USING THE ANALYTIC HIERARCHY PROCESS TO IMPROVE THE RUTGERS SIMPLE BRIDGE SECURITY CHECKLIST

by

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ABSTRACT OF THE THESIS

USING THE ANALYTIC HIERARCHY PROCESS TO IMPROVE THE RUTGERS SIMPLE BRIDGE SECURITY CHECKLIST

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Following the tragic events of September 11, 2001, the New Jersey Department of Transportation asked Rutgers University to develop a checklist to be used by bridge inspectors to provide department leaders with security data for the entire bridge inventory. Rutgers University quickly developed a concise checklist which could be used for this purpose. The existing tool consists of 37 questions broken down into 3 categories, which are Occurrence (O), Vulnerability (V), and Importance (I). The overall risk of the structure is measured in terms of the equation Risk = O x V x I. While the methodology behind the development of this tool was sound, the weights of the questions were based on academic case studies rather than statistical research. The use of this methodology limits the use of the checklist in real world applications. In order to implement this checklist, there was a need to statistically justify the weights assigned to each question.

In order to improve this tool, a survey was administered to industry subject matter experts from across the United States to determine the relative importance of each question within the checklist. The data from the survey was analyzed using the Analytic

Hierarchy Process (AHP), and new weights were assigned to each question. There were significant differences found between some of the new and the previously assigned question weights. Some of these differences could be accounted for by examining the practicality versus academic value of certain questions. It was concluded that although the survey was extremely long, the Analytic Hierarchy Process was an effective methodology to use in the assignment of the question weights. Following the completion of the analysis, the bridge security checklist was updated with the new weights, and presented to state leadership for future implementation.

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This work would not have been completed without the help and support of many individuals.

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CHAPTER 1. INTRODUCTION

One of the greatest challenges facing transportation owners today is determining the threats to their assets. Throughout the 1990's, terrorist attacks around the world demonstrated the creativity and determination of extremist organizations in their attacks against targets of interest. In terms of security, owners had a massive number of issues that needed to be answered, such as which national agency would assume the leadership role in developing security standards and where the resources would come from. The tragic events of September 11, 2001 further justified this need. Reacting to these events, and to address this knowledge gap, the American Association of State Highway and Transportation Officials (AASHTO) in conjunction with the Federal Highway Administration (FHWA) formed a Blue Ribbon Panel (BRP) on Bridge and Tunnel Security. This panel, working through a National Cooperative Highway Research Program (NCHRP) Project 20-59(3) "FHWA/AASHTO Blue Ribbon Panel on Bridge and Tunnel Security" was charged with two tasks. The first task was to provide direction for a national security-related policy to guide the owners/operators of highway infrastructure. The Second task was to develop short- and long-term strategies for improving the safety and security of the Nation's bridges and tunnels.

The panel conducted several meetings and site visits to identify and clarify the issues, develop and evaluate potential solutions, and formulate and refine recommendations for improving bridge and tunnel security. While the group received many briefings on the subject, it should be recognized that the material provided to them was all open source

material. Still, the panel was able to provide extremely valuable insights and recommendations from which to proceed. The first significant conclusion of the panel was that the threat to our transportation system was real. The panel concluded, "The success and safety of the system (during several historical events), and perceived number of parallel routes does not mean that the transportation system is invulnerable to significant disruption by terrorist attack." In fact, the transportation system in the United States was already straining to meet demand in many places and obvious choke points exist at major bridge crossing points and tunnels. The second conclusion was that an attack upon a major bridge or tunnel could result in severe economic consequences and prove to be extremely disruptive to regional and national economy. The panel concluded that the cost of replacement of a major river crossing and the economic loss would be tens of billions based on estimates from recent earthquakes.

Following the formation of the abovementioned panels, Rutgers University, in response to New Jersey Department of Transportation's request for proposal, developed a concise checklist, which could be used by bridge inspectors to collect security data on the entire bridge inventory. The checklist consists of a total of 37 questions, broken into three (3) categories, Occurrence (O), Vulnerability (V) and Importance (I). The overall Risk of the structure was computed using the relationship Risk = O x V x I. Within the three categories, each of the questions carried a certain weight, which was based on several case studies. These weights were not assigned using mathematical or analytical methods, but on an equal distribution in each category, which was a major disadvantage of using this checklist. As such, the purpose of this research was to re-examine the questions and

assigned weights within the existing Rutgers Simple Bridge Security Checklist. The Analytic Hierarchy Process (AHP) was chosen as the new methodology used to assign weights to the checklist questions. In order to use the AHP to assign weights, a survey was administered to 30 industry subject matter experts, asking them to compare the relative importance of each checklist question. From the results of this survey, statistically based weights were assigned to each question. There were significant differences found between the previously assumed weights and the new weights. This improved the accuracy of the checklist, and made the tool more attractive for future implementation.

CHAPTER 2. LITERATURE REVIEW

In response to the tragic events of September 11, 2001, the American Association of State Highway and Transportation Officials (AASHTO) assembled The Blue Ribbon Panel on Bridge and Tunnel Security, 2003. This panel convened with the purpose of examining bridge and tunnel security and to develop strategies and practices for deterring, disrupting and mitigating future terrorist attacks. The panel developed a seven step approach to bridge and tunnel security, which included:

1) Strategy for Bridge and Tunnel Security- As shown in Table 1 below, the Panel developed an overall strategy with issues that must be addressed to ensure that adequate measures are taken to protect the public as well as assets.

Key Topics in Infrastructure Security	Specific Issues
1. Foundations for Policy	• Criteria Establishing Investment Priorities • Institutional Continuity
2. Planning, Design, and Engineering	• Design Review for Secure Structures • Research and Development (R&D) Needed to Support "Design for Security" • Design Criteria • Design Specifications
3. Management and Operational Practices	• Best Practices • Practice Review • Institutional Relationships • Preparedness • Personnel and Vehicle Security • Communication/Outreach
4. Information Security	• Procurement Practices • Information Security
5. Mobilization ("Notice") and Response ("Trans-event")	• Threat Warning • Early Response • Initial Response
6. Recovery (Post-event)	• Damage Assessment • Functional Continuity

Table 1: Bridge and Tunnel Security Issues as identified by the Blue Ribbon Panel for Bridge and Tunnel Security

2) Planning, Design, and Engineering – this includes a framework for identifying critical bridges and determining the overall damages (post-attack) using risk assessment methods.

3) Prioritization and Risk Assessment- this identified the need to implement the use of a risk assessment tool in order to understand the threat facing our bridges and tunnels. This process would provide owners with likely targets and assist them in the development of countermeasures to mitigate this threat. The panel also discussed the need to determine the financial impact of deterrence, and to provide countermeasures that are appropriate based on the facility and the social cost from the loss of use.

4) Threats – effective countermeasures cannot be created without the understanding of the threat faced by each individual transportation facility. The panel identified several potential threats, which include: 1) low tech and high-tech conventional explosives (i.e. shape charges), 2) Explosively Formed Penetrating devices (i.e. EFP, kinetic energy penetrators), 3) Low-tech hand held cutting devices, 4) Truck size/barge size conventional explosives, 5) Chemical/Biological agents released in tunnels, 6) Incendiary conventional explosives, 7) HAZMAT release in tunnels, and 8) Intentional ramming via ship or barge.

5) Damage – considers any damage (as a result of an attack) that would result in the replacement of the transportation facility, cause major repair, closure of the facility for more than 30 days, or catastrophic failure of a facility.

6) Countermeasures – these are grouped into categories of deter attack, deny access, detect presence, defend the facility, or structural hardening. The purpose

of countermeasures is to minimize consequences of an attack to a predetermined acceptable level.

7) Code and Specification – identifies the need to provide guidance in design codes for structural hardening and implementation of the abovementioned countermeasures.

The panel also recommended the use of the National Bridge Inventory (NBI), which is maintained by FHWA for prioritization and risk assessment. They cited the need for a standard risk assessment procedure, since the countermeasures developed would likely be funded using federal dollars. The procedure that they suggested consisted of a two tier approach:

1) The prioritization of the facilities within a state, using the National Bridge Inventory (NBI), based on factors such as location, structure type, span length, average daily traffic volume, and military significance

2) The risk assessment of structures that are identified as high priority in the previous step, in order to determine vulnerabilities and develop countermeasures which detect, deter and defend against the potential threats identified. The panel stated that the Risk, R is determined using the following expression:

Where,

O= Occurrence Factor – likelihood that a basic threat will occur against a given structure.

V = Vulnerability Factor – how much damage or destruction will occur, and what effect that would have on the network.

I = Importance Factor – measures the consequences to the region or the public in the event that the structure is destroyed or severely damaged.

In 2002, the National Cooperative Highway Research Program (NCHRP) funded the development of "A Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection." The purpose of the guide was to assist State Departments of Transportation (DOTs) in assessing the vulnerability of their various highway transportation assets. Initially, the intent was also to better understand what common practices were being used in each state, and to provide the "best practices" as part of this guide. The guide was prepared so that users did not have to be proficient in the vulnerability assessment process, however, they did need to have a strong knowledge of the agency mission, critical assets, policies, plans and procedures.

The basic approach used in this guide is a six step procedure, shown in Figure 1. These six steps are integrated and iterative in nature, and depend highly upon the multidisciplinary team formed to conduct the assessment.

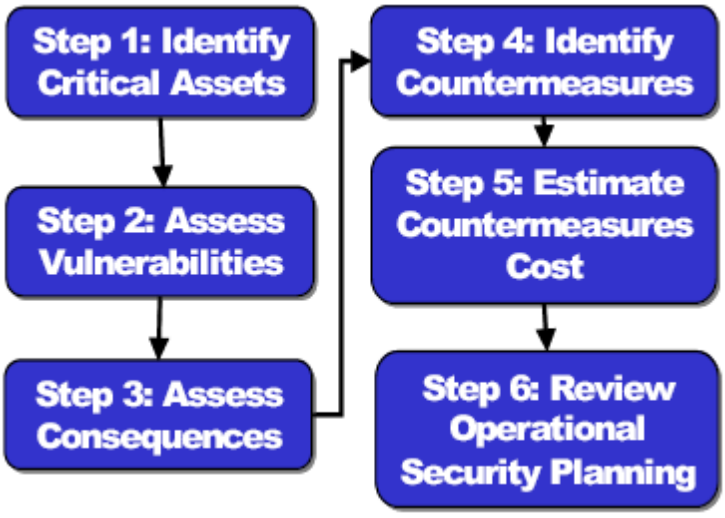

Figure 1: The six steps for conducting a vulnerability assessment (AASHTO 2002)

As mentioned above, this vulnerability assessment procedure requires the State DOTs to organize a multidisciplinary team of experts who are familiar with the department's mission, critical assets, policies, plans and procedures. The guide suggests that team members should represent the following departments:

- Budget
- Environmental Management
- Maintenance
- Purchasing
- Construction
- Facilities Management
- Materials Testing
- Safety
- Design
- Human Resources
- Planning
- Traffic Operations
- Communications

In addition, the team needs to include members of law enforcement, fire services, public safety, public health and emergency management personnel. In most cases, information on threats and vulnerabilities will originate from some of these organizations rather than from internal assets. It is also suggested that prior to conducting any vulnerability assessments, the team should go through classroom instruction and table top exercises in order to familiarize participants with the assessment process. In the classroom instruction, participants should be given instruction on the importance of the assessments as well as establish a common set of assumptions that the team will use during future assessments. The guide explicitly states that the composition of the team, number of members, and the level of experience and training will have a direct impact on the outcome and timeline of the vulnerability assessment. While this may be the case, it should be mentioned that it is

not feasible or attractive to owners to assemble such a team of experts on a regular basis to discuss these issues and conduct these assessments.

Time is also cited as being one of the most important resources available to the team conducting the assessment. It is stated that the vulnerability assessment process commonly occurs in three phases, 1) pre-assessment, 2) assessment, and 3) post-assessment. Depending on the complexity of the assessments conducted, it could take a team as long as six months to collect and analyze the data as well as implement the resulting countermeasures. The guide states that within this time period, it may be difficult for team members to carry out their normal job functions. Six months seems like a significant amount of time to have professionals dedicated to another mission beyond their normal job function. It does not seem feasible to ask State DOTs to dedicate personnel for this length of time, given today's budget constraints and high paced daily operations.

The first step of the NCHRP Vulnerability Assessment process is "Critical Assets Identification." This is where the team identifies the assets, infrastructure, facilities, equipment and personnel, that are critical in the context of achieving the overall mission of the agency. In order to develop this list of critical assets, the guide suggests using the following three step process:

1) **Create an all-inclusive list of critical assets** – this list should include all facilities, equipment, personnel and infrastructure that is critical to the department's mission. Table 2 below shows an example of a possible list of critical transportation assets:

INFRASTRUCTURE	FACILITIES	EQUIPMENT	PERSONNEL
▪ Arterial Roads ▪ Interstate Roads ▪ Bridges ▪ Overpasses ▪ Barriers ▪ Roads Upon Dams ▪ Tunnels	▪ Chemical Storage Areas ▪ Fueling Stations ▪ Headquarters Buildings ▪ Maintenance Stations/Yards ▪ Material Testing Labs ▪ Ports of Entry ▪ District/Regional Complexes ▪ Rest Areas ▪ Storm Water Pump Stations ▪ Toll Booths ▪ Traffic Operations Centers ▪ Vehicle Inspection Stations ▪ Weigh Stations	▪ Hazardous Materials ▪ Roadway Monitoring ▪ Signal & Control Systems ▪ Variable Messaging System ▪ Vehicles ▪ Communications Systems	▪ Contractors ▪ Employees ▪ Vendors ▪ Visitors

Table 2: Critical Transportation Assets (AASHTO 2002)

2) **Establish and assign values to the critical asset factors** – critical asset factors are the criteria used to identify and then prioritize critical assets. These factors indicate which factors the agency has determined would cause an asset to be labeled as critical. Each established factor is assigned a numerical value which is based on the importance of the factor in the overall criticality of an asset. Table 3 displays sample values that were developed by Texas DOT, and augmented by factors derived from the work of other states and federal agencies. This table shows a sample list of critical asset factors which can be used in the identification of critical assets.

CRITICAL ASSET FACTOR	VALUE	DESCRIPTION
Deter/Defend Factors		
A) Ability to Provide Protection	1	Does the asset lack a system of measures for protection? (i.e., Physical or response force)
B) Relative Vulnerability to Attack	2	Is the asset relatively vulnerable to an attack? (i.e., Due to location, prominence, or other factors)
Loss and Damage Consequences		
C) Casualty Risk	5	Is there a possibility of serious injury or loss of life resulting from an attack on the asset?
D) Environmental Impact	1	Will an attack on the asset have an ecological impact of altering the environment?
E) Replacement Cost	3	Will significant replacement cost (the current cost of replacing the asset with a new one of equal effectiveness) be incurred if the asset is attacked?
F) Replacement/Down Time	3	Will an attack on the asset cause significant replacement/down time?
Consequences to Public Services		
G) Emergency Response Function	5	Does the asset serve an emergency response function and will the action or activity of emergency response be affected?
H) Government Continuity	5	Is the asset necessary to maintain government continuity?
I) Military Importance	5	Is the asset important to military functions?
Consequences to the General Public		
J) Available Alternate	4	Is this the only asset that can perform its primary function? (i.e., There are no alternate facilities that will substitute adequately if this asset is damaged or destroyed)
K) Communication Dependency	1	Is communication dependent upon the asset?
L) Economic Impact	5	Will damage to the asset have an effect on the means of living, or the resources and wealth of a region or state?
M) Functional Importance	2	Is there an overall value of the asset performing or staying operational?
N) Symbolic Importance	1	Does the asset have symbolic importance?

Table 3: Critical Asset Factors and Values (AASHTO 2002)

3) **Prioritize the all-inclusive list of critical assets** – this is where the assessment team ranks each asset using the critical asset factors determined in the previous step. The guide suggests using a format shown in Table 4 to organize the team's data. Under Critical Asset, the team would list all of the assets identified, and then they would assign values for each asset using the criteria established above. At the end, columns A-N would be added horizontally, and a total score would be assigned for each asset. The scores are then organized from highest to lowest,

with the highest assets being the most critical and the lowest being the least critical. The maximum possible criticality value C_{max} is based on the values assigned in Table 3. C_{max} will undoubtedly vary from agency to agency, depending on the priorities of each department and the team assigned to conduct the vulnerability assessment. The total score calculated ( ) will also be used in calculating the criticality coordinate ( ) of each asset:

Criticality Coordinate ——

This criticality coordinate will be used later in the assessment process where a plot is created to graphically display the critical assets of a transportation agency.

