%	12.2%	100.0%	3.9%
a change in Fire	7.1%	0.0%	5.5%	7.8%	5.1%	100.0%

Print Close

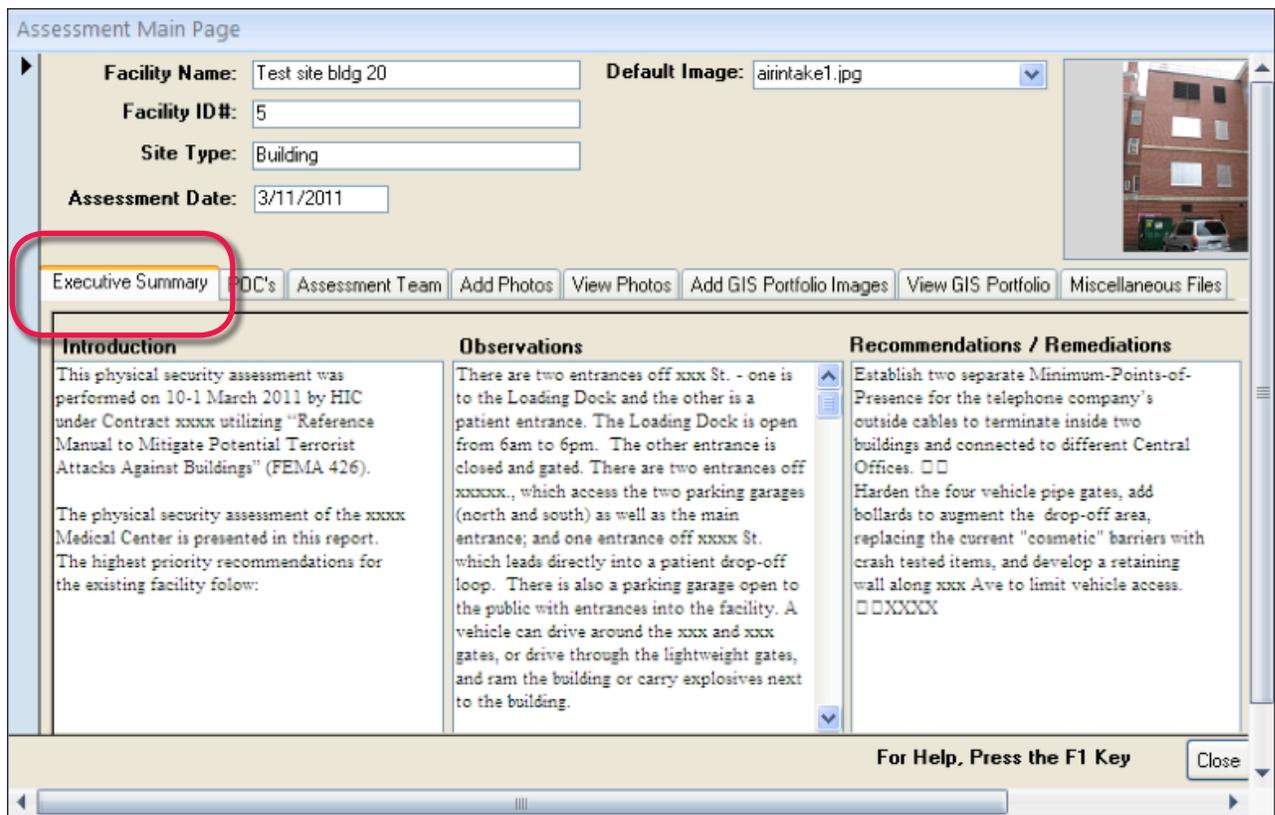
- Select **Close** to return to the previous screen.

7.4 Creating an Executive Summary

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select **Exec Sum/POC/Photos/GIS**.



3. Select the **Executive Summary** tab if the three sections of the Executive Summary don't automatically appear.



4. Enter information in the **Introduction, Observations, and Recommendations/Remediation** sections. The introduction usually contains the facility name, facility location, screening date, and other relevant background information.

Select **Close** to return to the **IRVS Record Listing** screen form or select another tab.

7.5 Adding Points of Contact

Points of contact (POCs) are people you identified or met during the screening and who may need to be contacted later for more information.

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select **Exec Sum/POC/Photos/GIS**.
3. Select the **POCs** tab.
4. To add a POC, select the **Add New POC** tab.

The screenshot shows the 'Assessment Main Page' with the following details:

- Facility Name: Test site bldg 20
- Facility ID#: 5
- Site Type: Building
- Assessment Date: 3/11/2011
- Default Image: aiintake1.jpg

The 'POCs' tab is selected in the navigation bar. Below it is a table of existing POCs:

First Name	Last Name	Title	Organization	Address	City	State	Zip
Joyce	Smith	Ms.	HIC 4	35 West Ave	Elba	NY	14058
Terry	Ryan	Mr.	HIC 4	35 West Ave	Elba	NY	14058

At the bottom of the page, the 'Add New POC' button is highlighted with a red circle. Other buttons include 'Delete POC: Terry Ryan' and 'Add New POC and Duplicate'. The status bar at the bottom indicates 'Record: 11 of 2 of 2' and 'No Filter'.

5. Enter information in the fields (**First Name, Last Name, Title, Organization, Address, City, State, Zip, Work Phone, Mobile Phone,**

- Email**). If not all of the fields are visible, slide the bar at the bottom of the screen or use the keyboard arrows to see the remaining fields.
- Press **Enter** or **Tab** on your keyboard to add the information to the database.
 - To edit the information for a POC, click the far left column in the row with the record and edit the information.
 - To delete a POC, select the POC by clicking the far left column in the row with the record and then selecting **Delete POC: [Name]**.
 - Since some POCs may have the same business address, you can duplicate an existing POC and use the information for the new POC that is the same for the existing POC. Click the left column of the POC with the address to be copied and then select **Add New POC and Duplicate**.
 - When you are finished adding, editing, and deleting POCs, select **Close** to return to the **IRVS Record Listing** screen or select another tab.

7.6 Adding Assessment Team Members

- In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
- Select **Exec Sum/POC/Photos/GIS**.
- Select the **Assessment Team** tab.

Assessment Main Page

Facility Name: Test site bldg 20 Default Image: bldg1.jpg

Facility ID#: 5

Site Type: Building

Assessment Date: 3/11/2011

Executive Summary POCs **Assessment Team** Add Photos View Photos Add GIS Portfolio Images View GIS Portfolio Miscellaneous Files

Team Member	Title	Organization	Work Phone	Mobile Phone	Email
▶ Jones, Bill	▼ Mr.	HIC	333.555.1234		13@www.com
Smith, Lora	▼ Ms.	HIC	333.555.1235		14@www.com
Smith, Terry	▼ Mr.	HIC	333.555.1236		15@www.com

Select Team Member from List Add New Team Member Delete Team Member: Jones, Bill

Record: 1 of 3 No Filter Search

For Help, Press the F1 Key Close

Add a new person to this Team

Add New Person

First Name:

Last Name:

Title:

Company:

Address:

City:

State:

Zip:

Email:

Work Phone:

Mobile Phone:

Entered By:

Enter Date:

Modified By:

Modify Date:

For Help, Press the F1 Key

4. Select **Add New Team Member** and complete the information.
5. To select a Team Member from a list of team members in other records, select **Select Team Member from List**. The user must add at least one new team member before using this function.
6. To delete a Team Member, select the Team Member by clicking the far left column in the row with the record and then selecting **Delete Team Member: [Name]**.
7. After completing the Team Member information, select **Add** to return to the previous screen. The information that you have entered should appear. Use the bar slide or keyboard arrows to see the off-screen information.
8. When you are finished adding or deleting team members, select **Close** to return to the **IRVS Record Listing** screen or select another tab.

7.7 Adding Photos, Setting the Default Image, Deleting Photos, and Viewing Photos

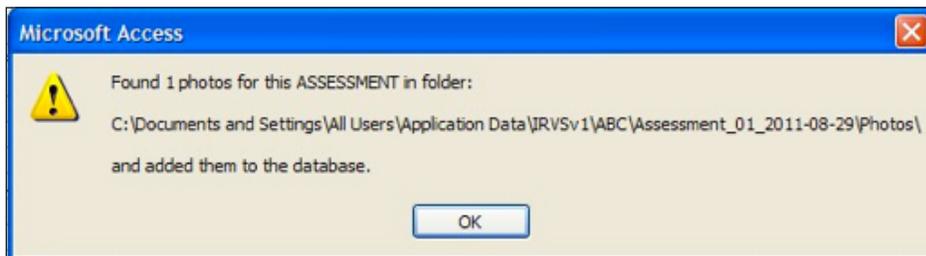
7.7.1 Adding Photos

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select **Exec Sum/POC/Photos/GIS**.
3. Select the **Add Photos** tab.
4. To add a single photo to the database, select **Copy only the selected image** if it is not already selected and select **Browse for a file**. Select the photo you want to add and select **Open**. Select **Yes** in the next menu, which lists the file name of the photo and the file path where it will be saved. The database recognizes any type of file in the "Miscellaneous" folder but only files with a "jpg," "gif," or "bmp" file extension in the "Photo" folder.
5. To add all the photos in a folder, select **Copy ALL from the folder** and select **Browse for a file**. Select the folder with the photos you want to

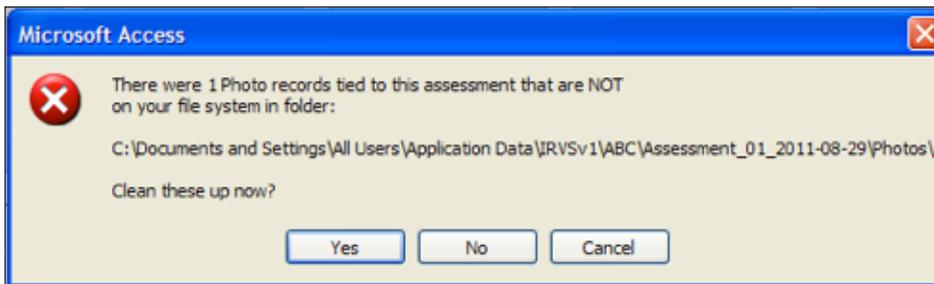
add and select **Open**. Select any file from the folder and select **Open**. Select **Yes** in the next menu, which lists the file name of the photo and the file path where it will be saved.

