

TABLE OF CONTENT
PAGE

Executive Summary	iii
Overview:	
Background	1
Statement of Auditing Standards	5
Audit Due Professional Care and Inherent Risk	5
Audit Scope	5
Audit Purpose and Objectives	5
Audit Methodology	6
Exclusions	6
Observations:	
1- No Departmental Policies and Procedures for DR and/or BC	6
2- Limited Information and Content in TS's DRP/BCP	7
3- No Written TS DRP/BCP for Essential District Departments	11
4- Undifferentiated DRP and BCP Processes and Procedures	12
5- TS's DRP/BCP Manual Lacks Foundational Core Principles	13
6- No Management Resolutions to Findings in New External Test Report	14
7- Un-Implemented Management Responses and Corrections (MRC)s	
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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

3. NO WRITTEN DRP/BCP FOR ESSENTIAL DISTRICT DEPARTMENTS

Condition: TS's DRP/BCP manual does not include or identify essential departments and their key procedures.

4. UNDIFFERENTIATED DRP AND BCP PROCESSES, PROCEDURES AND RESPONSIBILITIES

Condition: The TS DRP/BCP does not differentiate between working ~~and disaster~~ versus -0.0c39 ePm ()T1.

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OVERVIEW

management during the audit process and a collaborative effort on the corrections of the audit findings. No MRC are required; however, if management decides to provide them, they become part of the final audit report.

Regardless of the type of internal audit, the IIA performance and implementation standards should be followed when analyzing organization controls, governance, and risk management.

After a consultation audit is common practice to schedule and perform an assurance audit. The schedule for the upcoming assessment audit is discussed and agreed upon with management during the exit meeting.

During the exit meeting of the consultation audit, July 12, 2022 was selected by TS's Executive Management, and agreed upon by Internal Audit, as the date to conduct the assessment audit of the TS DRP/BCP.

Notification of this assurance audit was documented in the conclusions of the final consultation audit report, which read "An assessment audit of the IT DRBCP will be scheduled approximately one year from the date this final report is delivered to the Superintendent". The report was delivered to the Superintendent on June 30, 2022. This audit was also scheduled in the provided Annual Internal Audit Plan (Audit Plan) for a specified School Year (SY) 2022-2023. The Audit Plan is a worksheet that includes a list of audits and their estimated schedule to be performed during the upcoming SY. The Audit Plan for SY 2022-2023 was mailed to the Governing Board, Audit Committee, and Executive Leadership on May 13, 2022. The Audit Plan was also presented during the Audit Committee's public meeting on May 20, 2022, in which TS executive managers were present.

The focus of this audit was to review TS's processes and procedures regarding DRP/BCP. It was not intended to reflect or discount the effectiveness or abilities of the TS management or staff. It is noteworthy to acknowledge that the current TS management and staff have demonstrated and proven themselves capable of navigating the District through an unforeseeable pandemic.

Nonetheless, capabilities and qualifications of the current TS do not eliminate the need to have a comprehensive TS DRP/BCP manual, policies, procedures, and standards for the department. Having a DRP/BCP is a preventative measure to aid recovery and/or maintain operations in case of future unforeseeable catastrophes. It is possible that a future event may include the current TS management and staff members being unavailable.

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IMAGE FROM THE AUDIT GENERAL RISK AND BUSINESS CONTINGENCY PLANNING⁵

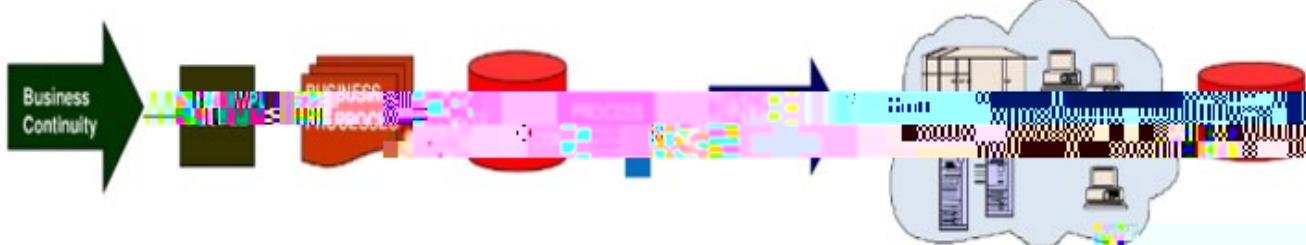
Having individual DRPs and BCPs with identifiable responsibilities, enhances the organization's efficiency and effectiveness of operation by eliminating potential tasks that could be overlooked during chaos.