CRITICAL ASSET	CRITICAL ASSET FACTOR														TOTAL SCORE (x)
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Asset 1															
Asset 2															
Asset 3															
Asset 4															
Asset 5															
Asset n															

Table 4: Critical Asset Scoring (AASHTO 2002)

The second step in the NCHRP Vulnerability Assessment process is the "Vulnerability Assessment" itself. This is designed to systematically identify and evaluate the critical assets cited in the previous step in terms of their susceptibility to terrorist attacks, and likewise the consequences if attacked. The suggested approach is also three steps:

1) Characterize the Threat – this step is one of the most complex and important steps in the entire vulnerability assessment process. Understanding the nature of the threat is critical in understanding the weaknesses of the overall system and

developing appropriate and effective countermeasures. Threat information can be briefed by many local law enforcement agencies, as well as the Transportation Security Administration. Some of this information is often classified, which means State DOTs need to remain proactive in ensuring that they have personnel within their offices who can receive this information.

2) Assign Vulnerability Factors to the Critical Assets – Table 5 shows the vulnerability factors that the guide suggests using to analyze the potential vulnerabilities of critical assets.

VULNERABILITY FACTOR	***DEFINITION***
Visibility and Attendance	Awareness of the existence of the asset and the number of people typically present
Access to the Asset	The availability of an asset to ingress and egress by a potential threat element
Site Specific Hazards	The presence of materials that have biological, nuclear, incendiary, chemical, or explosive properties in quantities that would expend initial response capabilities if compromised

Table 5: Vulnerability Factors (AASHTO 2002)

Furthermore, the vulnerability factors shown in the above table are then broken down into sub-elements as shown in Table 6. You will see each sub-element is labeled with a letter, which will be used in a chart later in this process.

VULNERABILITY FACTOR	*FIRST SUB-ELEMENT*	*SECOND SUB-ELEMENT*
Visibility and Attendance	Level of Recognition (A)	Attendance/Users (B)
Access to the Asset	Access Proximity (C)	Security Level (D)
Site Specific Hazards	Receptor Impacts (E)	Volume (F)

Table 6: Vulnerability Factor Sub-Elements (AASHTO 2002)

For the sub-elements shown above, values from 1 (less important) through 5 (extremely important) are assigned. See Tables 7 and 8 below for a more detailed description of the vulnerability factor default values and definitions.

VULNERABILITY FACTOR and DEFAULT VALUE			*DEFINITION*
Visibility and Attendance	**LEVEL OF RECOGNITION (A)**	1	Largely invisible in the community
		2	Visible by the community
		3	Visible Statewide
		4	Visible Nationwide
		5	Visible Worldwide
	ATTENDANCE/ USERS (B)	1	Less than 10
		2	10 to 100 (Major Incident per FEMA)
		3	100 to 1000
		4	1000 to 3000
		5	Greater than 3000 (Catastrophic Incident per FEMA)
Access to the Asset	**ACCESS PROXIMITY (C)**	1	Asset with no vehicle traffic and no parking within 50 feet
		2	Asset with no unauthorized vehicle traffic and no parking within 50 feet
		3	Asset with vehicle traffic but no vehicle parking within 50 feet
		4	Asset with vehicle traffic but no unauthorized vehicle parking within 50 feet
		5	Asset with open access for vehicle traffic and parking within 50 feet
	SECURITY LEVEL (D)	1	Controlled and protected security access with a response force available
		2	Controlled and protected security access without a response force
		3	Controlled security access but not protected
		4	Protected but not controlled security access
		5	Unprotected and uncontrolled security access

Table 7: Vulnerability Factor Default Values and Definitions- part 1(AASHTO 2002)

VULNERABILITY FACTOR and DEFAULT VALUE			DEFINITION
Site Specific Hazards	RECEPTOR IMPACTS (E)	1	No environmental or human receptor effects
		2	Acute or chronic toxic effects to environmental receptor(s)
		3	Acute and chronic effects to environmental receptor(s)
		4	Acute or chronic effects to human receptor(s)
		5	Acute and chronic effects to environmental and human receptor(s)
	VOLUME (F)	1	No materials present
		2	Small quantities of a single material present
		3	Small quantities of multiple materials present
		4	Large quantities of a single material present
		5	Large quantities of multiple materials present

Table 8: Vulnerability Factor Default Values and Definitions –part 2 (AASHTO 2002)

3) Score the Vulnerability Factor for each Critical Asset – this is the step where the vulnerability factor (is calculated for each critical asset. In the formula below, the sub-elements are multiplied by one another for visibility and attendance (A and B), access to the asset (C and D) and for site specific hazards (E and F). The three products are then added together to get the total vulnerability factor (.

Table 9, shown below, is used to organize the calculated data for each of the critical assets investigated.

CRITICAL ASSET	VULNERABILITY FACTOR											TOTAL SCORE (y)
	(A	*	B)	+	(C	*	D)	+	(E	*	F)	
	1-5	*	1-5	+	1-5	*	1-5	+	1-5	*	1-5	
Asset 1												
Asset 2												
Asset 3												
Asset 4												
Asset 5												
Asset n												

Table 9: Vulnerability Factor Scoring (AASTO 2002)

Once all the critical assets are scored, they should be ranked in order from highest to lowest total score. In order to calculate the Vulnerability Coordinate for each asset, the following formula is used:

—

Where, if using the tables above, 75 is the highest attainable vulnerability factor score, and 3 is the lowest attainable score. The calculated Vulnerability Coordinates will be plotted against the Criticality Coordinates calculated in the previous step to formulate a graphical display that can be used to assist agency leaders in understanding the results of the vulnerability assessments.

The third step in the vulnerability assessment process is "Consequence Assessment." This is where it is determined which assets, if attacked, produce the greatest risks for bad outcomes given specific circumstances. This step is broken down into two sub-steps:

1) Plot Critical Asset Criticality versus Vulnerability – The Criticality factors (X) and Vulnerability Factors (Y) calculated previously are plotted on the Criticality and Vulnerability Matrix as shown in Figure 2. As described previously, the equations for the X and Y coordinates are as follows:

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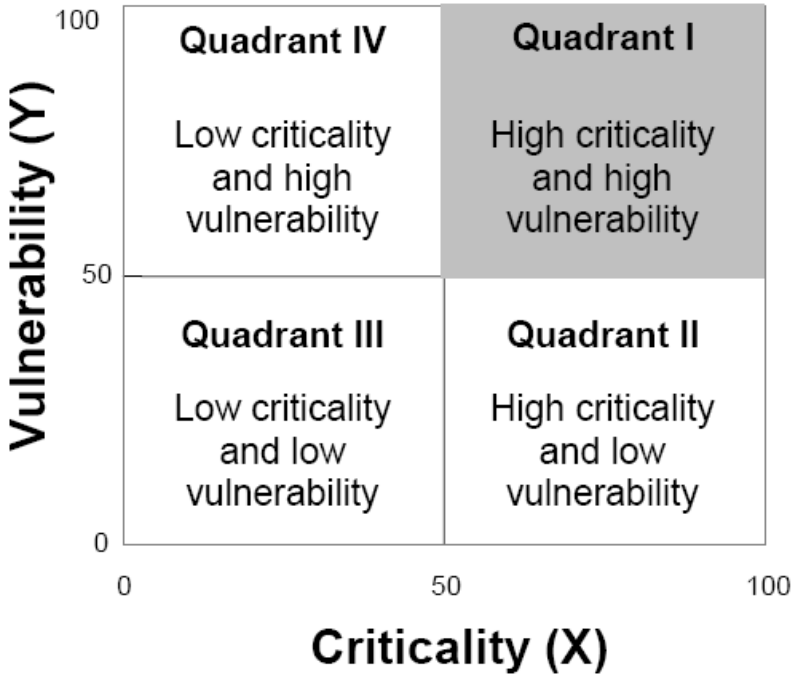

Figure 2: Criticality and Vulnerability Matrix (AASHTO 2002)

2) Consider Consequences for Quadrant I Critical Assets – As illustrated in the above figure, projects that are plotted in Quadrant I are projects that have both high criticality and high vulnerability, as opposed to projects which are plotted in Quadrant III, which have low criticality and low vulnerability. One of the major overall benefits of this method is that at the end of the vulnerability assessment phase, the agency has a graphical display of their results. This graph paints a clear picture to leadership as to how their assets compare to one another in terms of criticality and vulnerability. If most of the critical assets identified are in Quadrant III, then it may not justify spending a large sum of money on countermeasures, whereas if a majority of critical assets fall under Quadrant I, then leadership may need to prioritize more funds towards these efforts.

Steps four through six of the Vulnerability Assessment process consist of selecting appropriate countermeasures, estimating the cost of the selected countermeasures, and developing an operational security plan. The first three steps of the process provide the team members with adequate information and insight on what makes an asset critical and vulnerable, whereas, step four, "Select Countermeasures" is where the team makes decisions about what can be done to mitigate and reduce overall risk. It is impossible to believe that risk can be completely taken away, however, depending on what countermeasures are employed, critical assets can become far less vulnerable to attack. There are a large variety of common countermeasures employed by agencies, such as bollards, lights, CCTV Cameras, structural hardening, fencing, and eliminating parking. The above list is just a very small sample of possible methods of deterrence, detection and denial that an agency can employ to improve the security of their assets.

In today's society, there are many competing interests for funds, and therefore it is not possible to employ every countermeasure listed above in every situation. In step five of the vulnerability assessment process, "Cost Estimation" of the selected countermeasures is critical to implementation. This step is completed when a set of countermeasure packages has been established, and the agency needs to understand the cost and benefit of the overall package. There is an excellent tool, Costing Asset Protection for Transportation Agencies (CAPTA) that was created to assist transportation agencies in selecting appropriate countermeasures to mitigate risk under constrained budgetary requirements.

Overall, the NCHRP "A Guide to Highway Vulnerability Assessment" is an effective tool for agencies that have an excess of time and personnel to dedicate to the process. In many cases, it is not feasible to dedicate 10-12 personnel for up to six months on this project. Also, in order to determine the criticality and vulnerability of every bridge or highway project in the state, it would take the team an extremely long amount of time. The basic concepts from this report are useful, and are a good basis for personnel working on security projects to understand.

In a paper by Leung et. al (2004), the author presents a two level risk assessment system consisting of the system level, and the asset specific level. This two level system will assist owners and decision makers within the transportation industry to prioritize their assets in terms of which require the most protection. The basic process presented in this paper is called the Risk Filtering, Ranking, and Management (RFRM) Method. Figure 3 graphically displays the eight phases which this method is comprised of. The methodology uses the Hierarchical Holographic Model (HHM) to first identify potential risks, then ranks the possible sources of the risk. This allows leaders to focus their financial assets to mitigate the most critical source of risk. The prioritized risks that were identified earlier, are then further evaluated as they move into the risk management phase of the process. As with almost every risk management process, this is cyclical, meaning that once the process is completed, the overall system and assets are reviewed again to determine if the measures taken are acceptable.

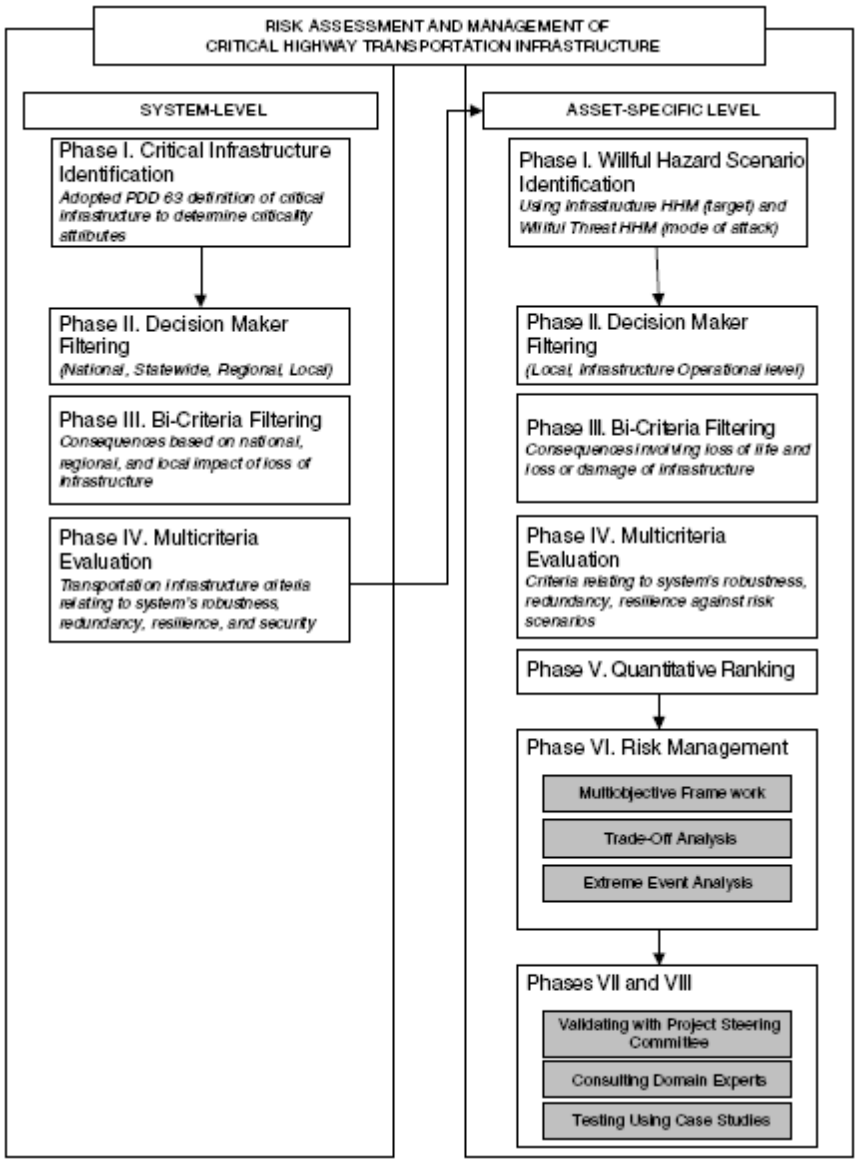

Figure 3: Risk Filtering, Ranking and Management (RFRM) Method Flow chart (Leung 2004)

In his paper, Williamson et. al (2005), described the need for designers to have a better understanding of risk and security as it relates to both aging and new construction. The author discusses in great detail several of the threats that bridges face. These threats include Vehicle Borne Improvised Explosive Devices (VBIED), hand placed explosives, and vehicle collisions. They also present the possibility of using "Countermeasure

packages" in order to simplify the risk management procedure and assist in prioritizing the allocation of resources to bridge categories. For example, a bridge that is found to be extremely critical, would be given a certain level of protection versus a bridge determined to be less critical. Table 10 shows an example of a "countermeasure package" based on the criticality and type of bridge in question.

Category			Protection measures	
Criticality category	Bridge importance	Protection level	Concrete girder bridge (<75 m span over land)	Cable stayed bridge (>100 m span over water)
All	All	Basic	Planning, coordination, and information control measures	
1	Very Important (criticality=91–100)	Maximum protection	CAT 2 and 3 measures Real-time CCTV Emergency telephones No parking under bridge Boundary penetration sensors below deck Steel jacketing around columns Additional rebar in top face of girder Additional measures based on threat level	CAT 2 and 3 measures Real-time CCTV Emergency telephones "Bridge out" warning system actuated by span failure detectors Intrusion detection systems inside tower Reinforce tower walls and use standoff barriers around towers Anchorages covered with protective armor plates Additional measures based on threat level
2	Important (criticality=71–90)	Some protection	CAT 3 measures Pier protection (concrete barricade)	CAT 3 measures Dummy CCTV cameras Pier protection (dolphins)
3	Slightly important (criticality=51–70)	Minimal protection	Improved lighting above deck	Improved lighting above and below deck Keyless entry systems on towers
4	Unimportant (criticality=0–50)	No additional protection	None	None

Note: CAT=category, and CCTV=closed circuit television. This table is only an example demonstrating bridge protection categories. It is not based on a cost–benefit assessment and is not intended to be all-inclusive or serve as a recommendation for specific protection measures.

Table 10: Example of Countermeasure Packages (Williamson 2005)

It became apparent in the days following September 11, 2001, that the New Jersey Department of Transportation did not have adequate security data collected on the bridges within their inventory. In an interview, former New Jersey State Bridge Engineer, Mr. Harry Capers Jr., P.E., stated that he was called into conversations with state leadership regarding the security of the bridges in New Jersey, and while he could point out several vulnerabilities off the top of his head, he did not have enough security data on the entire system. Shortly thereafter, the idea for the Rutgers Simple Bridge Security Checklist (Nassif et. al, 2006) was developed.