When the **Add Photo** or **View Photos** tabs are opened, the list of photos in the database is automatically updated after reopening the database if the photos in the subfolders that have been added to the database have changed (e.g., if you use the file manager folder where the photos for the database have been stored to modify current photos, delete photos, or add new photos; the next time you reopen the database, the list of photos will be updated).. See Section 7.7.4 for information on viewing photos.

If you add a photo using the file manager, the message below will appear. Select **OK**.



If you delete a photo using the file manager, the message below will appear. Select **Yes**.



7.7.2 Setting the Default Image

Once selected, the default image for a particular site will appear on various screens in the top right corner. The default image generally shows the screening site. It could be a photo of the building or a sign showing the name of the site. See Section 6, Step #11, for an example of a default image.

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.

2. Select the **Site ID, Address, Coordinates** tab.
3. Select one of the photos you have added in the dropdown menu in the **Default Facility Image** field at the top of the screen. The image will appear in the box at the top right of the screen.

7.7.3 Deleting Photos

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Add Photos** tab to see the list of photos in the database.
4. Select the photo you want to delete by clicking the far left column in the row with the photo. Select **Delete Photo**.
5. You will be asked to confirm that you want to delete the photo. Select **Yes**.

7.7.4 Viewing Photos

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **View Photos** tab. Thumbnails of the photos will appear.
4. To enlarge a photo, click the thumbnail of the photo and select **Zoom** or **Clip** for different view of the photo. Select **Open File** to open the Windows Picture and Fax Viewer, which allows you to rotate, enlarge, print, and save the photo.
5. If there are more than five photos in the database, use the arrows under the thumbnails to scroll through the thumbnails of the photos.

7.8 Adding GIS Images

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Add GIS Portfolio Images** tab.
4. Follow Steps #4 and #5 in Section 7.7.1.

7.8.1 Deleting GIS Images

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Add GIS Portfolio Images** tab to see the list of GIS images in the database.
4. Select the image you want to delete by clicking the far left column in the row with the photo. Select Delete GIS Portfolio Image.
5. You will be asked to confirm that you want to delete the photo. Select **Yes**.

7.8.2 Viewing GIS Portfolio Images

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **View GIS Portfolio** tab. Thumbnails of the images will appear.
4. To enlarge an image, click the thumbnail of the image and select **Zoom** or **Clip** for different view of the image. Select **Open File** to open the Windows Picture and Fax Viewer, which allows you to rotate, enlarge, print, and save the image.
5. If there are more than five GIS image in the database, use the arrows under the thumbnails to scroll through the thumbnails of the image.

7.9 Adding and Deleting Miscellaneous Information

7.9.1 Adding Miscellaneous Information

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Miscellaneous Files** tab.
4. Follow Steps #4 and #5 in Section 7.7.1.
5. To view the file, click on the file name.

7.9.2 Deleting Miscellaneous Files

1. In the **IRVS Record Listing** screen, if the record of the site you need isn't already selected, select it by clicking the far left column in the row with the record.
2. Select the **Site ID, Address, Coordinates** tab.
3. Select the **Miscellaneous Files** tab.
4. Select the file you want to delete by clicking the far left column in the row with the file. Select Delete File.
5. You will be asked to confirm that you want to delete the photo. Select **Yes**.

7.10 Exporting Screening Data

After a screening has been completed, the screening data in the Field Database must be copied and imported into the Master Database, which are administrative functions. See Section 10.

7.11 Emptying the Database

The final task in conducting a screening is to delete the screening data from the Field Database after the data have been transferred to the Master Database. This task is an administrative function. See Section 10.5.



Section 8

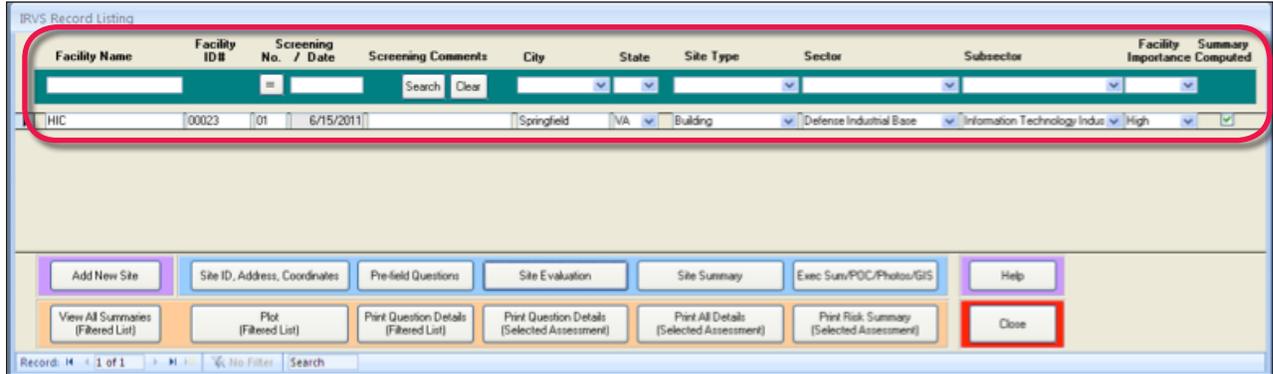
8. Filtering Records

Records can be filtered using the categories of information in a record (e.g., site type, location, sector, facility importance). After you create a filtered list of records, you can view all of the summaries of the records in the filtered list (see Section 8.1) and plot the sites of the records in the filtered list (see Section 8.2).

To filter the records in the database, follow these steps.

1. After logging on to the database, select **Rapid Visual Screening** from the **Main Menu** to open the **IRVS Record Listing** screen.
2. It is assumed that the database already contains more than one record. To filter the list of records, enter a search term or select a term from the dropdown menu in one or more of the fields at the top of the screen. For a range of dates before, after, or on a specific date, use "<" , ">" or "=". For example, if the screener wants to observe all the assessments before June 16,2011, the screener would use "<" by selecting the box to the left of the date input and selecting 6/16/2011 on the pop up calendar.

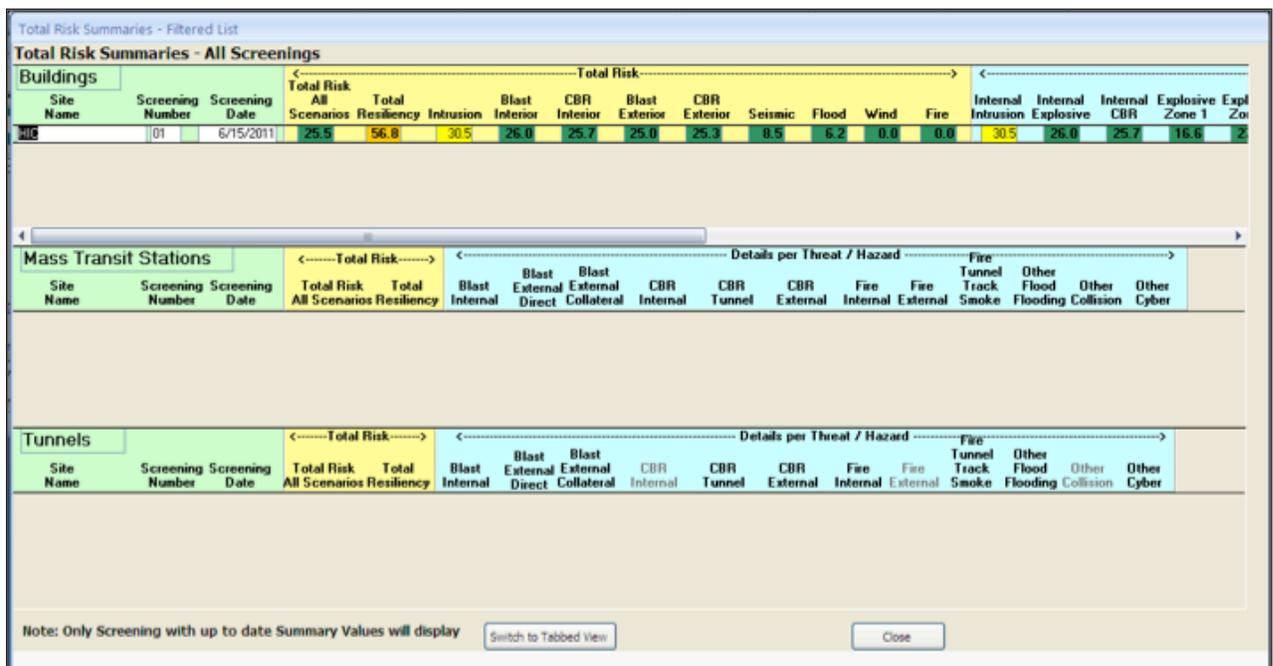
3. **Select Search.** The records that match the search will be listed.