This audit will refer to the DRP and BCP as two separate plans while noting some interconnected activities. References of DRP and BCP utilized in this report were focused whenever possible, on criteria and policies related to technology services, education, and combinations thereof.

The Information System Audit and Control Association (ISACA) formal definitions of a Disaster Recovery (DR) and Business Continuity (BC) are:

“Disaster Recovery (DR) Activities and programs designed to return the enterprise to an acceptable condition. The ability to respond to an interruption in services by implementing a disaster recovery plan (DRP) to restore an enterprise’s critical business functions.”⁶

“Business Continuity Plan (BCP) A plan used by an enterprise to respond to disruption of critical business processes. An organization depends on the contingency plan for restoration of critical systems.”



AUDITING BCP ON DURAND SAC PRESENTATION

The National Institute of Standards and Technology (NIST) is the federal government guiding document for Informatics and Information Technology (I&IT); its series document 800-34 addresses the required guidelines and provides a more comprehensive definition of DR and a BCP. (NIST's guidelines are consistent with the requirements of the Office of Management and Budget (OMB) Circular A30).

OVERVIEW

OBSERVATIONS

AUDIT METHODOLOGY

Compliance with acceptable DRP/BCP were determined by comparing the documents from TSD applicable district polices, acceptable practices, procedures, and research DRP/BCP standards from governing organizations and agencies.

Effectiveness and efficiencies of DRP/BCP were determined by evaluating and reviewing the processes content, and procedures to determine if the steps in the process were functional.

OBSERVATIONS

Effect: The department provide existing District policies pertinent to T\$ for the requested DRP/BCP policies; however, the provided policies do not reference DR or BC actions. During the previously conducted consultation audit questionnaire was performed which the department's executive managers responded to having a DRP/BCP policy was A 'Td [(i)2 (2 (n)1(u)1 (d)1 (i)

NIST SP 800-184	GUIDE FOR CYBERSECURITY EVENT RECOVERY
Table of Contents	
Executive Summary	vi
1. Introduction	1
1.1 Background	1
1.2 Purpose and Scope	2
1.3 Audience	2
1.4 Document Structure	3
2. Planning for Cyber Event Recovery	4
2.1 Enterprise Resiliency	6
2.2 Recovery Planning Prerequisites	6
2.3 Recovery Plan	7
2.3.1 Planning Document Development	7
NIST's GUIDE FOR CYBERSECURITY EVENT RECOVERY	
	17

ISAC's second Information System Recovery Principle states "Create a Recovery Team with Roles and Responsibilities. The team should include all the functions and roles necessary to quickly and completely restore computer operations. Should be a document that identifies the team members, their respective roles and the steps each would take in restoring operations".¹⁸

AZ Auditor states "The items necessary for each plan may vary by entity, but some basic DRP components include the following:

- x Identification of critical equipment, data, and resources, including site locations to store backup data and maintain redundant system resources to allow for emergency data processing.
- x Contact list of key individuals including their roles and responsibilities.
- x Procedures for regularly backing up systems and data, regularly testing backups.
- x Procedures for activating the DRP, notifying appropriate parties, and assessing the severity of the disruption and the required response.
- x Steps and procedures for restoring systems to full functionality.
- x Supporting information as necessary to ensure a comprehensive plan such as business impact analysis, vendor contract information,¹⁹etc."