The methodology of the Rutgers Simple Bridge Security Checklist is very comparable to the NCHRP "A Guide to Highway Vulnerability Assessment." In this case, Risk is defined as:

Where,

O = Occurrence Factor – measures relative likelihood of a basic threat actually occurring against a given component on the bridge

V = Vulnerability Factor – measures the likelihood that a bridge will be susceptible to destruction by a given threat

I = Importance Factor – measures the importance of an individual component to the bridge.

During the development of the checklist, one of the major priorities of the research team was to make the tool as simple as possible for future users. This was accomplished by creating a series of simple yes/no questions, broken down into the three categories above.

The questions within the Occurrence Factor are designed to measure the relative likelihood of a basic threat actually occurring against a given component on the bridge. The threat likelihood is defined as the likelihood that a certain type of threat will be chosen instead of another type of threat. As discussed in the literature review, the most preferred weapon of choice is either a Vehicle Borne Improvised Explosive Device (VBIED) or a hand –emplaced explosive device. Either of these weapons, placed in the correct location, could cause significant damage to structural components of the bridge. The likelihood of a given threat against a given component narrows down the specific choice of weapon based on the type of bridge. For example, cutting devices are less likely to be employed when an adversary attacks a reinforced concrete pier. Likewise, the cutting device would be more likely to be employed in a situation where there were cables or wires exposed. The visibility, attractiveness, and access of a component is the likelihood that a component of the bridge will be recognized as critical to the overall structural stability. There are a total of 12 questions within the occurrence factor, as shown in Table 11.

Questions Related to the Occurrence Factor	
1	Is there enough lighting on the superstructure?
2	Is there enough space around the bearings to place a 6"x6"x6" object?
3	Can someone park under/on bridge?
4	Is there a shoulder on the bridge?
5	Is there a sidewalk or a pedestrian walkway?
6	Is there easy access to the deck from underneath the bridge?
7	Is there an access to the bearings?
8	Is there easy access to the pile cap?
9	Is there easy access to the abutment and/or the wingwalls?
10	Are pipelines located under/over bridge?
11	Are gas pipes located under/over bridge?
12	Are power lines located under/over bridge?

Table 11: Occurrence Factor Questions (Nassif 2006)

The questions within the Vulnerability Factor measure the likelihood that a bridge will be susceptible to destruction by a certain threat. Recently, there has been a significant amount of research published in the area of blast resistance. Blast resistance measures the amount of destruction that a component will face, given a certain threat (i.e. type and size of explosives). Terrorists, by nature, are extremely creative and will attempt to attack their target from the location that will cause the most destruction with the least amount of risk of being detected. This will ultimately decrease the vulnerability of certain bridge components, as it would either take too long or draw too much attention to launch the attack from there. There are a total of 19 questions within the vulnerability factor, as shown in Table 12. Several of these questions are specifically related to emergency management processes, which if in place, decrease the overall vulnerability of the structure.

Questions Related to the Vulnerability Factor	
1	Are the bearings securely anchored in place?
2	Is the pier/tower a single column, two-column, three-column or more than 3?
3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
6	Are these plans coordinated with local and state police departments?
7	Are specific response agency numbers (other than 911) available and up to date?
8	Do personnel receive security awareness training? If yes, how often?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
10	Does the facility have auxiliary operation system?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
14	If radio communications are used, are there two or more dedicated radio frequencies?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?
18	What is the bridge sufficiency rating?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

Table 12: Vulnerability Factor Questions (Nassif 2006)

The questions within the Importance Factor measure the importance of an individual component to the bridge. It is important to examine the structural importance of each component, as it relates to the overall stability of the bridge. Each bridge has a certain number of components that if attacked, would result in the complete collapse and therefore, destruction of the bridge. Historical significance of certain bridge components also could cause certain components to be more attractive to adversarial attacks. High cost components are also important to consider, because of the financial burden it would cost to repair these items if attacked. Time out of service for the bridge if certain

components are damaged can cause a large impact on the traveling public and surrounding communities. For example, there are several bridges that connect mainland and island populations along the coast of the United States. If any of those bridges were shut down indefinitely, there is the potential for having large populations stranded for extended periods of time without life support. There are a total of 5 questions within the importance factor, as shown in Table 13.

Questions Related to the Importance Factor	
1	Is the bridge near or on route to high value target?
2	Is the bridge over or near chemical/refinery/industrial facility?
3	What is the length of the longest span in feet?
4	What is the annual average daily traffic of the bridge?
5	Is the bridge part of an Evacuation Route?

Table 13: Importance Factor Questions (Nassif 2006)

One of the major differences between the Rutgers Simple Bridge Security Checklist and the NCHRP "A Guide for Highway Vulnerability Assessment" is the length of time required to complete the assessment. In order to follow all of the steps (explained in detail above) for the NCHRP tool, it could take up to six months or more for the designated team of personnel dedicated to the project. Conversely, the Rutgers Simple Bridge Security Checklist allows agencies to collect data in a short time. The checklist was created using excel format, which makes this tool even more attractive, as there is no special software required for its use.

In terms of implementation, the Rutgers Simple Bridge Security Checklist could be easily added into the cyclical Bridge Inspection Programs. Several of the questions in the checklist could be answered simply by looking at a set of "As-built" plans in the office,

and the rest of the data is easily collected on-site. From the checklist data collected by the Bridge Inspectors, agencies would have a database full of security related information at their disposal. It was predicted that the checklist could be completed for most bridges within one hour, although for more complex and high profile bridges, it may take a longer time period to collect the necessary data.

Unlike the NCHRP "A Guide for Highway Vulnerability Assessment," The Rutgers Simple Bridge Security Checklist has not been used to collect security data for a real project. Case studies have been done using the checklist, and the results have seemed extremely promising. Currently, there are a series of weights assigned to each question, which were chosen arbitrarily. The tool was calibrated using the case studies mentioned above, and the results seemed consistent with the results of other tools run parallel. Since the weights were not assigned to the questions based on actual research, the validity of the overall assessment of risk has been questioned.

Similar approaches to risk were presented in a paper by Ray et. al (2007), where he describes a risk-based methodology that was developed to assist agencies in the prioritization of threat mitigation strategies on individual bridges. The unique perspective of this research included breaking down each bridge and looking at the overall risk based on the risk of each of their own individual structural components. In his analysis, he used the same equation as above,

> Where,
> O= Occurrence – measures the relative likelihood of a basic threat actually occurring against a given component

V = Vulnerability- the relative vulnerability of a given component, given the occurrence of a basic threat.

I = Importance – the importance of an individual component to the bridge.

In 2009, the National Infrastructure Protection Plan (NIPP) was updated. The goal of the NIPP is to:

"Build a safer, more secure, and more resilient America by preventing, deterring, neutralizing, or mitigating the effects of deliberate efforts by terrorists to destroy, incapacitate, or exploit elements of our Nation's Critical Infrastructure and Key Resources (CIKR) and to strengthen national preparedness, timely response, and rapid recovery of CIKR in the event of an attack, natural disaster, or other emergency." (NIPP 2009)

The National Infrastructure Protection Plan serves as the unifying document for integrating the existing and future critical infrastructure and key resource protection resources. As you can see from the graphic below, the NIPP includes actions to deter threats, mitigate vulnerabilities, and minimize consequences associated with a terrorist attack or other type of natural disaster. Initially, following the tragic events of September 11, 2001, our focus was only in the area of protection against terrorism. More recently, in the wake of the devastating effects of natural disasters such as Hurricane Katrina, our security focus has expanded to include minimizing the consequences caused by natural disasters.

Figure 4: Flow Chart on Protection (NIPP 2009)

There are many methodologies available for use in calculating new weights for the checklist questions. The Analytic Hierarchy Process (AHP) was created by Thomas L. Saaty in the early 1970's and is based on both mathematics and psychology (Saaty 1980). Since it was introduced, this methodology has been used and studied in many different applications. The AHP provides users with a rational framework for making a complex decision and evaluating numerous alternate solutions. It continues to be used in government, business, healthcare and education. The Analytic Hierarchy Process can be used by one person trying to make a straightforward decision, or can be even more effective when used by a group of people attempting to analyze a more complex problem.

The Analytic Hierarchy Process gives the user the ability to derive ratio scales from paired comparisons. The concept of paired comparisons is the basis for any analysis of a decision making problem through the use of AHP. A paired comparison is when a

decision maker compares elements two by two. This allows the decision maker to incorporate judgment into the decision. For example, suppose the user has to compare two different job locations, New York and California. The decision maker would have to choose which location they liked the best, and also how much more they like that location over the other location.

CHAPTER 3. METHODOLOGY AND DEVELOPMENT OF SURVEY

The Rutgers Simple Bridge Security Checklist is comprised of a series of mostly yes/no questions and a select few quantitative answers broken down into three categories Occurrence, Vulnerability and Importance. Currently, each question is given a weight which is used in the calculation of risk using the answers to the questions. When each question is answered, the spreadsheet automatically assigns a total value equal to the response (yes or no) multiplied by the weight. Currently, the phrasing of the questions in the checklist is not consistent with yes indicating increased risk, and no meaning less overall risk. The advantage of wording questions in this manner is that it is more intuitive to the user. If the answer yes is chosen for a question, this means that there is more risk for the bridge, i.e. the higher the overall risk value and the more critical the security of the structure is.

In addition, the assignment of the question weights was not based on statistical research, rather on a few case studies done to test the accuracy of the checklist. Changing the weights can have a serious impact on the overall results obtained from using this checklist, either by improving the accuracy or increasing the overall error. Bridge security is a widely discussed topic, however, the importance of many of the questions within the checklist is highly subjective. There were several different decision making methodologies available to calibrate the weights for the checklist. A survey could be created for which the participants were asked to rank each question from highest to lowest importance within each category. This type of survey would have been a very quick way to collect the data, however, the degree of importance of each of the questions

relative to one another would not have been measured. This survey would have only provided a ranking for each question, and not the degree of importance.

Instead of using the ranking approach, the Analytic Hierarchy Process (AHP) was chosen for this project. The Analytic Hierarchy Process is a decision making tool that is widely used by personnel in management, and science when faced with unique and complex decisions in order to better understand the problem that they are faced with and also to communicate with others why a particular course of action was chosen (Saaty 1980). Using the AHP for this type of application is a new concept, so part of the significance of the research presented in this paper is to evaluate the usefulness of the AHP in risk based analysis.

In order to collect data, a survey was created and distributed to subject matter experts from across the country, including New Jersey, New York, Pennsylvania, California, Texas, Washington, and Oregon. Many of the individuals selected to participate in the survey are current bridge owners and past bridge owners. Other participants included private sector bridge engineers, bridge inspectors, homeland security specialists, and academic researchers. Figure 5 shows the breakdown of participants within each of the three major categories; government, the private sector, and academia. As shown, over 50% of the survey respondents were representing government agencies. It was important to get a high amount of government participation in the conduct of this survey, since this is the audience of future users of the security checklist. It was recognized that in order to

encourage owners to use the checklist, their feedback on the importance of each of the questions was a critical component to success in future implementation.

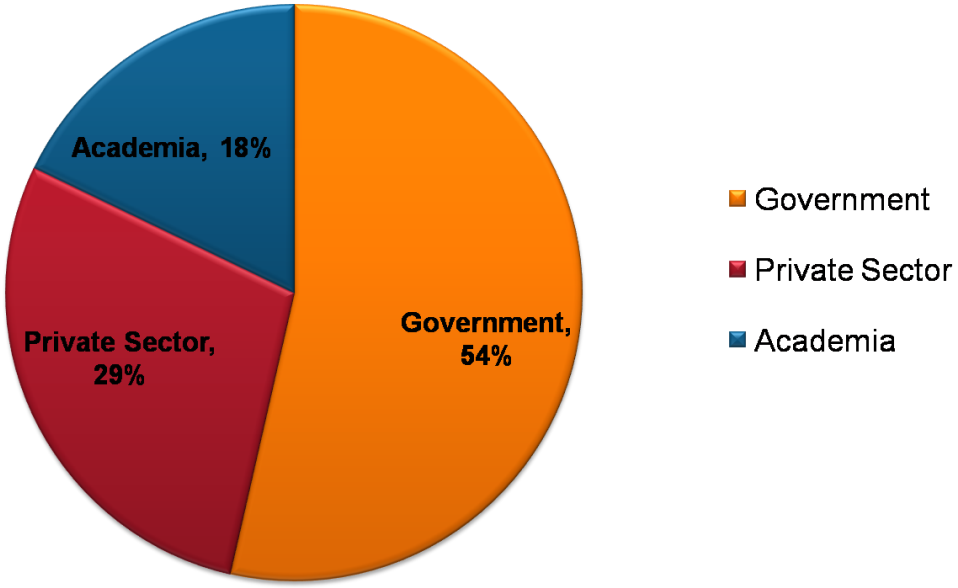

Figure 6: Survey Participant breakdown

The Rutgers Simple Bridge Security Checklist consists of 37 total questions broken into three categories. A major assumption during the development of the survey was that each of the three categories of questions would contribute equally to the overall risk. This meant that the survey could be written such that the questions within the Occurrence factor were only compared to each other, not the questions in the other two factors. The same holds true for the questions within the other two categories. Therefore, the checklist has three equal categories of questions, and each question has a unique weight assigned to it based on the importance of the question with regards to the other questions within the same category.

The survey was created as an electronic form in Microsoft Word 2007, and consisted of 246 multiple choice questions with the following answer choices:

a) Extreme Less Importance
b) Very Strong Less Importance
c) Strong Less Importance
d) Moderately Less Importance
e) Equal Importance
f) Moderate Importance
g) Strong Importance
h) Very Strong Importance
i) Extreme Importance

Participants were asked to choose only one answer to each survey question. A blank copy of the checklist can be found in Appendix A. In most AHP applications, in order to understand the accuracy of the answers, it is common to ask each question twice. The relative importance of two checklist questions would be assessed and then a few questions later, the same comparison would be asked. If both answers on the survey are consistent, it is a good indication of how strong the data is. Since there are so many questions to compare on the Rutgers Simple Bridge Security Checklist, this type of consistency check was not completed. In order to complete this type of consistency check, the survey would have required 492 questions. It was decided that a survey of this length would take too long to complete.

CHAPTER 4. ANALYSIS OF SURVEY RESULTS

In order to translate the judgments from the paired comparison, Saaty recommends using the scale given within Table 14 below. This numerical scale allows the decision maker to quantify the intensity of the judgments and give the results a mathematical basis for analysis. For example, elements that are viewed as being equal in importance, are assigned the numerical value of 1. An element that is viewed as being extremely more important than another element is assigned a numerical value of 9. Likewise, if an element is viewed as extremely less important than another element, the first element is assigned a numerical value of 1/9. As shown in Table 13, intermediate values of 2, 4, 6, and 8 could be used to describe intermediate levels of importance. However, use of these intermediate values complicates the fundamental scale of the AHP.

The Fundamental Scale for Pairwise Comparisons		
Intensity of Importance	**Definition**	**Explanation**
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation
Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities 1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance.		

Table 14: The Fundamental Scale of Pair-wise Comparisons (Saaty 1980)

For this project, the fundamental scale of pair-wise comparisons shown in Table 13 was used. Once the surveys were completed by the subject matter experts, the answers were input into an Excel spreadsheet for analysis. As shown in Table 15, a numerical value was assigned to the answer of each question.

	Multiple Choice Answer	Intensity of Importance
a	Extreme Less Importance	1/9
b	Very Strong Less Importance	1/7
c	Strong Less Importance	1/5
d	Moderately Less Importance	1/3
e	Equal Importance	1
f	Moderate Importance	3
g	Strong Importance	5
h	Very Strong Importance	7
i	Extreme Importance	9

Table 15: Fundamental Scale used in the analysis of survey results

Once all of the surveys were entered into the Excel spreadsheet, the numerical values for each of the questions were averaged among all of the survey participants. Once this was completed, a reciprocal matrix was created to calculate the new weights using all of the pair-wise comparisons. The size of the reciprocal matrix was determined by the number of pair-wise comparisons made. For this project, there were three (3) reciprocal matrices created, one for each of the three categories of questions.

In the case of the occurrence factor, there were 12 questions, thus 12 pair-wise comparisons made. As shown in Table 16, the 12x12 reciprocal matrix was built using the averaged responses of the survey participants. The diagonal elements of the matrix are all equal to 1, since it is assumed that when a question is compared to itself, the

relative importance is always equal. The values on the upper part of the diagonal within the matrix are the averaged values from the survey participants. The values on the lower part of the diagonal within the matrix are the reciprocal values of the upper part of the diagonal. Below the matrix, the sums of each column are shown in red. These values are used in the next step of the analysis in normalizing the reciprocal matrix.