4. To clear the search, select **Clear**.

8.1 Viewing All Summaries

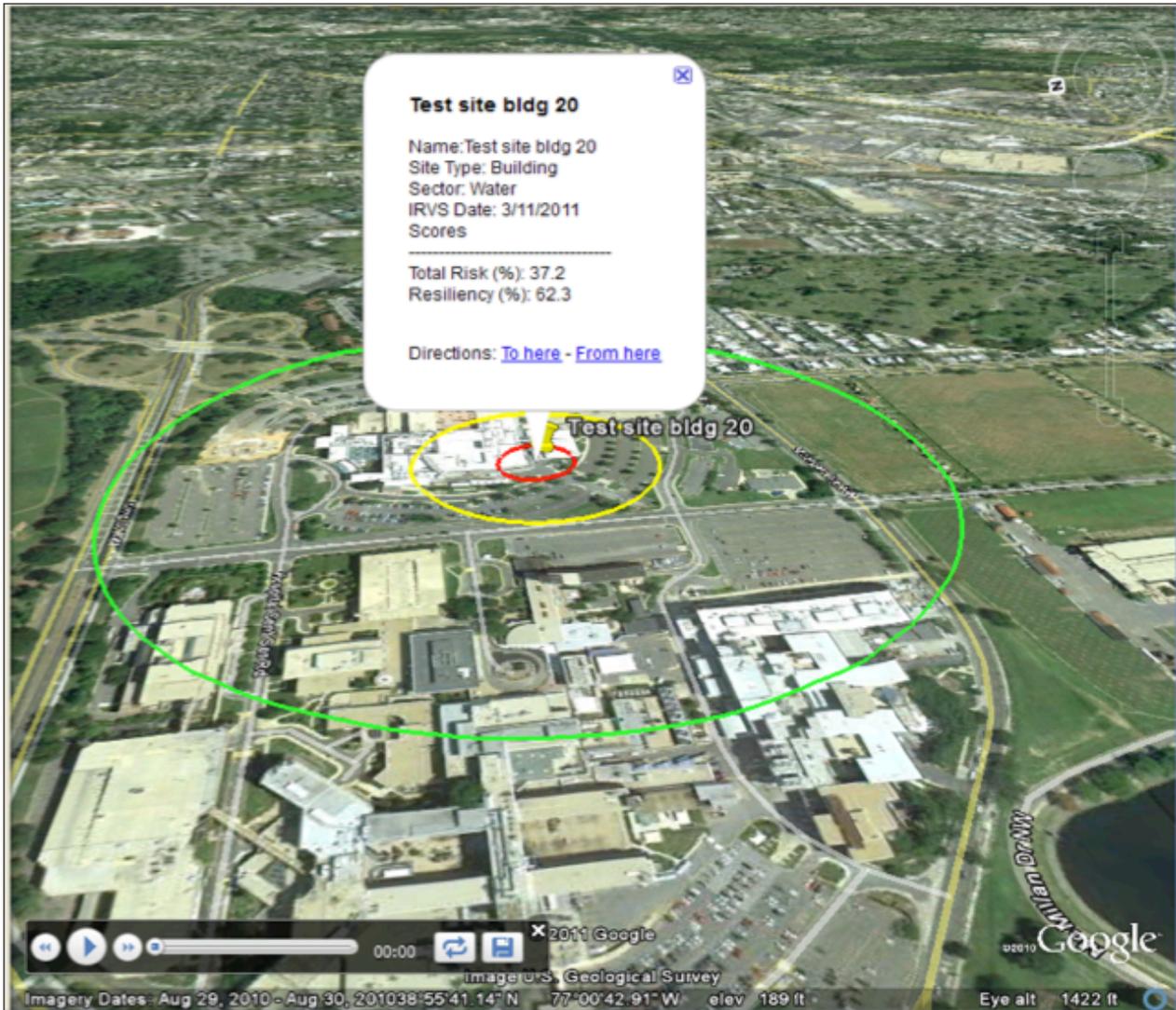
1. After you have created a filtered list, select **View All Summaries (Filtered List)** at the bottom of the screen to display the **Total Risk Summary – Filtered List** screen. If the screener does not filter the records, all the summaries in the database can be seen at the same time. The information that will be displayed is the same as the information that is displayed if you select **Site Summary** for one record except that you get a summary of more than one record. The summaries are grouped by site type.
2. To see the summaries for only one site type, select **Switch to Tabbed View**.



8.2 Plotting a Filtered List

If you have entered the coordinates for the screening sites and your computer has an installed mapping program that can read KML files, you can plot the records in a filtered list.

1. After you have created a filtered list, select **Plot (Filtered List)** to plot the sites that are in the filtered list.



9. Generating and Printing Reports

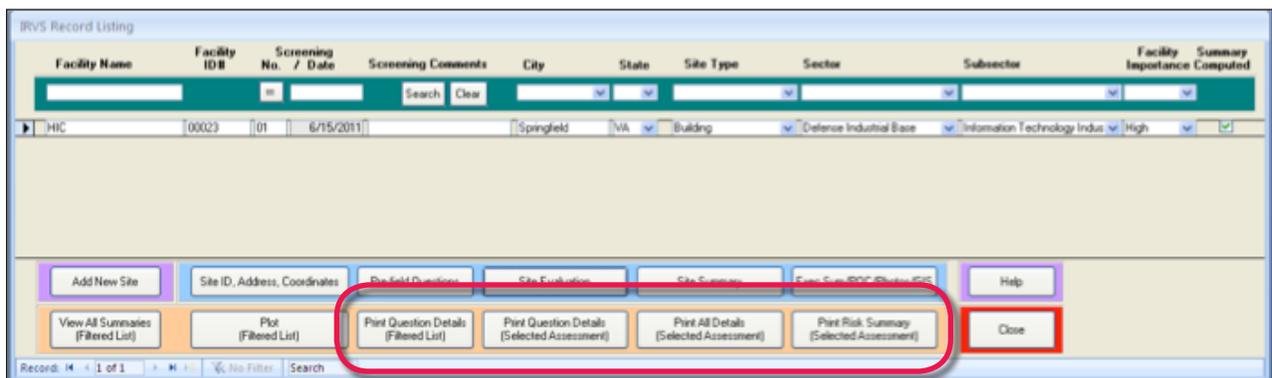
The **IRVS Record Listing** screen has four options for generating and printing reports:

- Print Question Details (Filtered List)
- Print Question Details (Selected Screening Record)
- Print All Details (Selected Screening Record)
- Print Risk Summary (Selected Screening Record)



Section 9

For all four options, you can print the information or export it as a MS Word document, or Text document, or PDF for editing or formatting by using the Output TAB. After selecting an option, to return to the previous screen, select **Close Report**. If you use the “X” on the upper right corner of the screen, you will close the database.



1. To generate and print a list of the answers to the pre-field and site evaluation questions for each record in the filtered list, you must first create a filtered list (see Section 8). Then select **Print Question Details (Filtered List)**. The risk and resiliency scores and other details (e.g., POCs, Assessment Team members, Executive Summary) will not be included.
2. To generate and print a list of the answers to the pre-field and site evaluation questions for a single record, first select a record on the **IRVS Record Listing** screen by clicking the far left column in the row with the record. Then select **Print Question Details (Selected Screening Record)**. The risk and resiliency scores and other details (e.g., POCs, Assessment Team members, Executive Summary) will not be included.
3. To generate and print an expanded amount of data for a single record, first select a record on the **IRVS Record Listing** screen by clicking the far left column in the row with the record. Then select **Print All Details (Selected Screening Record)**. The risk and resiliency scores will not be included.

- To generate a risk and resilience summary for a single record, first select a record on the **IRVS Record Listing** screen by clicking the far left column in the row with the record. Then select **Print Risk Summary (Selected Screening Record)**.

IRVS Risk and Resiliency Summary

IRVS Building/Facility: Scales: Scores and Color Mapping
 Facility ID#: Screening#: Risk Color Scale: 0-30 30-50 50-70 70-100
 Screening Date: Site Type: Resiliency Color Scale: 00-20 20-30 30-40 40-50

Summary Categories	Internal Intrusion	Internal Explosive	Internal CBR	Explosive Zone 1	Explosive Zone 2	Explosive Zone 3	CBR Zone 1	CBR Zone 2	CBR Zone 3
Total Consequences (scale of 100)	15.00	15.00	14.00	13.00	12.00	9.00	17.00	15.00	12.00
Total Threat (scale of 100)	7.50	7.50	7.00	6.50	6.00	4.50	8.50	7.50	6.00
Total Vulnerability (scale of 100)	31.87	30.50	30.41	29.33	28.00	20.24	37.41	30.00	26.00
Total Risk (scale of 100)	14.44	13.88	13.33	12.67	12.00	9.00	17.44	15.00	12.00

Summary Categories

EarthQk General	EarthQk Shaking	Flood Ground Failure	Flood Surge water	Wind Velocity	Wind Hurri- cane	Wind Tornado	Land- slide Other	Fire From Rainfall	Fire From EarthQk	Fire From Blast	Fire From Arson
Total Consequences (scale of 100)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Threat (scale of 100)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Vulnerability (scale of 100)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Risk (scale of 100)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Resiliency Scales (0-10)

Performance Measure	Time Measure	Robustness Measure	Resourcefulness Measure	Recovery Measure
75%	75%	75%	75%	75%

Total Score Summary
All Scores based on 1/100

Intrusion:	14.4
Blast (Interior):	12.0
CBR (Interior):	12.0
Blast (Exterior):	12.0
CBR (Exterior):	12.0
Seismic:	0.0
Flood:	0.0
Wind:	0.0
Fire:	0.0
Resiliency:	14.4
Total Risk All Scenarios:	14.4

Multihazards Interaction Matrix
... will result in this change for other hazards:

a change in:	Blast	CBR	Seismic	Flood	Wind	Fire
a change in Blast	100.0%	10.0%				
a change in CBR	3.0%	100.0%				
a change in Seismic						
a change in Flood						
a change in Wind						
a change in Fire						

To return to the previous screen, select **Close Print Preview**. Do not use the "X" in the upper right corner, or you will close the database.



Section 10

10. Administrative Functions

Administrative functions are not available to all users. You must have permission to log on as an Administrator, or your user name must include permission to access administrative functions. The administrative functions are as follows:

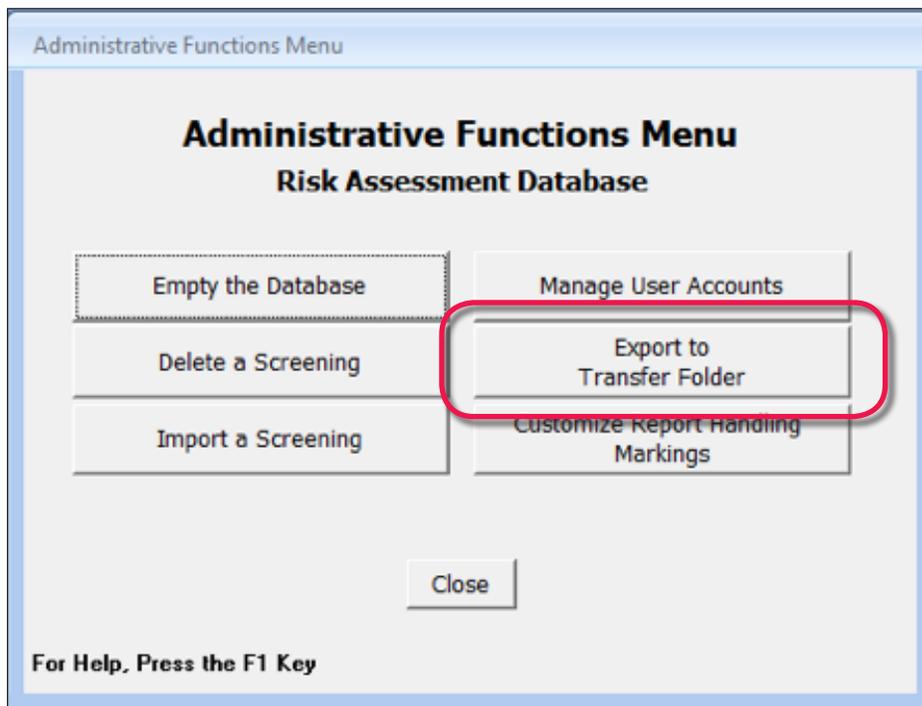
- Exporting screening data from the Field Database to transfer media
- Importing screening data into the Master Database from transfer media
- Importing screening data into the Master Database directly from the Field Database
- Deleting a single screening record
- Emptying the database
- Managing user accounts
- Customizing report handling markings

10.1 Exporting Screening Data from the Field Database to Transfer Media

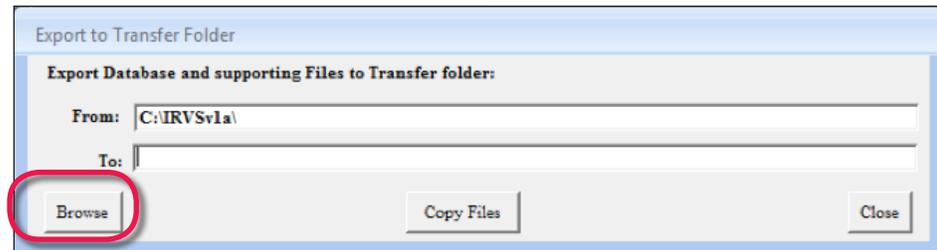
After a screening has been completed, the screening data must be transferred from the Field Database to the Master Database. The transfer can be accomplished in two ways: (1) copying the data to a USB drive, CD, DVD, or other type of transfer media and (2) importing the data directly from the Field Database into the Master Database.

Exporting screening data to transfer media is described in this section. For instructions on transferring data from the transfer media to the Master Database, see Section 10.2. For information on importing data directly into the Master Database from the Field Database, see Section 10.3.

1. Log on to the database or, if you are in the database, close the screens until you are back to the **Main Menu**.
2. Select **Administrative Functions**.
3. Select **Export to Transfer Folder**.
4. In the **Export to Transfer Folder** screen, the **From** field (location of the data to be copied) should be populated. Select **Browse** to identify the file path where you want the data to be copied.



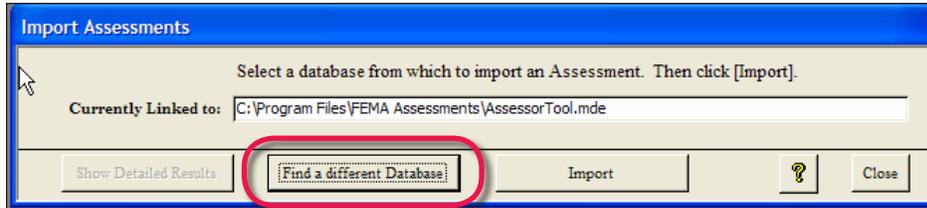
5. Select the folder where you want to copy the data and then select **Open**.
6. Select **Copy Files**. You will be asked to confirm that you want to copy the files. Select **Yes**.



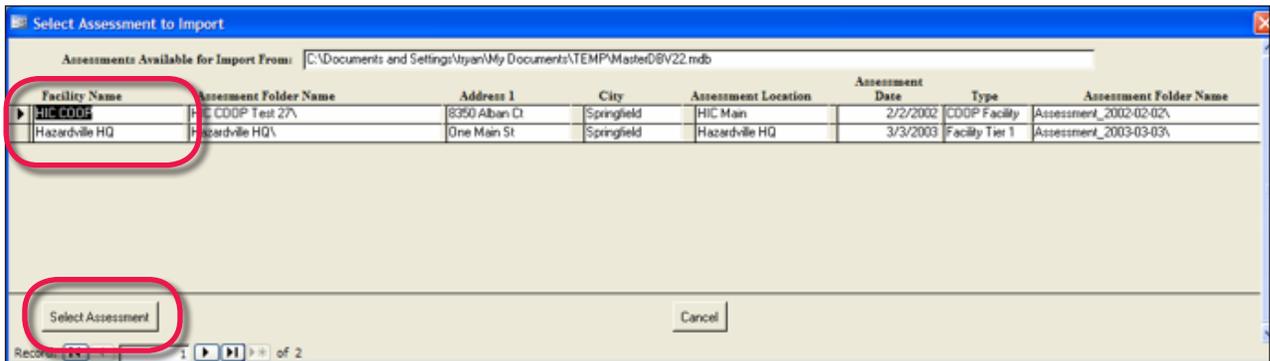
7. A message will appear indicating that the transfer is complete. Select **OK** and then **Close** to return to the **Administrative Functions** menu.
8. Give the transfer media containing the data to the Master Database operator (usually the IRVS Program Manager) who will copy the data to a temporary location on his or her computer until the data can be transferred to the Master Database. See Section 10.2 for instructions on importing screening data into the Master Database from transfer media.

10.2 Importing Screening Data into the Master Database from Transfer Media

1. Follow the instructions in Section 10.1 for transferring data from the Field Database to transfer media.
2. Insert the transfer media into the computer with the Master Database.
3. Select **Administrative Functions** from the **Main Menu** of the Master Database.
4. In the **Administrative Functions Menu**, select **Import Assessor Database**. This imports the database files with an mdb or mde extension that contain the screening data on the Field Database. The field for **Currently Linked to** in the **Import Assessments** screen will be populated with the last database file the Master Database was linked to.
5. To find a different database file to import, select **Find a different Database**.



6. When you have found the database file you want to import into the Master Database, select file and then select **Open**, which will take you back to the **Import Assessments** screen.
7. Select **Import**.
8. You will be asked to confirm that you want to import the database file. Select **Yes**.
9. A message will appear confirming that the file has been imported. Select **OK**.
10. The **Select Assessment to Import** screen will appear. Select the as-



essment to be imported and select **Select Assessment**.