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	3.63	1.78	2.96	3.14	1.92	2.00	2.54	2.56	2.41	1.18	2.88
2	0.28	1.00	1.76	2.03	1.59	1.19	0.79	1.80	2.15	1.30	1.16	1.74
3	0.56	0.57	1.00	4.61	4.45	2.83	3.10	3.31	3.86	3.65	2.01	3.60
4	0.34	0.49	0.22	1.00	1.70	1.21	1.34	1.45	1.95	1.55	1.13	1.58
5	0.32	0.63	0.22	0.59	1.00	1.03	0.92	1.49	1.40	1.52	1.01	1.70
6	0.52	0.84	0.35	0.82	0.97	1.00	1.85	2.15	3.44	2.45	1.55	2.58
7	0.50	1.26	0.32	0.74	1.09	0.54	1.00	2.27	2.99	2.57	1.35	3.00
8	0.39	0.56	0.30	0.69	0.67	0.47	0.44	1.00	2.45	2.58	1.52	2.86
9	0.39	0.46	0.26	0.51	0.71	0.29	0.33	0.41	1.00	1.85	0.71	2.39
10	0.42	0.77	0.27	0.65	0.66	0.41	0.39	0.39	0.54	1.00	0.51	1.90
11	0.84	0.86	0.50	0.88	0.99	0.65	0.74	0.66	1.40	1.96	1.00	5.15
12	0.35	0.57	0.28	0.63	0.59	0.39	0.33	0.35	0.42	0.53	0.19	1.00
SUM	**5.91**	**11.65**	**7.27**	**16.12**	**17.56**	**11.93**	**13.24**	**17.80**	**24.16**	**23.35**	**13.34**	**30.39**

Table 16: Reciprocal Matrix for the Occurrence Factor Questions

The next step in the analysis of the data according to the Analytic Hierarchy Process was to normalize the matrix shown in Table 16 using basic Linear Algebra concepts. This is accomplished by dividing each value of the reciprocal matrix by the sum of the column that the value is in. Therefore, the sum of the normalized matrix is equal to 1, which allows the values within each column to be compared. The matrix shown in Table 17 is the normalized matrix for the Occurrence Factor Questions. As shown, the sum of each of the columns now is equal to 1.

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.17	0.31	0.25	0.18	0.18	0.16	0.15	0.14	0.11	0.10	0.09	0.09
2	0.05	0.09	0.24	0.13	0.09	0.10	0.06	0.10	0.09	0.06	0.09	0.06
3	0.10	0.05	0.14	0.29	0.25	0.24	0.23	0.19	0.16	0.16	0.15	0.12
4	0.06	0.04	0.03	0.06	0.10	0.10	0.10	0.08	0.08	0.07	0.08	0.05
5	0.05	0.05	0.03	0.04	0.06	0.09	0.07	0.08	0.06	0.07	0.08	0.06
6	0.09	0.07	0.05	0.05	0.06	0.08	0.14	0.12	0.14	0.10	0.12	0.08
7	0.08	0.11	0.04	0.05	0.06	0.05	0.08	0.13	0.12	0.11	0.10	0.10
8	0.07	0.05	0.04	0.04	0.04	0.04	0.03	0.06	0.10	0.11	0.11	0.09
9	0.07	0.04	0.04	0.03	0.04	0.02	0.03	0.02	0.04	0.08	0.05	0.08
10	0.07	0.07	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.04	0.04	0.06
11	0.14	0.07	0.07	0.05	0.06	0.05	0.06	0.04	0.06	0.08	0.07	0.17
12	0.06	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.03
SUM	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Table 17: Normalized Reciprocal Matrix for the Occurrence Factor Questions

The final step in computing the weights using the Analytic Hierarchy Process was to calculate the principal eigenvector of the normalized matrix. The principal eigenvector is also called the priority vector, and is calculated by taking the average of each row of the normalized reciprocal matrix. Table 18 shows the principal eigenvector or priority vector for the questions within the Occurrence Factor. The end results, shown in the principal eigenvector, are now based on statistical concepts as opposed to the previous weights which were assumed as part of the Rutgers Simple Bridge Security Checklist.

	Weight
1	0.1613
2	0.0951
3	0.1720
4	0.0714
5	0.0605
6	0.0923
7	0.0856
8	0.0654
9	0.0450
10	0.0419
11	0.0775
12	0.0320
SUM	1

Table 18: Principal Eigenvector for the Occurrence Factor Questions

A similar analysis was completed for each of the three categories of questions and can be found in Appendix B. The principal eigenvector for the Vulnerability Factor and the Importance Factor questions are shown in Tables 19 and 20.

	Weight
1	0.0656
2	0.1044
3	0.1179
4	0.0674
5	0.0567
6	0.0521
7	0.0510
8	0.0518
9	0.0417
10	0.0399
11	0.0480
12	0.0419
13	0.0331
14	0.0253
15	0.0448
16	0.0565
17	0.0289
18	0.0417
19	0.0313
SUM	1

Table 19: Principal Eigenvector for the Vulnerability Factor Questions

	Weight
1	0.3624
2	0.2443
3	0.1250
4	0.1459
5	0.1225
SUM	1

Table 19: Principal Eigenvector for the Importance Factor Questions

Following the calculation of the weights using the Analytic Hierarchy Process, the consistency of the data was checked. A comparison matrix is said to be consistent if the following mathematical relationship is true:

Thomas Saaty proved that to achieve a consistent reciprocal matrix, the largest eigenvalue ( ) is equal to the size of the comparison matrix, or . Following this logic, Saaty then derived a measure of consistency, which is called the Consistency Index (CI). The consistency Index is defined using the following expression:

where: λ_{max} = Largest Principal Eigenvalue
n = size of the comparison matrix

The consistency ratio of a comparison matrix is calculated using the following expression:

where: CI = Consistency Index (calculated above)
RI = Random Consistency Index

The Random Consistency Index is taken from Table 21, which was developed by Thomas Saaty. The values displayed in the table were derived from a sample of over 500 randomly generated reciprocal matrices using the same scale as described previously for pair wise comparisons.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Table 21: Random Consistency Index (RI) values (Saaty 1980)

Saaty concluded that if the CR < 0.1, then the inconsistency is acceptable, however if the CR > 0.10 then the subjective judgment needs to be revised. Saaty also concluded that if the CR is very close to 0.10, then it is acceptable for most cases. The Consistency Ratios were checked for each of the three factors, following the calculation of the Principal Eigenvalues, and are shown in Table 22 below. In most cases, the CR was less than 0.10, however, in one case it was equal to 0.1277. Since this is still very close to 0.10, it was concluded that this value was acceptable for the purpose of this research.

	Occurrence Factor	Vulnerability Factor	Importance Factor
λ_{max} =	13.005	20.712	5.572
CI =	0.091	0.095	0.143
RI =	1.48	1.59	1.12
C.R. =	6.18%	5.98%	12.77%

Table 22: Consistency Check for Occurrence, Vulnerability and Importance Factor

Following the analysis of all of the survey results averaged together, there was an interest in breaking the survey responses down into the three groups mentioned previously; government, private sector and academia. It was important to further categorize the analysis of the survey data because this creates a clear picture of the ideological differences that are present between groups of subject matter experts. The same methodology (as described above) was followed for each of the three different groups. The resulting weights for each category were then compared to understand if ideological differences were present between the three different groups.

It was found that when the survey data was categorized, the trends between the different groups (Government, Private Sector, and Academia) were generally consistent with one another. However, this was not the case when the new weights were compared to the weights assumed previously for the checklist. There were several questions within each factor that varied from what was originally assumed. The figures in the next section graphically display the new weights for each question, as well as the weights that were originally assumed during previous versions of the checklist.

Occurrence Factor

The new weights for some of the questions within the Occurrence Factor varied greatly from the weights from previous versions of the checklist (see Figure 6). Some of these differences could be attributed to a shift in ideology by practitioners. For example, the first question of the checklist asks "Is there enough lighting on the superstructure?" In the development of the previous version of the checklist, this question was assigned a relatively low weight compared with other questions within the Occurrence Factor. When the weights were calculated using the Analytic Hierarchy Process, this question was found to be weighted approximately 1.5 times the original weight. Some of this difference can be accounted for by the fact that practitioners believe that proper lighting on a structure acts as a deterrent.

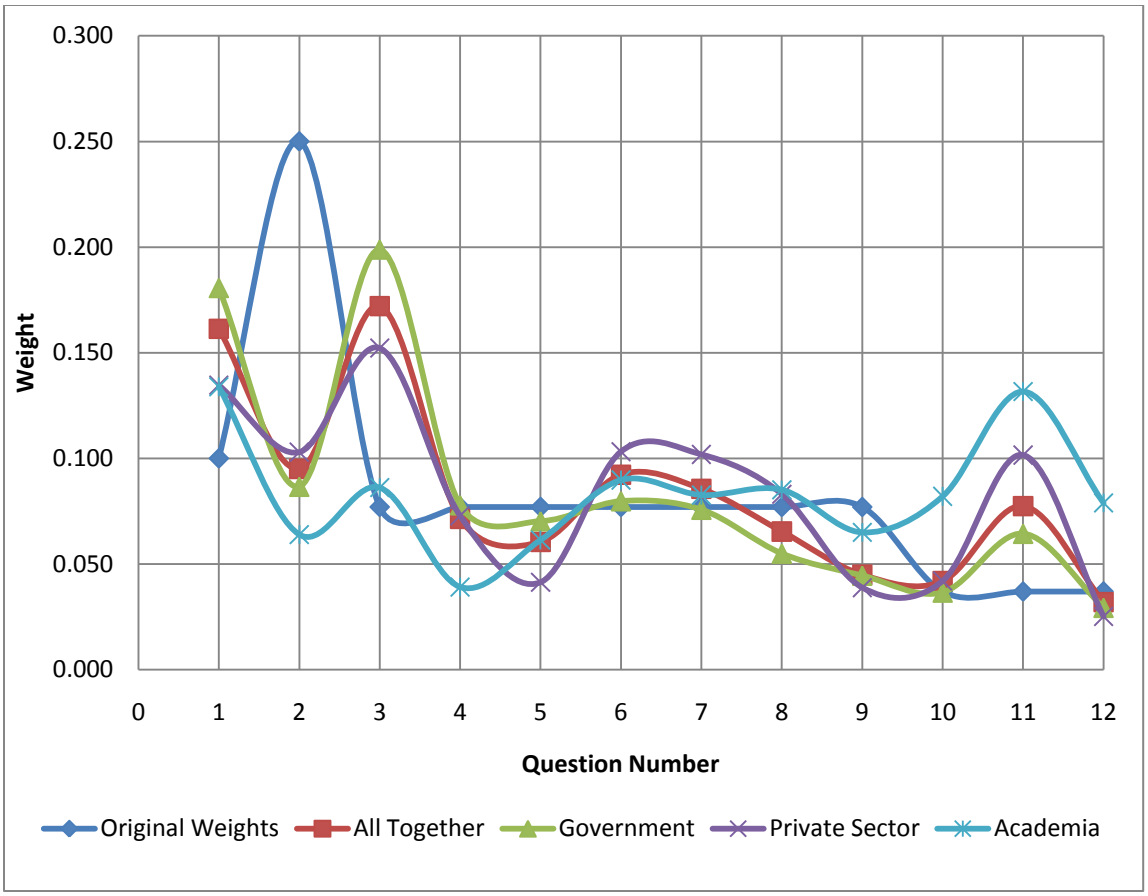

Figure 6: Comparison of Question Weights within the Occurrence Factor

Likewise, there is also a large difference between the original and new weights for question 2, which asks "Is there enough space between the bearings to place a 6"x6"x6" object?" In the previous version of the checklist, this question was weighted as 0.250, which was the highest weighted question within the Occurrence Factor. When the weights were calculated using the Analytic Hierarchy Process, the weight for this question was reduced to 0.095. A possible explanation for this change is that from the viewpoint of the practitioner, most bridges require spaces that are larger than 6"x6"x6" in the area of the bearings. This space is necessary for bridge inspectors to assess elements of the bridge, and is extremely common, with the exception of bridges with integral abutments. It is the viewpoint of many practitioners that the actual threat of a Vehicle

Borne Improvised Explosive Device (VBIED) far outweighs the threat of a package bomb placed in the area of the bearings. Thus, the overall weight of this question was significantly reduced, and the weight of question 3 was increased.

Question 3 asks "Can someone park under/on the bridge?" In the previous version of the checklist, this question was given a weight of 0.07, which was significantly smaller than the original weight of question 2. After this analysis, the weight for this question was increased to 0.172, making it the most heavily weighted question within the Occurrence Factor. As illustrated by the ranking of question 3, in general, practitioners feel that the most likely threat to a bridge is a VBIED. If access is limited under/on a bridge, then the structure is a less desirable target for a terrorist attack of this type.

The weights for questions 4 - 10 and 12 came out relatively similar to what was assumed in previous versions of the checklist. Most of these questions relate to access to several of the key components of a bridge. It is important to limit the amount of access to key components of a structure, however, it is not feasible to limit all access to components because of maintenance and inspection requirements.

Question 11 asks "Are gas pipes located under/over bridge?" The weights for this question increased from 0.04 in the previous version of the checklist to 0.0775 after this analysis. The presence of gas pipes located under/over the bridge aids a potential aggressor in his/her quest to cause destruction and could make the structure a more attractive target. Also, to maintain life support, it is important for owners to understand which structures include utility supply lines. The disruption of a utility adds to the

impact of an attack, so it could be concluded that the presence of a utility is an area of interest to a bridge owner. This was proven by the dramatic increase in weight of question 11 as a result of the survey.

Vulnerability Factor

The new weights for questions within the Vulnerability Factor also varied greatly from the weights assumed in previous versions of the checklist (see Figure 7). Question 1 asks "Are the bearings securely anchored in place?" This question attempts to determine the resistance of a specific component of the bridge to a given threat. If an all-hazards approach is taken, this question addresses the vulnerability of a structure to natural disasters, such as an earthquake, in addition to a terrorist attack. The weight that was assumed for this question in the previous version of the checklist was 0.05. The updated weight based on the research analysis is 0.066. While this is not a drastic change, the weights for questions 2 through 4 display a much different trend.

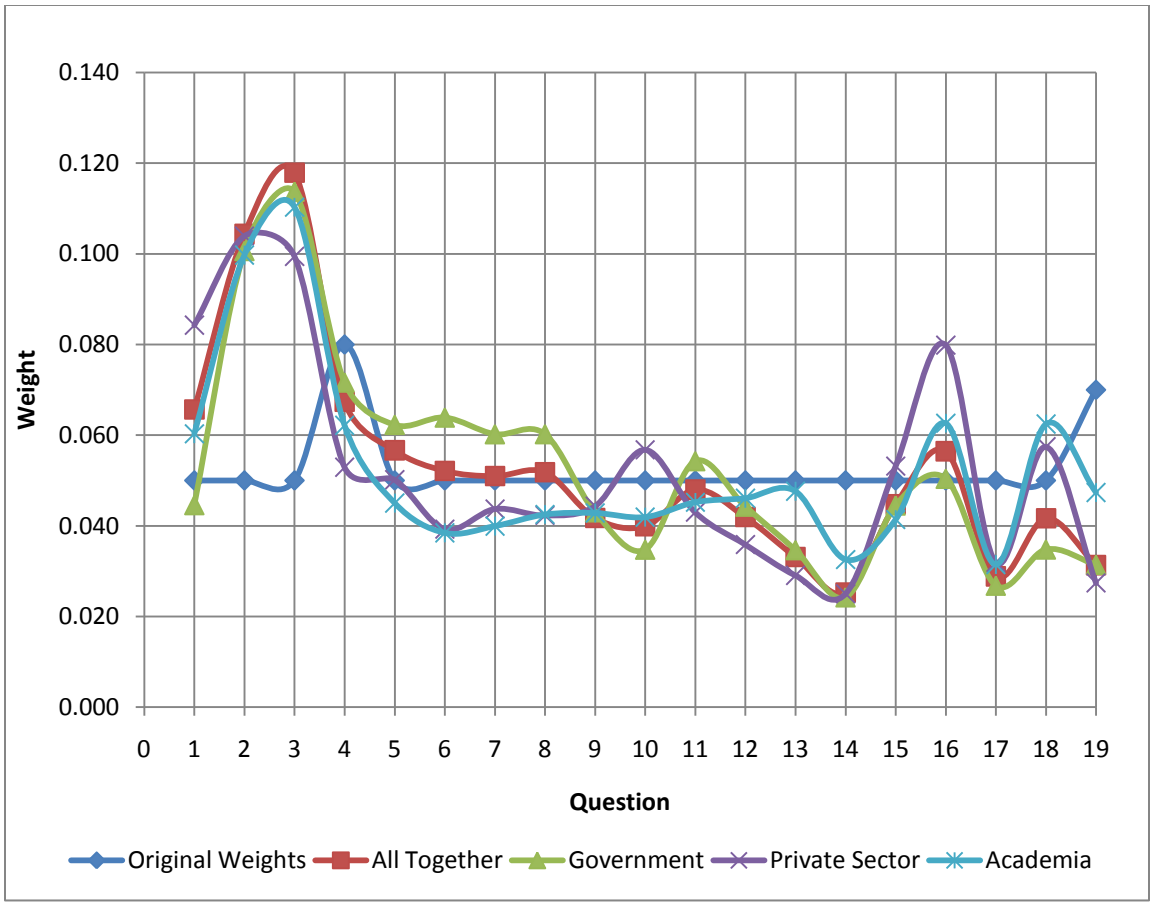

Figure 7: Comparison of Questions Weights within the Vulnerability Factor

Questions 2 and 3 are designed to quantify the redundancy of certain key components of a bridge, along with the resistance of this component to a given threat. Previously, the weight for questions 2 and 3 was 0.05 each. After this analysis, the weight for question 2 was increased to 0.104 and question 3 was increased to 0.118. These new weights are at least double what was originally assumed, which shows that practitioners feel strongly about the importance of redundancy and the resistance of certain key components against an attack.