11. You will be asked if you also want to transfer the supporting files (e.g., photos) that are tied to the assessment. Select **Yes** if you want to transfer the files. If there are no supporting files, you will get a message to that effect.
12. You will be asked to confirm that you want to transfer the files now. Select **Yes**.
13. Select **OK** to finish.



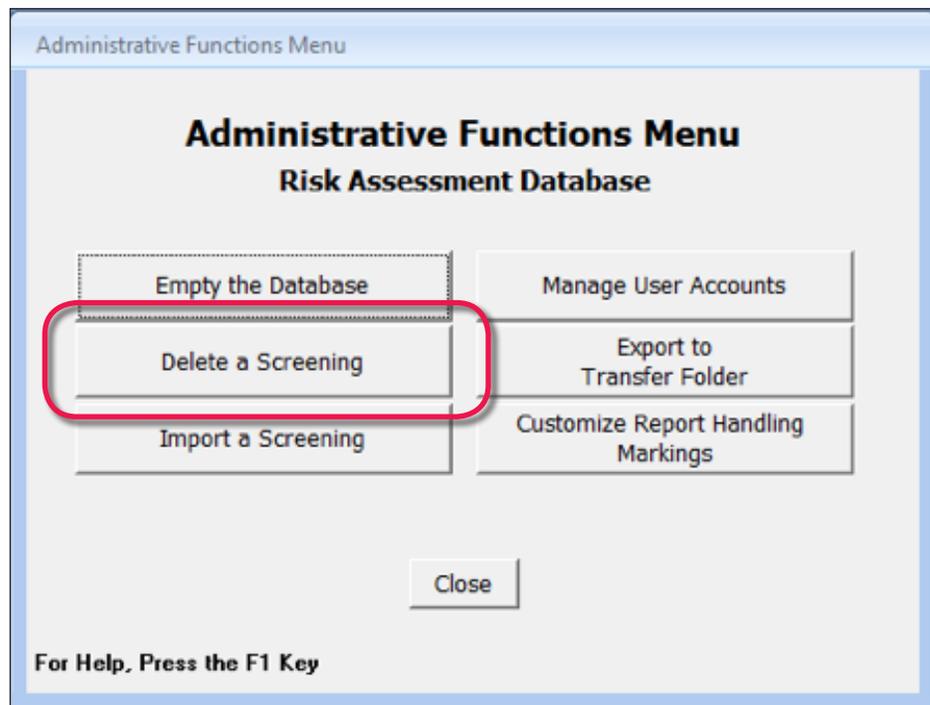
10.3 Importing Screening Data Directly into the Master Database from the Field Database

1. Connect the Field Database laptop to the computer with the Master Database using a USB cable or through a network.
2. Follow Step #3 through Step #13 in Section 10.2.

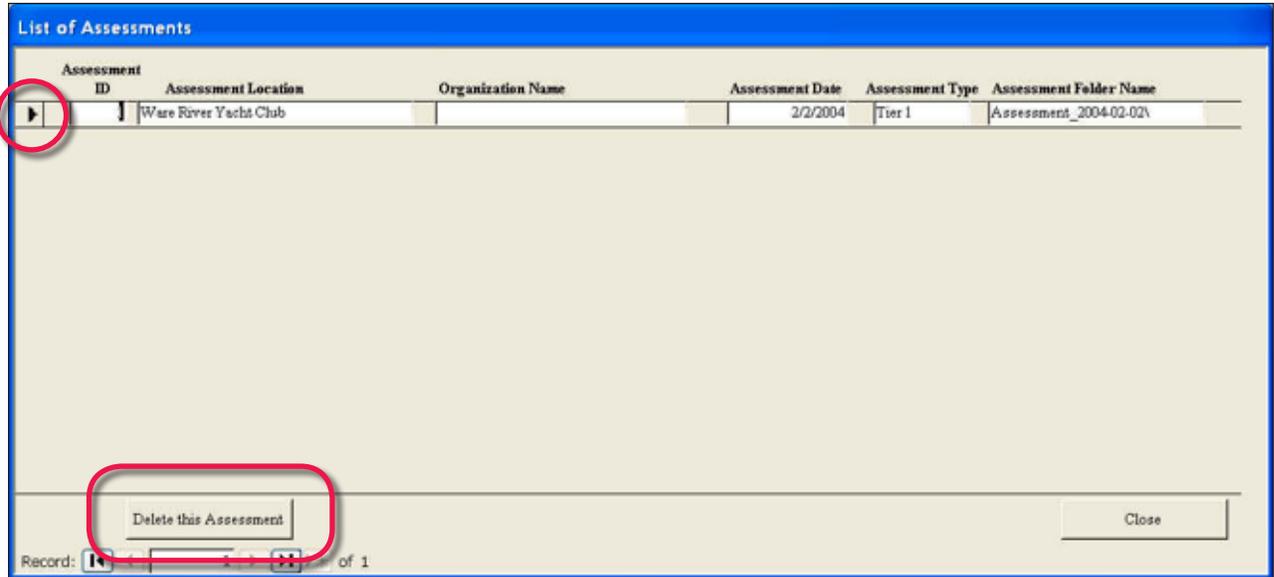
10.4 Deleting a Single Screening Record

If you have permission to access administrative functions, you can delete screening records permanently. Deleted data can't be restored.

1. Log on to the database or, if you are in the database, close the screens until you are back to the **Main Menu**.
2. Select **Administrative Functions**.
3. Select **Delete a Screening**.



4. The **List of Assessments** screen will appear. Select the screening record to erase and then select **Delete This Assessment**.
5. You will be asked to confirm that you want to permanently erase the selected screening record. Select **Yes**. **Warning: The screening record will be erased from the database permanently!**



10.5 Deleting All Screening Records from the Field Database

After the screening records have been transferred from the Field Database to the Master Database, the screening records should be deleted from the Field Database. The records will be deleted permanently and can't be restored. **Before deleting the records, confirm that the records have been successfully transferred to the Master Database.**

1. Log on to the Field Database or, if you are in the database, close the screens until you are back to the **Main Menu**.
2. Select **Administrative Functions**.
3. Select **Empty the Database**.
4. You will be asked to confirm that you want to permanently erase all screening records. Select **Yes** to continue or No or Cancel to cancel.
5. If you selected **Yes**, you will receive a warning that the action is non-reversible. Select **Yes** to continue or **No** or **Cancel** to cancel.
6. If you selected **Yes**, you will receive a final warning asking if you want to delete all files and folders. Select **Yes** to continue or **No** or **Cancel** to cancel.
7. If you selected **Yes**, the records will be deleted, and you will receive a message to that effect. Select **OK**.



Before deleting the records, confirm that the records have been successfully transferred to the Master Database.

8. You will be given the option to keep your customized system defaults or to reset the labels to their original listings. Select the option you prefer and select **Continue with these choices**.
9. Select **OK**. The database will close. The next time you open the database, you will get a message that the **Database** will be re-set. The purged database will have no screening records.

10.6 Managing User Accounts

The **Manage User Accounts** function enables an administrator to add a user, delete a user, and assign a user to one of three user groups. The user group determines the permission level.

The database is preloaded with the following four user names and passwords.

User Name	Password
Administrator	Administrator
Assessor	Assessor
Editor	Editor
Reader	Reader

10.6.1 User Groups

Three user groups are available in the database: Administrators (Admins), Full Data Users, and read-only users (Readers).

- **Admins** have full access to the database, including the administrative functions. The database starts with two users in this group, **Administrator** and **Assessor**.
- **Full Data Users** can view, record, and update data but not perform administrative functions. The database starts with one user in this group, **Editor**.
- **Readers** can only view data. The database starts with one user in this group, **Reader**.

The password and permission level for the four preloaded user names (Administrator, Assessor, Editor, and Reader) can be changed, but cannot be deleted. This is a safety feature to prevent users from erasing all Administrators from the program.

10.6.2 Add a User

1. From the **Main Menu**, select **Administrative Functions**.
2. From the **Administrative Functions Menu**, select **Manage User Accounts**.
3. From the **Manage User Accounts** screen, select **New User**.
4. From the **Add a New User Account** screen, type in the new user name.
5. Under User Level select a user group from the dropdown menu.
6. Select **Save/Close**.
7. Select **OK**.

The screenshot shows the 'Manage User Accounts' window. At the top, it indicates 'Currently Logged in As: Administrator' and 'User Level: Admin'. The main heading is 'User Accounts'. Below this is a table with two columns: 'User Name' and 'User Level'. The table contains four rows: Reader, Editor, Assessor, and Administrator. The 'Administrator' row is selected, indicated by a blue arrow on the left. At the bottom of the window, there are buttons for 'New User', 'Edit User', 'Delete', and 'Close'. A status bar at the very bottom shows 'Record: 4 of 4', 'No Filter', and a search field.

User Name	User Level
Reader	Reader
Editor	Editor
Assessor	Editor
Administrator	Admin

The screenshot shows the 'ADD User Account' window. At the top, it indicates 'Currently Logged in As: Administrator' and 'User Level: Admin'. The main heading is 'ADD User Account'. Below this are four input fields: 'User Name' (text box), 'User Level' (dropdown menu with 'Editor' selected), 'Password' (text box), and 'Confirm Password' (text box). Below the input fields is a note: '** Passwords must be at least 8 characters long, and they should conform to your organization's password requirements'. At the bottom of the window, there are buttons for 'Change Password', 'Clear Password', 'Save / Close', and 'Cancel'.