Questions 4 through 14 are directly related to emergency management and contingency planning. In previous versions of the checklist, these questions were all weighted

equally, which is in line with the results of this analysis. A common critique of the previous version of the checklist was that bridge inspection crews would not have this information/data easily available to them at the time of the inspection. Several owners felt that while questions 4 through 14 provide them with valuable information on existing emergency management procedures and contingency plans, the questions are better answered by State Emergency Management personnel. In order to improve the flexibility of the checklist and tailor it to the needs of the users, these questions were removed from the "Bridge Inspector" version of the checklist.

The new weight for question 17 was found to be significantly lower than what was used assumed in the previous version of the checklist. Question 17 asks "Is there a secure perimeter around the bridge? Around certain components?" One explanation for the difference in weights is the fact that it is impractical to provide a secure perimeter around a typical roadway bridge. In most cases, the level of deterrence provided by such a perimeter does not justify the cost of creating it. Academics suggest that providing a secure perimeter around a structure makes it less vulnerable to novice criminal activity and deters potential aggressors. Additionally, question 19 asks "Is there protection around the pier/tower?" The purpose of this question is similar to that of question 17. After the analysis of the new survey data, the weight for this question was greatly reduced from what was assumed in the previous version of the checklist.

Importance Factor

The Importance Factor question weights had the most dramatic changes out of all the three categories of questions (see Figure 8). There are a total of 5 questions within the Importance Factor. The purpose of these questions is to quantify the relative importance of a structure based on factors such as historical/cultural significance, length of span, proximity to high value targets and Average Daily Traffic (ADT) on the bridge. The questions within the Importance Factor could also easily be used for an all-hazards approach to emergency management and operations. The answers to these questions provide bridge owners with information that could be useful during a terrorist attack, a criminal incident, or a natural disaster.

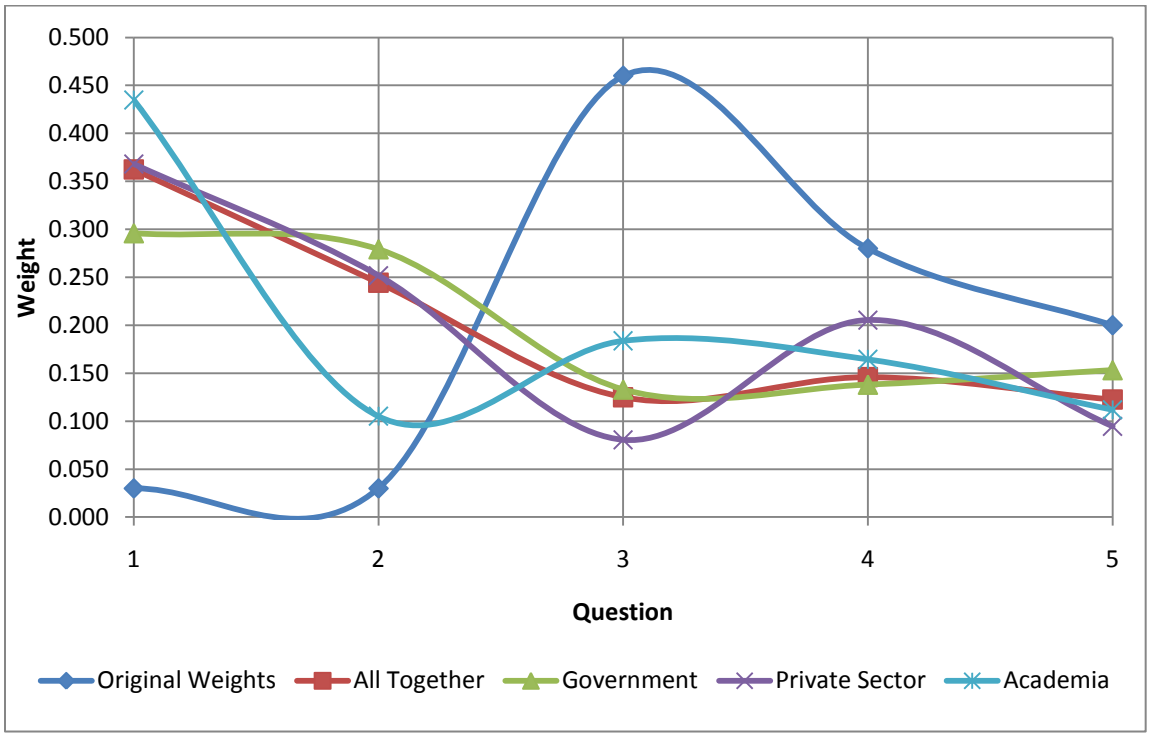

Figure 8: Comparison of Question Weights within the Importance Factor

In the previous version of the checklist, question 1 was weighted very low compared to the other questions within this factor. Following the analysis of the survey data, the weight for this question was drastically increased. Question 1 asks "Is the bridge near or en-route to a high value target?" Past terrorist incidents have shown that our adversaries have motivation to disrupt the American way of life. Attacking a bridge which is within close proximity to a high value target, allows terrorists to create additional chaos and confusion for first responders and possible evacuees.

In addition, the weight assigned to question 3 in the original version of the checklist was significantly higher than the new weight assigned after this analysis. Question 3 asks "What is the length of the longest span in feet?" Academically, it could be argued that this question quantifies the importance of the structure based on the magnitude of its longest span. Therefore, the longer the span, the greater the importance of the structure. It was recognized by practitioners that while the length of the longest span is important, the proximity of a bridge to a high value target or a chemical refinery/industrial facility is more critical.

CHAPTER 5. ANALYSIS OF TEST BRIDGES

Following the completion of the analysis of the survey data, the new weights were added to the previous version of the checklist. As noted in earlier chapters, there was a significant amount of difference between the previous weights and the new weights. In order to understand the overall effect that this change of weights had on the checklist, the new version of the checklist was used in an academic security analysis of three test bridges. The three bridges used for the test analysis were the George Washington Bridge, the Route 18 over River Road Bridge, and the Atlantic City Bridge over Beach Thorofare. These three bridges were selected and used to evaluate and test the previous version of the checklist.

The George Washington Bridge is a very well known suspension bridge spanning the Hudson River connecting New York City and Fort Lee, New Jersey. This bridge has two levels, and carries 14 lanes of traffic. It has been estimated to carry over 106 million vehicles per year, which makes it one of the most well traveled bridges in the world. The longest span on the George Washington Bridge is 3,500 feet, and the average daily traffic is estimated to be approximately 289,329. Of the three test bridges used to evaluate the checklist, this was the largest and most historically significant structure. When the previous version of the checklist was created, the overall value of risk was calculated for this structure. Of the three bridges tested, this bridge had the largest amount of risk, which was 0.67. When the new version of the checklist was created using the updated weights, the overall risk for this structure was found to be 0.54.

The Route 18 over River Road Bridge is a simple deck girder bridge which was opened to traffic in 1960. This bridge has a total of two spans, and carries a total of 7 lanes of traffic. The total length of the Route 18 over River Road Bridge is only 150 feet, and the average annual daily traffic for this bridge is approximately 96,128. Of the three bridges used to evaluate the checklist, this was the smallest and least historically significant bridge. When the previous version of the checklist was created, the overall value of risk was calculated for this structure. This bridge was found to have the smallest amount of risk, which was 0.12. When the new version of the checklist was created using the updated weights, the overall risk for this structure was found to be 0.02.

The Atlantic City Bridge over Beach Thorofare is a moveable bascule bridge which was built in 1946. This bridge has a total length of 475 feet with the largest span being 81 feet long. The average annual daily traffic for this bridge is approximately 57,000, and the bridge has a sufficiency rating of 45.5. Of the three bridges used to evaluate the checklist, this bridge was thought to have a moderate amount of risk associated with it because of the moving span. When the previous version of the checklist was created, the overall value of risk was calculated for this structure. This bridge was found to have a moderate risk of 0.44. When the new version of the checklist was created using the updated weights, the overall risk for this structure was found to be 0.37.

	Risk, R = O x V x I		
	Original Checklist	**New Checklist Inspector Version**	**New Checklist Owner Version**
Example 1: George Washington Bridge	**0.67**	**0.54**	**0.54**
Example 2: Route 18 over River Road Bridge	**0.12**	**0.02**	**0.03**
Example 3: Atlantic City Bridge over Beach Thorofare	**0.44**	**0.37**	**0.41**

Table 23: Comparison of overall risk of three test bridges

As shown in Table 23, the overall risk of each of the three bridges was calculated using both the previous version and the new version of the checklist. The table also shows two versions of the new checklist, the inspector version and the owner version. The difference between the inspector and the owner version is that questions 4-14 are removed from the Vulnerability Factor section of the checklist in the inspector version. Questions 4-14 are all related to emergency management and contingency planning operations. These questions enhance the value of the checklist by providing the owner additional security related data, however, the removal of these questions did not significantly change the overall value of risk for any of the three bridges tested. The owner version of the checklist includes questions 4-14. These trends are shown in Figure 9 below.

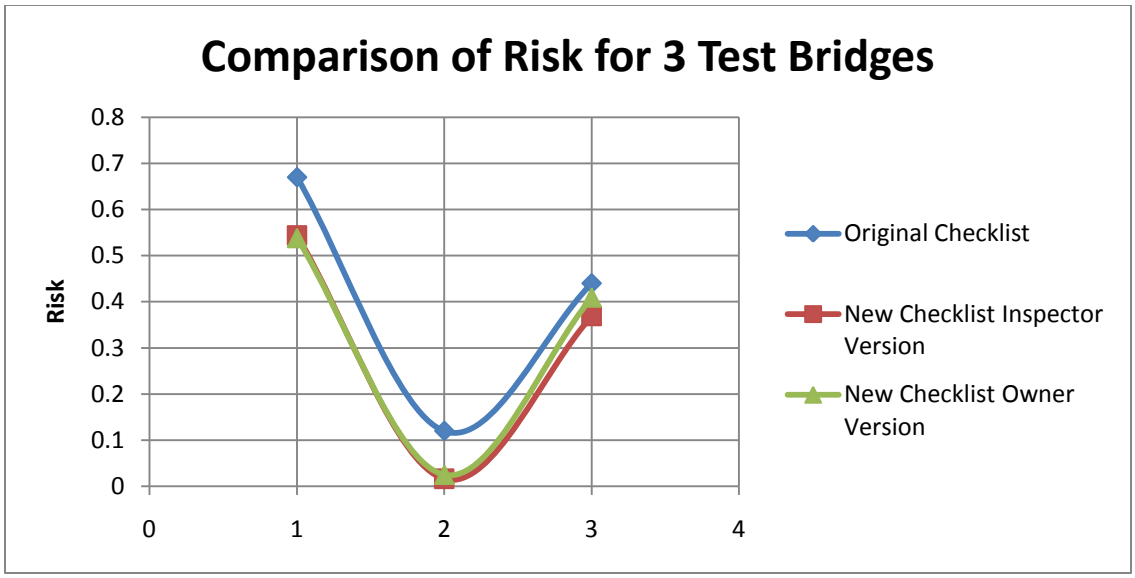

Figure 9: Comparison of Risk for 3 Test Bridges

The feasibility of the implementation of this checklist has been an area of concern because of the training, time and cost involved in using this tool. From the tests above, it was estimated that this checklist could be completed by an inspector in a total of approximately one hour per bridge. Given that there are roughly 6,900 bridges in the state of New Jersey, this would add a great amount of additional cost to the current bridge inspection program. It would also be necessary to provide bridge inspectors with training on the use of the checklist prior to its use. Although the initial cost of implementation would be high, this checklist would only have to be filled out once for every bridge, and then updated only when the bridge has been rehabilitated, replaced or a major change has occurred. The data collected would be maintained in a database managed by state leadership, and could be useful not only in the event of a terrorist attack, but also in emergency management operations.

In order to reduce the estimated amount of time to complete the checklist, a sensitivity analysis was conducted for the new version of the checklist. Since it was found that the emergency management related questions within the Vulnerability Factor section could be removed without the overall risk fluctuating a great deal, it was felt that there might be other questions that could be removed as well. The new checklist has a total of 37 questions, and the inspector version of the checklist (with the emergency management questions removed) has only 26 questions. The removal of the emergency management questions alone reduced the length of the checklist by approximately 30%.

In order to determine which questions should be removed, the new weights were looked at within each factor. The questions within each factor that had the lowest weights were removed. The weights for the remaining questions were then recalculated using the survey data and the Analytical Hierarchy Process. The questions within the Occurrence Factor were reduced from twelve to nine. The items chosen for removal all had weights smaller than 0.06. The new weights for the remaining nine questions were calculated and returned to the checklist for the test bridges. In all cases, the reduction of the number of questions also reduced the total value calculated for the Occurrence Factor.

	Occurrence Factor		
	New Checklist All Questions	New Checklist 9 Questions	New Checklist 7 Questions
Example 1: George Washington Bridge	0.81	0.79	0.76
Example 2: Route 18 over River Road Bridge	0.55	0.51	0.45
Example 3: Atlantic City Bridge over Beach Thorofare	0.74	0.71	0.67

Table 24: Sensitivity Analysis for the Occurrence Factor

	Occurrence Factor	
	New Checklist 9 Questions	New Checklist 7 Questions
Example 1: George Washington Bridge	2%	6%
Example 2: Route 18 over River Road Bridge	7%	18%
Example 3: Atlantic City Bridge over Beach Thorofare	4%	9%

Table 25: Percent change in values for the Occurrence Factor

As shown in Tables 24 and 25, when the number of questions within the Occurrence Factor was reduced from twelve to nine, the largest percentage of change in value was 7%. This seems like an acceptable difference. However, when the number of questions within the Occurrence Factor was reduced from twelve to seven, the percentage of change was not as small. In the case of the George Washington Bridge, the percentage change was only about 6%, but in the case of the smaller Route 18 over River Road Bridge, the percent change was 18%. This is a very large difference, which shows that the removal of these two questions would affect the validity of the checklist.

As discussed, questions 4 through 14 were removed from the Vulnerability Factor because there was a concern with the ability of bridge inspectors to answer these questions. Similar to the analysis done for the questions within the Occurrence Factor, these questions were removed and new weights were calculated using the Analytical Hierarchy Process and the survey data collected.

	Vulnerability Factor	
	New Checklist All Questions	New Checklist 8 Questions
Example 1: George Washington Bridge	0.67	0.67
Example 2: Route 18 over River Road Bridge	0.68	0.44
Example 3: Atlantic City Bridge over Beach Thorofare	0.67	0.61

Table 26: Sensitivity Analysis for the Vulnerability Factor

	Vulnerability
	New Checklist 8 Questions
Example 1: George Washington Bridge	0%
Example 2: Route 18 over River Road Bridge	35%
Example 3: Atlantic City Bridge over Beach Thorofare	9%

Table 27: Percent change in values for the Vulnerability Factor

As shown in Tables 26 and 27, when the number of questions within the Vulnerability Factor was reduced from nineteen to eight, the largest percentage of change in value was 35%. This is a very large difference, which shows that in some applications, the removal of these eleven questions would affect the validity of the checklist. For the larger structures, the removal of the emergency management questions does not have a huge effect on the outcome of the checklist. In the case of a smaller more typical highway bridge, the removal of these questions significantly reduces the overall vulnerability of the structure, thus reducing the overall risk. It could be recommended that the checklist is used by inspectors without these questions, however, the addition of the emergency management questions would increase the overall accuracy of the assessment and provide the owner with a greater amount of information for their database.

A sensitivity analysis was not completed for questions within the Importance Factor. There are only a total of six questions within this section of the checklist, and the removal of any of these questions would have a very large impact on the overall outcome of the value of the factor. Therefore, it was concluded that all of these questions were necessary and should be included in the checklist.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

The analytical hierarchy process (AHP) proved to be an effective methodology to use in determining the weights for the Rutgers Simple Bridge Security Checklist. It was relatively simple to create the survey, however, the drawback was that the survey was extremely long in length. On average, it took each participant approximately an hour to complete the survey, which made it a challenge to collect a large sample size of data. With more survey data, these weights would undoubtedly fluctuate, and the outcome would be stronger justification for the weights described in this research. Although the sample size of the data shown above was limited, the participants were from a wide variety of geographic areas, which makes the weights calculated relevant to all states, not just those within the northeast.

The consistency of the data collected and analyzed through the Analytical Hierarchy Process was very good overall. In all cases, the consistency ratio was less than or equal to 10%, which was the metric that Saaty used to justify the level of consistency within a sample of data. Since the survey was 246 questions long, the amount of data collected was extremely large and cumbersome. The creation of a simple excel spreadsheet to compile the survey data made the manipulation of survey data and analysis of this data much easier. If additional survey data was collected, the process for compiling the data would be an important consideration because of the large amount. An online survey could be created, which self compiles the results into a database. This would greatly reduce the length of time spent organizing the data, and would also eliminate some of the possible error involved in inputting the results into excel.

Consensus from many of the survey participants was that the survey itself was entirely too long, and many suggested that a ranking system would have been a more efficient way to generate these weights. In the future, it would be beneficial to test this theory and generate weights for the questions using this approach, and then compare the results. The Analytical Hierarchy Process was carefully selected as the methodology for calculating the weights for this checklist because of the unique opportunity to understand the relationships between questions, not just the overall ranking of each question. Since the survey provided a paired comparison of each question and its relationship with every other question, less important questions could be removed, the analysis could be re-run and it was possible to run a sensitivity analysis.

From the results of the sensitivity analysis, it was concluded that there could be some reduction of the number of total questions within the checklist, particularly within the Occurrence Factor. It was established that removing 3 questions from that factor, reduced the overall result by less than 10%. However, when 5 questions were removed from the Occurrence Factor, the overall result of the factor changed 18%, which is a very large difference. Therefore, it could be concluded that the removal of the first 3 questions was feasible, however, the last 2 would make too much of a difference, especially in the case of a typical highway deck girder bridge. In the case of the larger, more important structures, the percent difference is much less.

Following the sensitivity analysis described above, it is recommended that the number of questions within the checklist remain at 37 for the owner version, and 26 for the inspector version. While the removal of the 3 additional questions from the Occurrence Factor did not significantly change the result of the overall checklist, the exclusion of these questions limits the amount of security data collected by the agency. The benefit of reducing the checklist by a total of 3 questions is extremely narrow. The exclusion of only 3 questions will not change the overall length of time of completion by a large enough margin to make it worthwhile.

Likewise, the permanent elimination of the 11 questions within the Vulnerability Factor is not recommended. It is recommended that two versions of the checklist remain, so that the owner can continue to collect the data related to emergency management operations. The inspector version is what the owners can expect the bridge inspectors to use if the checklist is added to the current inspection program. These 26 questions would be answered initially, then updated only when there are significant changes to the bridge or the environment around the bridge.

As stated, the purpose of this checklist is to assist owners in collecting security data on all bridges within their inventory. It is believed that with the improvements noted above, this checklist will be a simplistic method for owners to accomplish this task, and improve the overall preparedness of their organization.

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APPENDIX A: BRIDGE SECURITY SURVEY

Rutgers Simple Bridge Security Checklist Survey

Please select only 1 answer per question.

A. Survey Question: Compare the questions within the Occurrence Factor

1. How do you compare the importance of Question 1 with respect to Question 2?

1	Is there enough lighting on the superstructure?
2	Is there enough space around the bearings to place a 6"x6"x6" object?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

2. How do you compare the importance of Question 1 with respect to Question 3?

1	Is there enough lighting on the superstructure?
3	Can someone park under/on bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

3. How do you compare the importance of Question 1 with respect to Question 4?

1	Is there enough lighting on the superstructure?
4	Is there a shoulder on the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

4. How do you compare the importance of Question 1 with respect to Question 5?

1	Is there enough lighting on the superstructure?
5	Is there a sidewalk or a pedestrian walkway?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

5. How do you compare the importance of Question 1 with respect to Question 6?

1	Is there enough lighting on the superstructure?
6	Is there easy access to the deck from underneath the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

6. How do you compare the importance of Question 1 with respect to Question 7?

1	Is there enough lighting on the superstructure?
7	Is there an access to the bearings?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

7. How do you compare the importance of Question 1 with respect to Question 8?

1	Is there enough lighting on the superstructure?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

8. How do you compare the importance of Question 1 with respect to Question 9?

1	Is there enough lighting on the superstructure?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

9. How do you compare the importance of Question 1 with respect to Question 10?

1	Is there enough lighting on the superstructure?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

10. How do you compare the importance of Question 1 with respect to Question 11?

1	Is there enough lighting on the superstructure?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

11. How do you compare the importance of Question 1 with respect to Question 12?

1	Is there enough lighting on the superstructure?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

12. How do you compare the importance of Question 2 with respect to Question 3?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
3	Can someone park under/on bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

13. How do you compare the importance of Question 2 with respect to Question 4?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
4	Is there a shoulder on the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

14. How do you compare the importance Question 2 with respect to Question 5?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
5	Is there a sidewalk or a pedestrian walkway?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

15. How do you compare the importance of Question 2 with respect to Question 6?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
6	Is there easy access to the deck from underneath the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

16. How do you compare the importance of Question 2 with respect to Question 7?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
7	Is there an access to the bearings?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

17. How do you compare the importance of Question 2 with respect to Question 8?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

18. How do you compare the importance of Question 2 with respect to Question 9?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

19. How do you compare the importance of Question 2 with respect to Question 10?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

20. How do you compare the importance of Question 2 with respect to Question 11?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

21. How do you compare the importance of Question 2 with respect to Question 12?

2	Is there enough space around the bearings to place a 6"x6"x6" object?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

22. How do you compare the importance of Question 3 with respect to Question 4?

3	Can someone park under/on bridge?
4	Is there a shoulder on the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

23. How do you compare the importance of Question 3 with respect to Question 5?

3	Can someone park under/on bridge?
5	Is there a sidewalk or a pedestrian walkway?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

24. How do you compare the importance of Question 3 with respect to Question 6?

3	Can someone park under/on bridge?
6	Is there easy access to the deck from underneath the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

25. How do you compare the importance of Question 3 with respect to Question 7?

3	Can someone park under/on bridge?
7	Is there an access to the bearings?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

26. How do you compare the importance of Question 3 with respect to Question 8?

3	Can someone park under/on bridge?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

27. How do you compare the importance of Question 3 with respect to Question 9?

3	Can someone park under/on bridge?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

28. How do you compare the importance of Question 3 with Question 10?

3	Can someone park under/on bridge?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

29. How do you compare the importance of Question 3 with Question 11?

3	Can someone park under/on bridge?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

30. How do you compare the importance of Question 3 with Question 12?

3	Can someone park under/on bridge?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

31. How do you compare the importance of Question 4 with respect to Question 5?

4	Is there a shoulder on the bridge?
5	Is there a sidewalk or a pedestrian walkway?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

32. How do you compare the importance of Question 4 with respect to Question 6?

4	Is there a shoulder on the bridge?
6	Is there easy access to the deck from underneath the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

33. How do you compare the importance of Question 4 with respect to Question 7?

4	Is there a shoulder on the bridge?
7	Is there an access to the bearings?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

34. How do you compare the importance of Question 4 with respect to Question 8?

4	Is there a shoulder on the bridge?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

35. How do you compare the importance of Question 4 with respect to Question 9?

4	Is there a shoulder on the bridge?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

36. How do you compare the importance of Question 4 with respect to Question 10?

4	Is there a shoulder on the bridge?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

37. How do you compare the importance of Question 4 with respect to Question 11?

4	Is there a shoulder on the bridge?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

38. How do you compare the importance of Question 4 with respect to Question 12?

4	Is there a shoulder on the bridge?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

39. How do you compare the importance of Question 5 with respect to Question 6?

5	Is there a sidewalk or a pedestrian walkway?
6	Is there easy access to the deck from underneath the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

40. How do you compare the importance of Question 5 with respect to Question 7?

5	Is there a sidewalk or a pedestrian walkway?
7	Is there an access to the bearings?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

41. How do you compare the importance of Question 5 with respect to Question 8?

5	Is there a sidewalk or a pedestrian walkway?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

42. How do you compare the importance of Question 5 with respect to Question 9?

5	Is there a sidewalk or a pedestrian walkway?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

43. How do you compare the importance of Question 5 with respect to Question 10?

5	Is there a sidewalk or a pedestrian walkway?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

44. How do you compare the importance of Question 5 with respect to Question 11?

5	Is there a sidewalk or a pedestrian walkway?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

45. How do you compare the importance of Question 5 with respect to Question 12?

5	Is there a sidewalk or a pedestrian walkway?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

46. How do you compare the importance of Question 6 with respect to Question 7?

6	Is there easy access to the deck from underneath the bridge?
7	Is there an access to the bearings?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

47. How do you compare the importance of Question 6 with respect to Question 8?

6	Is there easy access to the deck from underneath the bridge?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

48. How do you compare the importance of Question 6 with respect to Question 9?

6	Is there easy access to the deck from underneath the bridge?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

49. How do you compare the importance of Question 6 with respect to Question 10?

6	Is there easy access to the deck from underneath the bridge?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

50. How do you compare the importance of Question 6 with respect to Question 11?

6	Is there easy access to the deck from underneath the bridge?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

51. How do you compare the importance of Question 6 with respect to Question 12?

6	Is there easy access to the deck from underneath the bridge?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

52. How do you compare the importance of Question 7 with respect to Question 8?

7	Is there an access to the bearings?
8	Is there easy access to the pile cap?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

53. How do you compare the importance of Question 7 with respect to Question 9?

7	Is there an access to the bearings?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

54. How do you compare the importance of Question 7 with respect to Question 10?

7	Is there an access to the bearings?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

55. How do you compare the importance of Question 7 with respect to Question 11?

7	Is there an access to the bearings?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

56. How do you compare the importance of Question 7 with respect to Question 12?

7	Is there an access to the bearings?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

57. How do you compare the importance of Question 8 with respect to Question 9?

8	Is there easy access to the pile cap?
9	Is there easy access to the abutment and/or the wingwalls?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

58. How do you compare the importance of Question 8 with respect to Question 10?

8	Is there easy access to the pile cap?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

59. How do you compare the importance of Question 8 with respect to Question 11?

8	Is there easy access to the pile cap?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

60. How do you compare the importance of Question 8 with respect to Question 12?

8	Is there easy access to the pile cap?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

61. How do you compare the importance of Question 9 with respect to Question 10?

9	Is there easy access to the abutment and/or the wingwalls?
10	Are pipelines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

62. How do you compare the importance of Question 9 with respect to Question 11?

9	Is there easy access to the abutment and/or the wingwalls?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

63. How do you compare the importance of Question 9 with respect to Question 12?

9	Is there easy access to the abutment and/or the wingwalls?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

64. How do you compare the importance of Question 10 with respect to Question 11?

10	Are pipelines located under/over bridge?
11	Are gas pipes located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

65. How do you compare the importance of Question 10 with respect to Question 12?

10	Are pipelines located under/over bridge?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

66. How do you compare the importance of Question 11 with respect to Question 12?

11	Are gas pipes located under/over bridge?
12	Are power lines located under/over bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

B. Survey Question: Compare the questions within the Vulnerability Factor

67. How do you compare the importance of Question 1 with respect to Question 2?

1	Are the bearings securely anchored in place?
2	Is the pier/tower a single column, two-column, three-column or more than 3?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

68. How do you compare the importance of Question 1 with respect to Question 3?

1	Are the bearings securely anchored in place?
3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

69. How do you compare the importance of Question 1 with respect to Question 4?

1	Are the bearings securely anchored in place?
4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

70. How do you compare the importance of Question 1 with respect to Question 5?

1	Are the bearings securely anchored in place?
5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

71. How do you compare the importance of Question 1 with respect to Question 6?

1	Are the bearings securely anchored in place?
6	Are these plans coordinated with local and state police departments?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

72. How do you compare the importance of Question 1 with respect to Question 7?

1	Are the bearings securely anchored in place?
7	Are specific response agency numbers (other than 911) available and up to date?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

73. How do you compare the importance of Question 1 with respect to Question 8?

1	Are the bearings securely anchored in place?
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

74. How do you compare the importance of Question 1 with respect to Question 9?

1	Are the bearings securely anchored in place?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

75. How do you compare the importance of Question 1 with respect to Question 10?

1	Are the bearings securely anchored in place?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

76. How do you compare the importance of Question 1 with respect to Question 11?

1	Are the bearings securely anchored in place?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

77. How do you compare the importance of Question 1 with respect to Question 12?

1	Are the bearings securely anchored in place?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

78. How do you compare the importance of Question 1 with respect to Question 13?

1	Are the bearings securely anchored in place?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

79. How do you compare the importance of Question 1 with respect to Question 14?

1	Are the bearings securely anchored in place?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

80. How do you compare the importance of Question 1 with respect to Question 15?

1	Are the bearings securely anchored in place?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

81. How do you compare the importance of Question 1 with respect to Question 16?

1	Are the bearings securely anchored in place?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

82. How do you compare the importance of Question 1 with respect to Question 17?

1	Are the bearings securely anchored in place?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

83. How do you compare the importance of Question 1 with respect to Question 18?

1	Are the bearings securely anchored in place?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

84. How do you compare the importance of Question 1 with respect to Question 19?

1	Are the bearings securely anchored in place?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

85. How do you compare the importance of Question 2 with respect to Question 3?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

86. How do you compare the importance of Question 2 with respect to Question 4?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

87. How do you compare the importance of Question 2 with respect to Question 5?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

88. How do you compare the importance of Question 2 with respect to Question 6?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
6	Are these plans coordinated with local and state police departments?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

89. How do you compare the importance of Question 2 with respect to Question 7?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
7	Are specific response agency numbers (other than 911) available and up to date?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

90. How do you compare the importance of Question 2 with respect to Question 8?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

91. How do you compare the importance of Question 2 with respect to Question 9?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

92. How do you compare the importance of Question 2 with respect to Question 10?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

93. How do you compare the importance of Question 2 with respect to Question 11?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

94. How do you compare the importance of Question 2 with respect to Question 12?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

95. How do you compare the importance of Question 2 with respect to Question13?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

96. How do you compare the importance of Question 2 with respect to Question 14?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

97. How do you compare the importance of Question 2 with respect to Question 15?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

98. How do you compare the importance of Question 2 with respect to Question 16?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

99. How do you compare the importance of Question 2 with respect to Question 17?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

100. How do you compare the importance of Question 2 with respect to Question 18?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

101. How do you compare the importance of Question 2 with respect to Question 19?

2	Is the pier/tower a single column, two-column, three-column or more than 3?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

102. How do you compare the importance of Question 3 with respect to Question 4?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

103. How do you compare the importance of Question 3 with respect to Question 5?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

104. How do you compare the importance of Question 3 with respect to Question 6?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
6	Are these plans coordinated with local and state police departments?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

105. How do you compare the importance of Question 3 with respect to Question7?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
7	Are specific response agency numbers (other than 911) available and up to date?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

106. How do you compare the importance of Question 3 with respect to Question 8?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

107. How do you compare the importance of Question 3 with respect to Question9?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

108. How do you compare the importance of Question 3 with respect to Question 10?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

109. How do you compare the importance of Question 3 with respect to Question 11?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

110. How do you compare the importance of Question 3 with respect to Question 12?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

111. How do you compare the importance of Question 3 with respect to Question 13?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

112. How do you compare the importance of Question 3 with Question 14?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

113. How do you compare the importance of Question 3 with respect to Question 15?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

114. How do you compare the importance of Question 3 with respect to Question 16?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

115. How do you compare the importance of Question 3 with respect to Question 17?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

116. How do you compare the importance of Question 3 with respect to Question 18?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

117. How do you compare the importance of Question 3 with respect to Question 19?

3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

118. How do you compare the importance of Question 4 with respect to Question 5?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