10.6.3 Delete a User

1. From the **Main Menu**, select **Administrative Functions**.
2. From the **Administrative Functions Menu**, select **Manage User Accounts**.
3. From the **List of Users and the Group to which they belong** screen, select one of the existing users by left clicking on the far left column.
4. Select **Delete**.

5. You will be asked to confirm the deletion. Select **Yes** to confirm or No or Cancel to cancel the action.
6. Select **OK**.

10.6.4 Change the User Level

You want need to change the user level that a particular user belongs to.

1. From the **Main Menu**, select Administrative Functions.
2. From the Administrative Functions Menu, select **Manage User Accounts**.
3. From the **User Accounts** screen, select one of the existing users by left clicking on the far left column.
4. Select **Edit User**.
5. Select a level from a dropdown menu.
6. Select **Save/Close** to continue or **Cancel** to cancel the action.

10.7 Customizing Report Handling Markings

The database administrator can establish customized report handling markings that will be automatically printed on the top and bottom of all reports.

1. From the **Main Menu**, select **Administrative Functions**.
2. From the **Administrative Functions Menu**, select **Customize Report Handling Markings**.
3. **The Customize Report Handling Markings for Printed Reports** screen will appear. Edit the default marking or type in the desired text under **Report Page Markings – TOP** and **Report Page Markings – BOTTOM**.
4. Add top and bottom markings by selecting **New Report Marking**. Select the marking you want to be used when reports are printed by selecting the marking in the **Active Marking** column.
5. Delete top and bottom markings by selecting **Delete Marking**.
6. Select **Close** to return to the previous screen.

Customize the Report Handling Markings for Printed Reports		
Report Page Markings - TOP	Report Page Markings - BOTTOM	Active Marking
<p>***To change this heading, go to Master Database Mode/Admin Functions/Customize Report Markings***</p>	<p>*** Edit TOP and BOTTOM Markings, then click the [Active Marking] Checkbox***</p>	<input checked="" type="checkbox"/>
<input type="button" value="New Report Marking"/>	<input type="button" value="Delete Marking"/>	<input type="button" value="Close"/>
Record: <input type="button" value="Home"/> <input type="button" value="Left"/> <input type="text" value="1"/> <input type="button" value="Right"/> <input type="button" value="End"/> of 1		

D

Data Collection Form: Paper Version



Pre-Field Information

Complete the information on this page before the field assessment, using additional sheets as needed. The numbers in parentheses refer to the ID number in the catalog. Refer to the catalog for explanations of the information that is requested on this page and for the potential sources of the information.

Tunnel name/identification _____ Address/intersection _____ Transportation authority _____ Mode _____ Year built _____ Footprint (in square feet) _____ Overview of the tunnel from the transportation authority (use additional pages if necessary) _____ _____ _____ Number of tracks / lanes (1.1) _____ Tunnel medium (1.2) _____ Peak daily use (e.g., vehicles per day, riders per day) (1.3, 2.2) _____ Replacement value (1.9) _____ Geology: Soil conditions (3.9) _____ Terrorist threats against the tunnel (2.3.1) _____ _____ Terrorist threats against this transportation system (2.3.2) _____ _____ History of flooding affecting the tunnel since opening (2.11) _____ _____ Year(s) of major retrofits (5.5) _____ Retrofit description _____	<p>Target Density. Number of potential high-value/CIKR targets/buildings within 300 feet and between 300 and 1000 feet of any point of the perimeter of the station (1.7, 2.5).</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 80%;">CIKR Sector</th> <th style="width: 10%;">Within 300 feet</th> <th style="width: 10%;">From 300 to 1000 feet</th> </tr> </thead> <tbody> <tr><td>Agriculture and Food</td><td></td><td></td></tr> <tr><td>Banking and Finance</td><td></td><td></td></tr> <tr><td>Chemical</td><td></td><td></td></tr> <tr><td>Commercial Facilities</td><td></td><td></td></tr> <tr><td>Communications</td><td></td><td></td></tr> <tr><td>Critical Manufacturing</td><td></td><td></td></tr> <tr><td>Dams</td><td></td><td></td></tr> <tr><td>Defense Industrial Base</td><td></td><td></td></tr> <tr><td>Emergency Services</td><td></td><td></td></tr> <tr><td>Energy</td><td></td><td></td></tr> <tr><td>Government Facilities</td><td></td><td></td></tr> <tr><td>Healthcare and Public Health</td><td></td><td></td></tr> <tr><td>Information Technology</td><td></td><td></td></tr> <tr><td>National Monuments/Icons</td><td></td><td></td></tr> <tr><td>Nuclear Reactors, Materials, and Waste</td><td></td><td></td></tr> <tr><td>Postal and Shipping</td><td></td><td></td></tr> <tr><td>Transportation Systems</td><td></td><td></td></tr> <tr><td>Water</td><td></td><td></td></tr> <tr><td>TOTAL</td><td></td><td></td></tr> </tbody> </table>	CIKR Sector	Within 300 feet	From 300 to 1000 feet	Agriculture and Food			Banking and Finance			Chemical			Commercial Facilities			Communications			Critical Manufacturing			Dams			Defense Industrial Base			Emergency Services			Energy			Government Facilities			Healthcare and Public Health			Information Technology			National Monuments/Icons			Nuclear Reactors, Materials, and Waste			Postal and Shipping			Transportation Systems			Water			TOTAL		
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1. Consequences Rating

Characteristic		Attribute Options	Red Flag	Comments					
					(a)/(f)	(b)/(g)	(c)/(h)	(d)/(i)	(e)/(j)
1.1	Number of Tracks/Lanes	1			2	3 – 4	5 – 8	> 8	> 8
1.2	Tunnel Medium	Below grade (dry)			Below grade (under water table)	Underwater	—	—	—
1.3	Peak Number of Riders/Trains per Day	< 1,000			1,000 – 2,000	2,000 – 5,000	5,000 – 10,000	10,000 – 20,000	10,000 – 20,000
		50,000 – 100,000			100,000 – 150,000	150,000 – 200,000	> 200,000		20,000 – 50,000
1.4	Locality of Tunnel Exits	Remote			Rural	Suburban	Urban	Dense urban	Dense urban
1.5	Adjacent/Nearby Transportation Systems or Public Assembly Venues	None			Close	Tightly integrated	—	—	—
1.6	High-Value/CIKR Targets	None			1 – 6	7 – 12	13 – 19	≥ 20	≥ 20
		None			1 – 6	7 – 12	13 – 19	≥ 20	≥ 20
1.7	Impact of Physical Loss/Criticality	Local			Regional	National	—	—	—
		Local			Regional	National	—	—	—
1.8	Social Impact	Low			Moderate	High	—	—	—
1.9	Replacement Value (Fair Market Value), in millions (m) of dollars	< \$1 m			\$1 m – \$5 m	\$5 m – \$20 m	\$20 m – \$50 m	\$50 m – \$100 m	\$50 m – \$100 m
		\$200 m – \$350 m			\$350 m – \$600 m	\$600 m – \$900 m	> \$900 m		\$100m – \$200m
1.10	Operational Redundancy	Very high			High	Moderate	Low	Very low	Very low
1.11	Estimated Down Time after a Large Disaster	Very short			Short	Moderate	Long	Very long	Very long

2. Threat Rating

Characteristic	Attribute Options						Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)			
2.1	Remote	Rural	Suburban	Urban	Dense urban			
2.2	Locality of Tunnel Exits							
	Peak Number of Riders/Trains per Day	< 1,000	1,000 – 2,000	2,000 – 5,000	5,000 – 10,000	10,000 – 20,000		
2.3	Terrorist Threat (Credible)	20,000 – 50,000	100,000 – 150,000	150,000 – 200,000	> 200,000			
		2.3.1 Tunnel	No	Previous	Current	—	—	
2.4	High Value/CIKR Targets	2.3.2 System	No	Previous	Current	—		
		Zone 1: Within 300 feet	None	1 – 6	7 – 12	13 – 19	> 20	
2.5	Significance of Tunnel	Zone 2: Between 300 feet and 1000 feet	None	1 – 6	7 – 12	13 – 19	> 20	
		Local	Regional	National	International	—		
2.6	Function Criticality within a System or Region	Very low	low	Moderate	High	Very high		
2.7	Number of Approaches	1 – 2	3 – 4	5 – 8	9 – 12	>12		
2.8	Plaza/Public Areas	None	Well-controlled	Medium-controlled	Not-controlled	—		
2.9	Protective Deterrence Measures	High	Medium	Low	—	—		
2.10	Flooding History	None	Limited	Moderate	Severe	—		
2.11	Flooding History	N/A	None	Limited	Moderate	Severe		