119. How do you compare the importance of Question 4 with respect to Question 6?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
6	Are these plans coordinated with local and state police departments?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

120. How do you compare the importance of Question 4 with respect to Question 7?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
7	Are specific response agency numbers (other than 911) available and up to date?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

121. How do you compare the importance of Question 4 with respect to Question 8?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

122. How do you compare the importance of Question 4 with respect to Question 9?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

123. How do you compare the importance of Question 4 with respect to Question 10?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

124. How do you compare the importance of Question 4 with respect to Question 11?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

125. How do you compare the importance of Question 4 with respect to Question 12?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

126. How do you compare the importance of Question 4 with respect to Question 13?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

127. How do you compare the importance of Question 4 with respect to Question 14?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

128. How do you compare the importance of Question 4 with respect to Question 15?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

129. How do you compare the importance of Question 4 with respect to Question 17?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

130. How do you compare the importance of Question 4 with respect to Question 18?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

131. How do you compare the importance of Question 4 with respect to Question 19?

4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

132. How do you compare the importance of Question 5 with respect to Question 6?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
6	Are these plans coordinated with local and state police departments?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

133. How do you compare the importance of Question 5 with respect to Question 7?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
7	Are specific response agency numbers (other than 911) available and up to date?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

134. How do you compare the importance of Question 5 with respect to Question 8?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

135. How do you compare the importance of Question 5 with respect to Question 9?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

136. How do you compare the importance of Question 5 with respect to Question 10?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

137. How do you compare the importance of Question 5 with respect to Question 11?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

138. How do you compare the importance of Question 5 with respect to Question 12?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

139. How do you compare the importance of Question 5 with respect to Question 13?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

140. How do you compare the importance of Question 5 with respect to Question 14?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

141. How do you compare the importance of Question 5 with respect to Question 15?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

142. How do you compare the importance of Question 5 with respect to Question 16?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

143. How do you compare the importance of Question 5 with respect to Question 17?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

144. How do you compare the importance of Question 5 with respect to Question 18?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

145. How do you compare the importance of Question 5 with respect to Question 19?

5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

146. How do you compare the importance of Question 6 with respect to Question 7?

6	Are these plans coordinated with local and state police departments?
7	Are specific response agency numbers (other than 911) available and up to date?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

147. How do you compare the importance of Question 6 with respect to Question 8?

6	Are these plans coordinated with local and state police departments?
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

148. How do you compare the importance of Question 6 with respect to Question 9?

6	Are these plans coordinated with local and state police departments?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

149. How do you compare the importance of Question 6 with respect to Question 10?

6	Are these plans coordinated with local and state police departments?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

150. How do you compare the importance of Question 6 with respect to Question 11?

6	Are these plans coordinated with local and state police departments?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

151. How do you compare the importance of Question 6 with respect to Question 12?

6	Are these plans coordinated with local and state police departments?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

152. How do you compare the importance of Question 6 with respect to Question 13?

6	Are these plans coordinated with local and state police departments?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

153. How do you compare the importance of Question 6 with respect to Question 14?

6	Are these plans coordinated with local and state police departments?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

154. How do you compare the importance of Question 6 with respect to Question 15?

6	Are these plans coordinated with local and state police departments?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

155. How do you compare the importance of Question 6 with respect to Question 16?

6	Are these plans coordinated with local and state police departments?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

156. How do you compare the importance of Question 6 with respect to Question 17?

6	Are these plans coordinated with local and state police departments?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

157. How do you compare the importance of Question 6 with respect to Question 18?

6	Are these plans coordinated with local and state police departments?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

158. How do you compare the importance of Question 6 with respect to Question 19?

6	Are these plans coordinated with local and state police departments?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

159. How do you compare the importance of Question 7 with respect to Question 8?

7	Are specific response agency numbers (other than 911) available and up to date?
8	Do personnel receive security awareness training? If yes, how often?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

160. How do you compare the importance of Question 7 with respect to Question 9?

7	Are specific response agency numbers (other than 911) available and up to date?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

161. How do you compare the importance of Question 7 with respect to Question 10?

7	Are specific response agency numbers (other than 911) available and up to date?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

162. How do you compare the importance of Question 7 with respect to Question 11?

7	Are specific response agency numbers (other than 911) available and up to date?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

163. How do you compare the importance of Question 7 with respect to Question 12?

7	Are specific response agency numbers (other than 911) available and up to date?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

164. How do you compare the importance of Question 7 with respect to Question 13?

7	Are specific response agency numbers (other than 911) available and up to date?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

165. How do you compare the importance of Question 7 with respect to Question 14?

7	Are specific response agency numbers (other than 911) available and up to date?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

166. How do you compare the importance of Question 7 with respect to Question 15?

7	Are specific response agency numbers (other than 911) available and up to date?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

167. How do you compare the importance of Question 7 with respect to Question 16?

7	Are specific response agency numbers (other than 911) available and up to date?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

168. How do you compare the importance of Question 7 with respect to Question 17?

7	Are specific response agency numbers (other than 911) available and up to date?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

169. How do you compare the importance of Question 7 with respect to Question 18?

7	Are specific response agency numbers (other than 911) available and up to date?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

170. How do you compare the importance of Question 7 with respect to Question 19?

7	Are specific response agency numbers (other than 911) available and up to date?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

171. How do you compare the importance of Question 8 with respect to Question 9?

8	Do personnel receive security awareness training? If yes, how often?
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

172. How do you compare the importance of Question 8 with respect to Question 10?

8	Do personnel receive security awareness training? If yes, how often?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

173. How do you compare the importance of Question 8 with respect to Question 11?

8	Do personnel receive security awareness training? If yes, how often?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

174. How do you compare the importance of Question 8 with respect to Question 12?

8	Do personnel receive security awareness training? If yes, how often?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

175. How do you compare the importance of Question 8 with respect to Question 13?

8	Do personnel receive security awareness training? If yes, how often?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

176. How do you compare the importance of Question 8 with respect to Question 14?

8	Do personnel receive security awareness training? If yes, how often?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

177. How do you compare the importance of Question 8 with respect to Question 15?

8	Do personnel receive security awareness training? If yes, how often?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

178. How do you compare the importance of Question 8 with respect to Question 16?

8	Do personnel receive security awareness training? If yes, how often?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

179. How do you compare the importance of Question 8 with respect to Question 17?

8	Do personnel receive security awareness training? If yes, how often?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

180. How do you compare the importance of Question 8 with respect to Question 18?

8	Do personnel receive security awareness training? If yes, how often?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

181. How do you compare the importance of Question 8 with respect to Question 19?

8	Do personnel receive security awareness training? If yes, how often?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

182. How do you compare the importance of Question 9 with respect to Question 10?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
10	Does the facility have auxiliary operation system?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

183. How do you compare the importance of Question 9 with respect to Question 11?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

184. How do you compare the importance of Question 9 with respect to Question 12?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

185. How do you compare the importance of Question 9 with respect to Question 13?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

186. How do you compare the importance of Question 9 with respect to Question 14?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

187. How do you compare the importance of Question 9 with respect to Question 15?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

188. How do you compare the importance of Question 9 with respect to Question 16?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

189. How do you compare the importance of Question 9 with respect to Question 17?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

190. How do you compare the importance of Question 9 with respect to Question 18?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

191. How do you compare the importance of Question 9 with respect to Question 19?

9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

j. ☐ Extreme Less Importance
k. ☐ Very Strong Less Importance
l. ☐ Strong Less Importance
m. ☐ Moderately Less Importance
n. ☐ Equal Importance
o. ☐ Moderate Importance
p. ☐ Strong Importance
q. ☐ Very Strong Importance
r. ☐ Extreme Importance

192. How do you compare the importance of Question 10 with respect to Question 11?

10	Does the facility have auxiliary operation system?
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

193. How do you compare the importance of Question 10 with respect to Question 12?

10	Does the facility have auxiliary operation system?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

194. How do you compare the importance of Question 10 with respect to Question 13?

10	Does the facility have auxiliary operation system?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

195. How do you compare the importance of Question 10 with respect to Question 14?

10	Does the facility have auxiliary operation system?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

196. How do you compare the importance of Question 10 with respect to Question 15?

10	Does the facility have auxiliary operation system?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

197. How do you compare the importance of Question 10 with respect to Question 16?

10	Does the facility have auxiliary operation system?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

198. How do you compare the importance of Question 10 with respect to Question 17?

10	Does the facility have auxiliary operation system?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

199. How do you compare the importance of Question 10 with respect to Question 18?

10	Does the facility have auxiliary operation system?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

200. How do you compare the importance of Question 10 with respect to Question 19?

10	Does the facility have auxiliary operation system?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

201. How do you compare the importance of Question 11 with respect to Question 12?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

202. How do you compare the importance of Question 11 with respect to Question 13?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

203. How do you compare the importance of Question 11 with respect to Question 14?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

204. How do you compare the importance of Question 11 with respect to Question 15?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

205. How do you compare the importance of Question 11 with respect to Question 16?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

206. How do you compare the importance of Question 11 with respect to Question 17?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

207. How do you compare the importance of Question 11 with respect to Question 18?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

208. How do you compare the importance of Question 11 with respect to Question 19?

11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

209. How do you compare the importance of Question 12 with respect to Question 13?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

210. How do you compare the importance of Question 12 with respect to Question 14?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

211. How do you compare the importance of Question 12 with respect to Question 15?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

212. How do you compare the importance of Question 12 with respect to Question 16?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

213. How do you compare the importance of Question 12 with respect to Question 17?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

214. How do you compare the importance of Question 12 with respect to Question 18?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

215. How do you compare the importance of Question 12 with respect to Question 19?

12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

216. How do you compare the importance of Question 13 with respect to Question 14?

13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
14	If radio communications are used, are there two or more dedicated radio frequencies?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

217. How do you compare the importance of Question 13 with respect to Question 15?

13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

218. How do you compare the importance of Question 13 with respect to Question 16?

13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

219. How do you compare the importance of Question 13 with respect to Question 17?

13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

220. How do you compare the importance of Question 13 with respect to Question 18?

13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

221. How do you compare the importance of Question 13 with respect to Question 19?

13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

222. How do you compare the importance of Question 14 with respect to Question 15?

14	If radio communications are used, are there two or more dedicated radio frequencies?
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

223. How do you compare the importance of Question 14 with respect to Question 16?

14	If radio communications are used, are there two or more dedicated radio frequencies?
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

224. How do you compare the importance of Question 14 with respect to Question 17?

14	If radio communications are used, are there two or more dedicated radio frequencies?
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

225. How do you compare the importance of Question 14 with respect to Question 18?

14	If radio communications are used, are there two or more dedicated radio frequencies?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

226. How do you compare the importance of Question 14 with respect to Question 19?

14	If radio communications are used, are there two or more dedicated radio frequencies?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

227. How do you compare the importance of Question 15 with respect to Question 16?

15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

228. How do you compare the importance of Question 15 with respect to Question 17?

15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

229. How do you compare the importance of Question 15 with respect to Question 18?

15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

230. How do you compare the importance of Question 15 with respect to Question 19?

15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

231. How do you compare the importance of Question 16 with respect to Question 17?

16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

232. How do you compare the importance of Question 16 with respect to Question 18?

16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

233. How do you compare the importance of Question 16 with respect to Question 19?

16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

234. How do you compare the importance of Question 17 with respect to Question 18?

17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?
18	What is the bridge sufficiency rating?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

235. How do you compare the importance of Question 17 with respect to Question 19?

17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

236. How do you compare the importance of Question 18 with respect to Question 19?

18	What is the bridge sufficiency rating?
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

C . Survey Question: Compare the questions within the Importance Factor

237. How do you compare the importance of Question 1 with respect to Question 2?

1	Is the bridge near or on route to high value target?
2	Is the bridge over or near chemical/refinery/industrial facility?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

238. How do you compare the importance of Question 1 with respect to Question 3?

1	Is the bridge near or on route to high value target?
3	What is the length of the longest span in feet?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

239. How do you compare the importance of Question 1with respect to Question 4?

1	Is the bridge near or on route to high value target?
4	What is the annual average daily traffic of the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

240. How do you compare the importance of Question 1with respect to Question 5?

1	Is the bridge near or on route to high value target?
5	Is the bridge part of a Coastal Evacuation Route?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

241. How do you compare the importance of Question 2 with respect to Question 3?

2	Is the bridge over or near chemical/refinery/industrial facility?
3	What is the length of the longest span in feet?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

242. How do you compare the importance of Question 2 with respect to Question 4?

2	Is the bridge over or near chemical/refinery/industrial facility?
4	What is the annual average daily traffic of the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

243. How do you compare the importance of Question 2 with respect to Question 5?

2	Is the bridge over or near chemical/refinery/industrial facility?
5	Is the bridge part of a Coastal Evacuation Route?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

244. How do you compare the importance of Question 3 with respect to Question 4?

3	What is the length of the longest span in feet?
4	What is the annual average daily traffic of the bridge?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

245. How do you compare the importance of Question 3 with respect to Question 5?

3	What is the length of the longest span in feet?
5	Is the bridge part of a Coastal Evacuation Route?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

246. How do you compare the importance of Question 4 with respect to Question 5?

4	What is the annual average daily traffic of the bridge?
5	Is the bridge part of a Coastal Evacuation Route?

a. ☐ Extreme Less Importance
b. ☐ Very Strong Less Importance
c. ☐ Strong Less Importance
d. ☐ Moderately Less Importance
e. ☐ Equal Importance
f. ☐ Moderate Importance
g. ☐ Strong Importance
h. ☐ Very Strong Importance
i. ☐ Extreme Importance

D. Personal Data:

247. What is your experience level with regards to Bridge Design?

a. ☐ 0-10 years
b. ☐ 11-15 years
c. ☐ 16-20 years
d. ☐ Over 20 years

248. What is your experience level with regards to Security?

a. ☐ 0-10 years
b. ☐ 11-15 years
c. ☐ 16-20 years
d. ☐ Over 20 years

APPENDIX B: AHP SAMPLE CALCULATIONS

How do you compare question A (Y axis) with Question B (X-Axis)?

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	3.63	1.78	2.96	3.14	1.92	2.00	2.54	2.56	2.41	1.18	2.88
2	0.28	1.00	1.76	2.03	1.59	1.19	0.79	1.80	2.15	1.30	1.16	1.74
3	0.56	0.57	1.00	4.61	4.45	2.83	3.10	3.31	3.86	3.65	2.01	3.60
4	0.34	0.49	0.22	1.00	1.70	1.21	1.34	1.45	1.95	1.55	1.13	1.58
5	0.32	0.63	0.22	0.59	1.00	1.03	0.92	1.49	1.40	1.52	1.01	1.70
6	0.52	0.84	0.35	0.82	0.97	1.00	1.85	2.15	3.44	2.45	1.55	2.58
7	0.50	1.26	0.32	0.74	1.09	0.54	1.00	2.27	2.99	2.57	1.35	3.00
8	0.39	0.56	0.30	0.69	0.67	0.47	0.44	1.00	2.45	2.58	1.52	2.86
9	0.39	0.46	0.26	0.51	0.71	0.29	0.33	0.41	1.00	1.85	0.71	2.39
10	0.42	0.77	0.27	0.65	0.66	0.41	0.39	0.39	0.54	1.00	0.51	1.90
11	0.84	0.86	0.50	0.88	0.99	0.65	0.74	0.66	1.40	1.96	1.00	5.15
12	0.35	0.57	0.28	0.63	0.59	0.39	0.33	0.35	0.42	0.53	0.19	1.00
SUM	**5.91**	**11.65**	**7.27**	**16.12**	**17.56**	**11.93**	**13.24**	**17.80**	**24.16**	**23.35**	**13.34**	**30.39**

Normalize the Reciprocal Matrix:

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.17	0.31	0.25	0.18	0.18	0.16	0.15	0.14	0.11	0.10	0.09	0.09
2	0.05	0.09	0.24	0.13	0.09	0.10	0.06	0.10	0.09	0.06	0.09	0.06
3	0.10	0.05	0.14	0.29	0.25	0.24	0.23	0.19	0.16	0.16	0.15	0.12
4	0.06	0.04	0.03	0.06	0.10	0.10	0.10	0.08	0.08	0.07	0.08	0.05
5	0.05	0.05	0.03	0.04	0.06	0.09	0.07	0.08	0.06	0.07	0.08	0.06
6	0.09	0.07	0.05	0.05	0.06	0.08	0.14	0.12	0.14	0.10	0.12	0.08
7	0.08	0.11	0.04	0.05	0.06	0.05	0.08	0.13	0.12	0.11	0.10	0.10
8	0.07	0.05	0.04	0.04	0.04	0.04	0.03	0.06	0.10	0.11	0.11	0.09
9	0.07	0.04	0.04	0.03	0.04	0.02	0.03	0.02	0.04	0.08	0.05	0.08
10	0.07	0.07	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.04	0.04	0.06
11	0.14	0.07	0.07	0.05	0.06	0.05	0.06	0.04	0.06	0.08	0.07	0.17
12	0.06	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.03
SUM	1	1	1	1	1	1	1	1	1	1	1	1

Principal Eigenvector: Shows the relative weights

	weight
1	0.1613
2	0.0951
3	0.1720
4	0.0714
5	0.0605
6	0.0923
7	0.0856
8	0.0654
9	0.0450
10	0.0419
11	0.0775
12	0.0320
SUM	1.0000

λ_{max} = 12.99403
CI = 0.090367
RI = 1.48
C.R. = 6.11% < 10% Good

How do you compare question A (Y axis) with Question B (X-Axis)? starts at Question #67 on survey

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.0000	1.6199	0.8457	2.0034	1.8574	1.9406	1.5956	1.2112	1.4139	1.4188	1.2911	1.3278	1.2220	1.9434	1.2004	1.1014	0.9168	0.9596	0.9715
2	0.6173	1.0000	2.2818	2.4123	2.9111	2.7531	2.9753	2.7827	2.6247	2.5407	2.3757	2.8843	2.1057	3.5531	2.3608	1.5961	1.2761	2.4994	1.4715
3	1.1824	0.4382	1.0000	3.2229	3.2229	3.3485	3.4790	3.5778	3.7259	3.4593	3.3781	3.3958	2.5810	4.0025	2.9951	2.0048	1.9357	3.1209	1.4353
4	0.4991	0.4145	0.3103	1.0000	1.5383	2.0250	1.8988	1.7436	1.9778	2.3778	1.6025	1.8473	2.0744	3.7358	2.0004	0.9908	3.0555	1.3184	1.5510
5	0.5384	0.3435	0.3103	0.6501	1.0000	1.8226	1.5707	1.5531	1.7802	1.5016	1.8444	1.5975	3.1115	1.8111	1.0611	1.0868	2.5073	1.1263	1.6004
6	0.5153	0.3632	0.2986	0.4938	0.5487	1.0000	1.1975	2.0568	2.5259	1.3880	1.3111	1.4444	3.1432	1.9872	0.9842	0.8608	2.7192	1.1028	1.3041
7	0.6267	0.3361	0.2874	0.5267	0.6366	0.8351	1.0000	1.6469	2.1929	1.5065	1.2222	1.2963	2.6296	2.0514	0.9645	0.8225	2.9024	0.9102	2.6198
8	0.8256	0.3594	0.2795	0.5735	0.6439	0.4862	0.6072	1.0000	2.3975	1.8649	1.4840	1.8741	3.2469	1.9385	1.1670	1.1336	2.4250	1.0146	1.7259
9	0.7073	0.3810	0.2684	0.5056	0.5617	0.3959	0.4560	0.4171	1.0000	1.3506	1.2123	1.3210	2.4074	1.7650	1.0661	0.9969	2.6111	1.2328	1.4390
10	0.7048	0.3936	0.2891	0.4206	0.6660	0.7205	0.6638	0.5362	0.7404	1.0000	1.5630	1.2123	2.2691	1.2443	0.6454	0.8098	2.2496	0.9327	1.8473
11	0.7745	0.4209	0.2960	0.6240	0.5422	0.7627	0.8182	0.6739	0.8248	0.6398	1.0000	1.8247	3.1679	2.0126	1.2213	1.1561	2.9469	1.3920	2.2214
12	0.7531	0.3467	0.2945	0.5413	0.6260	0.6923	0.7714	0.5336	0.7570	0.8248	0.5480	1.0000	2.9012	1.6345	1.1740	0.5586	2.7213	1.0426	3.0670
13	0.8183	0.4749	0.3875	0.4821	0.3214	0.3181	0.3803	0.3080	0.4154	0.4407	0.3157	0.3447	1.0000	2.2941	1.0649	1.0294	2.4333	1.5016	0.8845
14	0.5146	0.2814	0.2498	0.2677	0.5522	0.5032	0.4875	0.5159	0.5666	0.8036	0.4969	0.6118	0.4359	1.0000	0.6470	0.4182	1.8007	0.4643	1.0106
15	0.8331	0.4236	0.3339	0.4999	0.9424	1.0160	1.0368	0.8569	0.9380	1.5495	0.8188	0.8518	0.9391	1.5455	1.0000	1.3309	2.9875	0.8822	1.7633
16	0.9080	0.6265	0.4988	1.0093	0.9202	1.1617	1.2159	0.8822	1.0031	1.2349	0.8649	1.7901	0.9714	2.3911	0.7514	1.0000	3.4061	1.7880	4.0229
17	1.0908	0.7837	0.5166	0.3273	0.3988	0.3678	0.3445	0.4124	0.3830	0.4445	0.3393	0.3675	0.4110	0.5553	0.3347	0.2936	1.0000	1.7901	1.3271
18	1.0422	0.4001	0.3204	0.7585	0.8879	0.9068	1.0987	0.9856	0.8112	1.0721	0.7184	0.9592	0.6660	2.1537	1.1335	0.5593	0.5586	1.0000	2.4871
19	1.0293	0.6796	0.6967	0.6448	0.6249	0.7668	0.3817	0.5794	0.6949	0.5413	0.4502	0.3260	1.1305	0.9895	0.5671	0.2486	0.7535	0.4021	1.0000
SUM	14.98	10.09	9.77	16.96	19.40	21.82	21.98	22.27	26.77	25.96	22.84	26.28	36.41	38.61	22.34	18.00	41.21	24.48	33.75

Normalize the Reciprocal Matrix:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	0.066752	0.160592	0.086605	0.118099	0.095729	0.088926	0.072599	0.054378	0.052809	0.054655	0.056537	0.050532	0.033558	0.050337	0.053734	0.061193	0.022248	0.039197	0.028787
2	0.041208	0.099139	0.233664	0.142206	0.150039	0.126156	0.135371	0.124936	0.098034	0.097873	0.104028	0.109767	0.057827	0.092029	0.105683	0.088683	0.030968	0.102096	0.0436
3	0.078927	0.043447	0.102402	0.189989	0.16611	0.153439	0.158288	0.160632	0.139166	0.133256	0.147926	0.129231	0.070878	0.103668	0.134074	0.111391	0.046975	0.127485	0.042527
4	0.033319	0.041096	0.031773	0.058949	0.079283	0.092794	0.08639	0.078281	0.073871	0.091595	0.070171	0.070301	0.056968	0.096761	0.089546	0.055052	0.074151	0.053855	0.045955
5	0.035939	0.034055	0.031773	0.038322	0.05154	0.083516	0.071465	0.069729	0.066493	0.057843	0.080767	0.060797	0.085447	0.046908	0.047502	0.060383	0.060848	0.046007	0.047418
6	0.034397	0.03601	0.030581	0.02911	0.028279	0.045823	0.054485	0.092344	0.094345	0.053468	0.057413	0.054971	0.086319	0.05147	0.04406	0.047827	0.06599	0.045047	0.038639
7	0.041834	0.033321	0.029434	0.031046	0.032813	0.038265	0.045498	0.073942	0.081908	0.058033	0.05352	0.049333	0.072215	0.053133	0.043175	0.045697	0.070435	0.03718	0.077623
8	0.055114	0.035627	0.028622	0.03381	0.033186	0.022279	0.027626	0.044897	0.089549	0.071839	0.064981	0.071321	0.089167	0.050209	0.052239	0.062983	0.058851	0.041445	0.051139
9	0.047212	0.037772	0.027484	0.029806	0.028951	0.018141	0.020747	0.018726	0.037351	0.052028	0.053088	0.050272	0.066112	0.045714	0.047723	0.055392	0.063365	0.050359	0.042639
10	0.047048	0.03902	0.029602	0.024792	0.034324	0.033014	0.030201	0.024075	0.027655	0.038521	0.068441	0.046138	0.062315	0.032229	0.028891	0.044991	0.054594	0.038102	0.054734
11	0.051701	0.041731	0.030313	0.036786	0.027943	0.03495	0.037226	0.030255	0.030809	0.024646	0.043789	0.069442	0.086997	0.052128	0.054671	0.064237	0.071514	0.056862	0.06582
12	0.050272	0.034372	0.030156	0.031912	0.032262	0.031724	0.035098	0.023957	0.028275	0.031774	0.023998	0.038057	0.079674	0.042334	0.052555	0.031037	0.066041	0.042588	0.090876
13	0.054626	0.047081	0.039676	0.028417	0.016565	0.014579	0.017302	0.013828	0.015515	0.016976	0.013823	0.013117	0.027462	0.059419	0.04767	0.057195	0.05905	0.061338	0.026209
14	0.034347	0.027902	0.025585	0.01578	0.028459	0.023059	0.022179	0.023161	0.021162	0.030958	0.021758	0.023284	0.011971	0.025901	0.028964	0.023237	0.043699	0.018967	0.029943
15	0.05561	0.041993	0.03419	0.029469	0.04857	0.046557	0.047173	0.038474	0.035036	0.059687	0.035855	0.032416	0.025788	0.040031	0.044765	0.073945	0.072501	0.036036	0.052247
16	0.060609	0.062112	0.051078	0.059495	0.047425	0.053234	0.05532	0.039607	0.037465	0.047571	0.037875	0.068127	0.026678	0.061931	0.033636	0.055561	0.082659	0.073038	0.119199
17	0.072813	0.077691	0.052902	0.019293	0.020556	0.016852	0.015676	0.018514	0.014305	0.017124	0.01486	0.013985	0.011286	0.014384	0.014984	0.016312	0.024268	0.073125	0.039322
18	0.069566	0.039666	0.032812	0.044713	0.045761	0.041553	0.049988	0.044252	0.030297	0.041299	0.031458	0.036503	0.018289	0.055783	0.050743	0.031075	0.013557	0.040849	0.073693
19	0.068707	0.067373	0.071347	0.038008	0.032205	0.035139	0.017367	0.026013	0.025955	0.020853	0.019712	0.012408	0.031047	0.02563	0.025387	0.013811	0.018286	0.016424	0.02963
SUM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Principal Eigenvector: Shows the relative weights

	weights
1	0.065646
2	0.104385
3	0.117885
4	0.067374
5	0.056671
6	0.052136
7	0.050969
8	0.051836
9	0.041731
10	0.039931
11	0.047991
12	0.041945
13	0.03315
14	0.02528
15	0.044755
16	0.056454
17	0.028855
18	0.041677
19	0.031332
SUM	1

λ_{max} = 20.66023
CI = 0.092235
RI = 1.59 conservative
C.R. = 5.80% < 10% Good

How do you compare question A (Y axis) with Question B (X-Axis)?

	1	2	3	4	5
1	1.0000	2.4871	3.8374	2.7225	1.6098
2	0.4021	1.0000	3.6568	2.5019	1.5180
3	0.2606	0.2735	1.0000	1.6255	1.3925
4	0.3673	0.3997	0.6152	1.0000	2.6426
5	0.6212	0.6587	0.7181	0.3784	1.0000
SUM	**2.65**	**4.82**	**9.83**	**8.23**	**8.16**

Normalize the Reciprocal Matrix:

	1	2	3	4	5
1	0.37719	0.516106	0.390474	0.330869	0.197206
2	0.151657	0.207511	0.372097	0.304062	0.18597
3	0.098293	0.056747	0.101755	0.197549	0.170587
4	0.138545	0.08294	0.062599	0.12153	0.323731
5	0.234315	0.136696	0.073075	0.04599	0.122506
SUM	1	1	1	1	1

Principal Eigenvector: Shows the relative weights

	weight
1	0.362369
2	0.24426
3	0.124986
4	0.145869
5	0.122516
SUM	1

λ_{max} = 5.566451
CI = 0.141613
RI = 1.12
C.R. = 12.64% > 10%, but close, so OK

Comparion of Weights calculated using AHP and previous weights:

	Questions Related to the Occurrence Factor	Old Weight	All Together New Weight	Government New Weight	Private Sector New Weight	Academia New Weight
1	Is there enough lighting on the superstructure?	0.100	0.1613	0.1807	0.1347	0.1339
2	Is there enough space around the bearings to place a 6"x6"x6" object?	0.250	0.0951	0.0867	0.1030	0.0640
3	Can someone park under/on bridge?	0.077	0.1720	0.1989	0.1522	0.0862
4	Is there a shoulder on the bridge?	0.077	0.0714	0.0779	0.0729	0.0391
5	Is there a sidewalk or a pedestrian walkway?	0.077	0.0605	0.0703	0.0414	0.0614
6	Is there easy access to the deck from underneath the bridge?	0.077	0.0923	0.0798	0.1032	0.0898
7	Is there an access to the bearings?	0.077	0.0856	0.0758	0.1019	0.0827
8	Is there easy access to the pile cap?	0.077	0.0654	0.0550	0.0831	0.0852
9	Is there easy access to the abutment and/or the wingwalls?	0.077	0.0450	0.0446	0.0389	0.0650
10	Are pipelines located under/over bridge?	0.037	0.0419	0.0366	0.0420	0.0821
11	Are gas pipes located under/over bridge?	0.037	0.0775	0.0644	0.1016	0.1317
12	Are power lines located under/over bridge?	0.037	0.0320	0.0294	0.0252	0.0789
	Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

	Questions Related to the Vulnerability Factor	Old Weight	All Together New Weight	Government New Weight	Private Sector New Weight	Academia New Weight
1	Are the bearings securely anchored in place?	0.050	0.066	0.045	0.084	0.060
2	Is the pier/tower a single column, two-column, three-column or more than 3?	0.050	0.104	0.101	0.104	0.100
3	Do the pier columns have confinement comparable to seismic zone (eg. Spiral stirrups, steel jackets, carbon fiber)	0.050	0.118	0.114	0.099	0.110
4	Does the bridge have a current written security/contingency plan or surrounding evacuation plan?	0.080	0.067	0.072	0.053	0.062
5	Are there current written evacuation procedures in case of an emergency on the bridge? If yes, are they posted?	0.050	0.057	0.062	0.050	0.045
6	Are these plans coordinated with local and state police departments?	0.050	0.052	0.064	0.039	0.038
7	Are specific response agency numbers (other than 911) available and up to date?	0.050	0.051	0.060	0.044	0.040
8	Do personnel receive security awareness training? If yes, how often?	0.050	0.052	0.060	0.042	0.042
9	Is there a communication system in use by bridge personnel such as radio, phone, cell phones, duress system?	0.050	0.042	0.043	0.044	0.043
10	Does the facility have auxiliary operation system?	0.050	0.040	0.035	0.057	0.042
11	Are there external (local, state, federal) response agencies available? Fire department, volunteer fire dept, county law enforcement, local police dept, federal law enforcement, dept of homeland security, HAZMAT team, bomb squad, FEMA? What are their response times?	0.050	0.048	0.054	0.043	0.045
12	Are joint drills between the bridge and local response agencies conducted? If yes, how often and how recent?	0.050	0.042	0.044	0.036	0.046
13	Are the following type of emergency(s) is/are covered? Flood, fire, hurricane, collision, earthquake, bomb	0.050	0.033	0.035	0.029	0.048
14	If radio communications are used, are there two or more dedicated radio frequencies?	0.050	0.025	0.024	0.025	0.033
15	Does roadway drain to beneath bridge?(gasoline fire under bridge from truck accident)	0.050	0.045	0.044	0.053	0.041
16	Is right of way intrusion under bridge?(illegal storage of vehicles under bridge or excessive garbage accumulation)	0.050	0.056	0.050	0.080	0.063
17	Is there a secure perimeter or zone around the bridge? Around certain bridge components?	0.050	0.029	0.027	0.032	0.031
18	What is the bridge sufficiency rating?	0.050	0.042	0.035	0.057	0.062
19	Is there a protection around the pier/tower? (eg. Bollards, barriers)	0.070	0.031	0.031	0.027	0.047
	Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

	Questions Related to the Importance Factor	Old Weight	All Together New Weight	Government New Weight	Private Sector New Weight	Academia New Weight
1	Is the bridge near or on route to high value target?	0.030	0.362	0.296	0.368	0.435
2	Is the bridge over or near chemical/refinery/industrial facility?	0.030	0.244	0.279	0.252	0.105
3	What is the length of the longest span in feet?	0.460	0.125	0.133	0.080	0.184
4	What is the annual average daily traffic of the bridge?	0.280	0.146	0.138	0.205	0.164
5	Is the bridge part of a Evacuation Route?	0.200	0.123	0.153	0.094	0.112
	Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Risk = O * V * I =