3. Vulnerability Rating: Site

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
3.1 Tunnel Service Building Equipment	Available/redundant	Some availability /some redundancy	Available/not redundant	Not available/not redundant	—		
3.2 Portals	Protected	Exposed front	Exposed back	Underwater	—		
3.3 Tunnel Approaches	More than 3	2 – 3	Only 1	—	—		
3.4 Presence of Stand Pipes and/or Fire Hydrants (Water Supply)	Yes	No	—	—	—		
3.5 Water Drainage	Excellent	Moderate	Limited	Deficient	—		
3.6 Natural Protective Barriers	N/A	High	Medium	Low	—		
3.7 Manmade Barriers	N/A	High	3.4.1 Barriers/ Bollards	Low	—		
			3.4.2 Fencing	Low			
3.8 Tunnel Medium	Below grade (dry)	Below grade (under water table)	Underwater	—	—		
3.9 Depth of Cut and Cover above Tunnel	N/A	Deep	Shallow	Exposed	—		
3.10 Geology: Soil Condition	Hard rock	Medium	Poor	—	—		
3.11 Adjacent Buildings	None	Some	Numerous	—	—		
3.12 Hazardous Materials Storage	No	Yes	—	—	—		

4. Vulnerability Rating: Architectural

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
4.1 Number of Tubes	1	2	More than 2	—	—		
4.2 Service Entrances	Not Applicable	No. Service entrance not present.	Yes. Service entrance present	—	—		
4.3 Crowding/Congestion	Never crowded	Sometimes	Rush hour only	Always crowded	—		
4.4 Emergency Exits	More than 4	3 – 4	2	1	None		
4.5 Number of Levels	1	2 – 3	More than 3	—	—		
4.6 Ease of Egress from Vehicle /Trains to Tunnel	Difficult	Moderate	Easy	—	—		
4.7 Flood Gates	No	Yes	—	—	—		
4.8 Plaza/Public Areas	None	Well-controlled	Medium-controlled	Not controlled	—		



5. Vulnerability Rating: Structural

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
5.1 Method of Construction	Drilled rock	Drilled soil	Cut-cover	Immersed	—		
5.2 Liner Cross Section	Circular	Oval	Rectangular/square	—	—		
5.3 Liner Relative Thickness	N/A	Thick	Medium	Thin	Very thin		
5.4 Construction Material	High-strength concrete or steel	Steel/ concrete/ prestressed concrete	Wrought iron	Brick or masonry	—		
5.5 Known Retrofits	Yes	No	—	—	—		
5.6 Longest Span	N/A	15 to 25 feet	25 to 40 feet	40 to 50 feet	50 feet or more		
5.7 Controlling Height	N/A	Less than 25 feet	25 to 40 feet	40 to 50 feet	50 feet or more		
5.8 Type of Framing	Shell	Plate	Frame	—	—		
5.9 Seismic Design	N/A	Yes	No	—	—		
5.10 Overall Structural Conditions	Excellent	Good	Average	Below average	Poor		

6. Vulnerability Rating: Ventilation Systems

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
6.1 Degree of Protection of Ventilation Shafts	N/A	Very	Somewhat	Not protected	—		
6.2 Protection of Ventilation Structures	N/A	Very	Somewhat	Not protected	—		
6.3 Redundancy of Ventilation Systems	N/A	Yes	No	—	—		
6.4 Ventilation Hardware Exposure	N/A	Hardened enclosure	Covered, not hardened	Visible	—		



7. Vulnerability Rating: Fire Protection Systems

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)/	(c)/	(d)/	(e)/		
7.1 Protection of Fire Control Equipment	Yes	No	—	—	—		
7.2 Effectiveness of Protection of Fire Control Equipment	N/A	High	Medium	Low	None		
7.3 First Responder Awareness of and Accessibility to Fire Equipment	Yes	No	—	—	—		
7.4 Emergency Lighting	Yes	No	—	—	—		
7.5 Presence and Adequacy of Tunnel Cross Passageways	Single tube	Double-tube adequate corridor	Double-tube not adequate	—	—		

8. Vulnerability Rating: Operational Systems

Characteristic	Attribute Options					Red Flag	Comments
	(a)/(f)	(b)/(g)	(c)/(h)	(d)/(i)	(e)/(j)		
8.1 Power Supply and Distribution: Enclosures	Well protected	Marginally protected	Not protected	—	—		
8.2 Surveillance and Control	Complete	Partial	None	—	—		
8.2.2 Quality of Control Systems	High	Medium	Low	—	—		
8.3 Public Address and Communications	Low ridership (see ID I.4)						
	Class 3	Class 2	Class 1	Present – non-operational	None		
	High ridership (see ID I.4)						
8.3.2 Effectiveness of Public Awareness	Class 3	Class 2	Class 1	Present – non-operational	None		
8.3.2 Effectiveness of Public Awareness	High	Moderate	Limited	—	—		
8.3.3 Asset-related Communications	Low ridership (see ID I.4)						
	Class 3	Class 2	Class 1	Present – non-operational	None		
	High ridership (see ID I.4)						
8.3.4 Effectiveness of Asset-related Communications	High	Moderate	Limited	—	—		
8.4 Quality of Lighting	High	Medium	Low	—	—		
	High	Medium	Low	—	—		
8.4.1 Exterior	High	Medium	Low	—	—		
8.4.2 Interior	High	Medium	Low	—	—		



9. Vulnerability Rating: Nonstructural

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
9.1 Wall and Ceiling Finish	High	Medium	Low	—	—		
9.2 Pavement Driving/Track Quality	High	Medium	Low	—	—		
9.3 Quality of Security Personnel Booths	High	Medium	Low	None	—		
9.4 Fixture Attachments	Secured	Not secured	—	—	—		
9.5 Quality of Barriers/Curbs	High	Medium	Low	—	—		

10a. Vulnerability Rating: Physical Security, Security System Checklist

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
10.1a	Yes	No	—	—	—		
10.2a	Yes	No	—	—	—		
10.3a	Yes	No	—	—	—		
10.4a	Yes	No	—	—	—		
10.5a	Yes	No	—	—	—		
10.6a	Yes	No	—	—	—		
10.7a	Yes	No	—	—	—		
10.8a	Yes	No	—	—	—		
10.9a	Yes	No	—	—	—		
10.10a	Yes	No	—	—	—		
10.11a	Yes	No	—	—	—		
10.12a	Yes	No	—	—	—		
10.13a	Yes	No	—	—	—		
10.14a	Yes	No	—	—	—		



**10b. Vulnerability Rating: Physical Security, Waterside Security Systems
(Applicable to Underwater Tunnels)**

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
10.1b Water Intrusion Detection Systems (IDS)	Yes	No	—	—	—		
10.2b Vessel Boarding Teams	Yes	No	—	—	—		
10.3b Dive Teams	Yes	No	—	—	—		
10.4b Patrol Boats	Yes	No	—	—	—		
10.5a Transit/Maritime Domain Command and Control	Yes	No	—	—	—		
10.6a Unarmed Guards (Waterside)	Yes	No	—	—	—		
10.7a Armed Guards (Waterside)	Yes	No	—	—	—		
10.8a Law Enforcement Patrols (Waterside)	Yes	No	—	—	—		

10c. Vulnerability Rating: Physical Security Systems Evaluation

Characteristic	Attribute Options						Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)			
10.1c Blast Threat: Internal	10.1c.1 Number of Systems	8 or more	4 – 7	1 – 3	None	None		
	10.1c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective			No security
10.2c Blast Threat: External (Direct)	10.2c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—		
	10.2c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective			No security
10.3c CBR Threat: Tunnel	10.3c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—		
	10.3c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective			No security
10.4c CBR Threat: External	10.4c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—		
	10.4c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective			No security
10.5c Fire Threat: Internal	10.5c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—		
	10.5c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective			No security



10c. Vulnerability Rating: Physical Security Systems Evaluation (continued)

10.6c	Fire Threat: Tunnel/Track/ Smoke	10.6c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—	
		10.6c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective	No security	
10.7c	Fire Threat: Tunnel/Track/ Smoke	10.7c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—	
		10.7c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective	No security	
10.8c	Other Threats: Flood/Flooding	10.8c.1 Number of Systems	5 or more	3 – 4	1 – 2	None	—	
		10.8c.2 Overall System Effectiveness	High	Effective	Minimal	Ineffective	No security	

11. Vulnerability Rating: Cyber Infrastructure

Characteristic	Attribute Options						Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)			
11.1 Effectiveness of Cyber Security Plan	High	Medium	Low	None	—			
11.2 Effectiveness of Training Programs	High	Medium	Low	None	—			
11.3 Security of Communications, Signal, and Power Systems	Secured	Medium	Marginal	No security	—			
11.4 Redundancy of Communication Systems	Yes	No	—	—	—			
11.5 Security of Power Supply	Secured	Medium	Marginal	No security	—			
11.6 Effectiveness of Wireless, Radio, or Satellite Systems During Emergencies	High (regional)	Medium (within jurisdiction)	Low (system only)	—	—			



12. Vulnerability Rating: Operational Security

Characteristic	Attribute Options					Red Flag	Comments
	(a)	(b)	(c)	(d)	(e)		
12.1 Emergency Plans	Yes	No	—	—	—		
12.2 Emergency Response Exercises	Full scale	Table top	Workshop	None	—		
12.3 Effectiveness of Emergency Plans	Highly effective	Effective	Minimally effective	Ineffective	—		
12.4 Security Plans	Yes	No	—	—	—		
12.5 Security Plans Update Status	12 months	2 years	2 – 5 years	More than 5 years	None		
12.6 Transit Agency Mass Evacuation Plan	Both tunnel and train (if rail tunnel)™	Train only (if rail tunnel)™	None	—	—		
12.7 Effectiveness of Mass Evacuation Plan	High	Effective	Minimal	Ineffective	—		
12.8 Continuity of Security	Yes	No	—	—	—		
12.9 Report/Exchange Threat Information	Frequent	Seldom/infrequent	None	—	—		
12.10 Training Programs	Well established	Marginal	None	—	—		
12.11 Coordinated Efforts of Local/Regional First Responders	Well established	Marginal	None	—	—		



DHS Infrastructure Taxonomy

Infrastructure Taxonomy¹

This appendix contains an abbreviated version of the Infrastructure Taxonomy prepared by the Department of Homeland Security. It provides a listing of facility types included as part of each of the 18 critical infrastructure categories. Selected facilities provided below focus on facility types that include buildings. This appendix can be used as a reference for tabulating the target density information provided on page 1 of the Data Collection Form).

Agriculture and Food

- Supply
- Processing/Packaging/Production
- Agriculture and Food Product Storage
- Agriculture and Food Product Transportation
- Agriculture and Food Product Distribution
 - Farm Product Wholesalers
 - Grocery and Related Product Wholesalers

¹ Source: DHS, 2006, Infrastructure Taxonomy, Version 2, Risk Management Division Office of Infrastructure Protection, Department of Homeland Security, Washington, D.C.



- Food and Beverage Retailers
 - Supermarkets and Grocery Stores
- Food Service and Drinking Facilities
 - Full Service Restaurants
 - Limited Service Food Facilities
 - Drinking Establishments
 - Bars
 - Nightclubs
- Agriculture and Food Supporting Facilities
- Regulatory, Oversight, and Industry Organizations

Banking and Finance

- Banking and Credit
- Securities, Commodities, and Financial Investments
- Insurance Carriers

Chemical

- Chemical Manufacturing Plants
- Hazardous Chemical Transport
- Hazardous Chemical Storage/Stockpile/Utilization/Distribution
- Regulatory, Oversight, and Industry Organizations

Commercial Facilities

- Entertainment and Media Facilities
 - Broadcasting
 - Cable and Other Subscription Programming
 - Radio Broadcasting
 - Television Broadcasting
 - Internet Publishing
 - Motion Picture and Sound Recording Facilities
 - Print Media



- Newspaper and Periodical Publishing
 - Other Print Publishing
- Gambling Facilities/Casinos (Resorts)
 - Gambling Cruises Horse and Dog Racetracks
 - Land-Based Casinos
 - Permanently-Moored Casinos
 - Riverboat Casinos
 - Other Gambling Establishments
- Lodging Facilities
 - Bed and Breakfast Inns
 - Hotels and Motels
 - Other Lodging Facilities
- Outdoor Events Facilities
 - Amusement, Theme, and Water Parks
 - Community Parks, Fairgrounds, Pavilions
 - Community Water Facilities
 - Community Special Gatherings
 - Parades
 - Special Events
- Public Assembly/Sports Leagues Facilities
 - Amphitheaters
 - Arenas
 - Convention Centers
 - Golf Courses and Country Clubs
 - Motor Racetracks
 - Movie Theaters
 - Museums, Planetariums
 - Performing Arts Centers and Auditoriums
 - Stadiums
 - Zoos, Aquariums, Botanical Gardens



- Public Assembly/Other Facilities
 - Entertainment Districts
 - Fitness and Recreational Facilities
 - Marinas
 - Skiing Facilities
 - Other Amusement and Recreational Facilities
- Real Estate Facilities
 - Office Buildings
 - Office Buildings – Stand Alone
 - Office Districts
 - Office Parks
 - Residential Units
 - Multi-Family Residences
 - Single-Family Residences
- Retail Facilities
 - Store Retailers
 - Shopping Centers and Malls
 - Shopping Districts
 - Stand-Alone Stores
 - Non-Store Retailers
- Community Organization Facilities
 - Religious Organization Facilities
 - Social Advocacy Organization Facilities
 - Civic and Social Organization Facilities
 - Political Organization Facilities
- Other Commercial Facilities
 - Weather Forecasting Services



Communications

- Wired Communications
- Wireless Communications
- Satellite Communications
- Internet
- Information Services
- Next Generation Networks
- Regulatory, Oversight, and Industry Organizations
- Other Communication Facilities

Critical Manufacturing

- Primary Metal Manufacturing
- Machinery Manufacturing
- Electrical Equipment, Appliance, and Component Manufacturing
- Manufacturing
- Transportation Equipment Manufacturing

Dams

- Dam Projects
- Navigation Locks
- Mine Tailings Dams
- Hurricane Barriers
- River Control Structures
- Levees
- Regulatory, Oversight, and Industry Organizations
- Other Dam Facilities

Defense Industrial Base

- Shipbuilding Industry
- Aircraft Industry



- Missile Industry
- Space Industry
- Combat Vehicle Industry
- Ammunition Industry
- Weapons Industry
- Troop Support Industry
- Information Technology Industry
- Electronics Industry
- Electrical Industry Commodities
- Electronic Industry Commodities
- Mechanical Industry Commodities
- Structural Industry Commodities

Emergency Services

- Law Enforcement
- Fire, Rescue, and Emergency Services
- Search and Rescue
- Emergency Medical Services
- Emergency Management

Energy

- Electricity
- Petroleum
- Natural Gas
- Coal
- Ethanol
- Regulatory, Oversight, and Industry Organizations

Government Facilities

- Personnel-Oriented Government Facilities
 - Personnel-Oriented Buildings and Structures



- Offices and Office Building Complexes
 - Agency Headquarters
 - Field, District and Satellite Offices
 - Legislative Chambers and Offices
 - Judicial Chambers and Offices
 - Data and Call Centers
- Housing
- Correctional Facilities
- Embassies, Consulates, and Border Facilities
- Educational Facilities
 - Pre-Kindergarten
 - Licensed Day Care Facilities
 - K-12 Schools
 - Higher Education Facilities
 - Specialized Education Facilities
- Personnel-Oriented Land
- Service-Oriented Government Facilities
 - Service-Oriented Buildings and Structures
 - Emergency Services
 - Maintenance and Repair Shops
 - Operations, Command, Dispatch, and Control Centers
 - Training Buildings
 - Libraries
 - Service-Oriented Land
- Government Research Facilities
 - Government Research and Development Buildings and Structures
 - Analysis and Assessment Research Facilities
 - Environmental Research
 - Basic Science Research



- Aerospace Research Facilities
 - Military Research
- Government Research and Development Land
- Government Storage and Preservation Facilities
 - Storage and Preservation Buildings and Structures
 - Archive and Record Centers
 - Warehouses
 - Weapons and Ammunition Storage
 - Precious Metal Storage
 - Currency Storage
 - Special Nuclear Materials and Waste Storage
 - Storage and Preservation Land
- Government Sensor and Monitoring Systems
 - Global Positioning System
 - Global Positioning System (GPS) Space Segment
 - GPS Control Segment
 - Government Observation Systems
- Government Space Systems
 - Military Facilities
 - Launch Vehicles
 - Launch Facilities
 - Mission Control Facilities
 - Satellites
 - National Aeronautics and Space Administration (NASA) Facilities
 - Launch Vehicles
 - Launch Facilities
 - Mission Control Facilities
 - Satellites
 - Military Facilities
 - Army Bases



- Navy Bases
- Marine Corps Bases
- Air Force Bases
- Coast Guard Bases
- National Guard Facilities
- Joint and Combined Military Installations
- Reservations
- Other Government Facilities
- Other Government Buildings and Structures
- Other Government Land

Healthcare and Public Health

- Direct Patient Healthcare
- Public Health Agencies
- Healthcare Educational Facilities
- Health Supporting Facilities
- End-of-Life Facilities
- Regulatory, Oversight, and Industry Organizations

Information Technology

- Hardware Production
- Software Production
- Information Technology Services
- Internet
- Next Generation Networks
- Regulator, Oversight, and Industry Organizations

National Monuments and Icons

- National Monument/Icon Structures
- National Monument/Icon Geographic Areas
- National Monument/Icon Documents and Objects



- Other National Monuments and Icons

Nuclear Reactors, Materials and Waste

- Nuclear Power Plants
- Research, Training, and Test Reactors
- Nuclear Fuel Cycle Facilities
- Radioactive Waste Management
- Nuclear Materials Transport
- Deactivated Nuclear Facilities
- Radioactive Source Production and Distribution Facilities
- Regulatory, Oversight, and Industry Organizations
- Other Nuclear Facilities

Postal and Shipping

- U.S. Postal Service
- Couriers
- Other Postal and Shipping Facilities

Transportation Systems

- Aviation
- Railroad
- Road
- Maritime
- Mass Transit
- Pipelines
- Regulatory, Oversight and Industry Organizations

Water

- Raw Water Supply
- Raw Water Transmission
- Raw Water Storage



- Water Treatment Facilities
- Treated (Finished) Water Storage
- Treated Water Distribution Systems
- Treated Water Monitoring Systems
- Treated Water Distribution Control Centers
- Wastewater Facilities
- Regulatory, Oversight, and Industry Organizations