Effect: DRPs/BCPs are meant to be a comprehensive guide on how to coordinate, and navigate through an incident. This document does not include basic content such as scope, purposes, processes, team responsibilities, and procedures to guide the department prior to, during, or after a disaster.

OBSERVATIONS

OBSERVATIONS

- x Protections and procedures to be performed to protect staff and infrastructure (e.g., hardware and software components).
 - x Mitigation, necessary measures to minimize or eliminate losses/damages
 - x Response stabilizing a situation, establishing a safe environment, facilitating and coordinating processes.
 - x Recovery, essential activities for the department's operation.
- b) No listed responsibilities, and specified roles associated with DRIPBCP
x Operational call tree, as recommended by the Auditor General

IMAGES FROM THE AUDITOR GENERAL RISK AND BUSINESS

OBSERVATIONS

Cause:

OBSERVATIONS

members of the SDR team would be available, or that other technicians (experienced or not) would be familiar with the District's (x02)(i) fist@e T - ()TJ -0

CONNECTION BETWEEN BUSINESS CONTINUITY PLAN AND DISASTER RECOVERY PLAN²¹

Cause: Combined DRP/BCP rather than independent plans with unique functions, activities, and requirements.

Recommendations:

- a. Create separate DRP and BCP processes, procedures and responsibilities

5. TS DRP/BCP MANUAL LACKS FOUNDATIONAL CORE PRINCIPLES

Condition: The TS DRP/BCP manual does not disclose the basic core principles and/or fundamental followed to create the department's manual.

Criteria Best practices, most written DRP and BCP guides, policies, procedures, and standards note and reference the governance, authority/principles the document is based on, aligned with, or follows. Thi2 90 379w.r4 Tw 3.02//24 Tm (P)Tj ET Q q 0279w.r92 0oq 027(y(eJ -

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Responses to audit findings are an acknowledgment from management of the necessary corrections and a commitment to improve they are necessary to perform required quality assurance of corrective actions

NOTERecommendations for the findings in the external test report were in a confidential report; therefore, to preserve the confidentiality of the document, they will not be disclosed in this public report.

CAUSE

OBSERVATIONS

8. RESTRICTIONS AND DELAYED ACCESS TO INFORMATION

CONDITIONS created delays on requested preliminary documents, requested extensions, re schedules, and requested audit limitations.

C RITERIA US D Policy Code DIFA Office of Internal Audit (OIA) Unrestricted Access: "The OIA shall be provided unrestricted access to all functions, records (including data and databases), property, and personnel relevant to the subject being reviewed. The OIA shall be free of interference in determining the scope of internal audits, performing audit work, and communicating audit results. Any auditee impositions, limitations, objections, and other issues, that could potentially impair or jeopardize the audit independence or the timely completion of an audit, shall be reported to the Superintendent(y)2 (4 (thh0d2 (a3[.91 -1.22]

OBSERVATIONS

reveal any threats and vulnerabilities and a planning component to develop strategies for minimizing risk. The result is a business impact analysis report, which describes the potential risks specific to the organization studied. One of the basic assumptions behind a BIA is that every component of the organization relies on the continued functioning of all the others. However, some are more crucial than others and require a greater allocation of funds and operational resources in the event of a disaster.³⁸

Global Technology Audit Guide (GTA) Business Continuity Management³⁹—Business Impact Analysis“ A BIA is used to identify critical business processes that need to be recovered following a disaster event....

A.- Identifying the Business Processes: The first step in a BIA is to identify the business processes performed by the functional team, the resources needed to perform the function, and the critical staff performing the work. The business processes initially should not be broken down into too many individual-processes. Business processes should be identified separately if they have different staffing (e.g., staff roles), service providers (e.g., third party, outsourcer, etc.), or resources (e.g., systems).

B.-Determining RTO and RPO Based on Business Impact: The second step in a BIA is to identify the type of business impact if the business process cannot be performed...Then, determine a recovery time objective (RTO) based on the types of business impact...Typically, the cost of the recovery solution will rise as the RTO decreases (i.e., if the business process must be restored immediately, the cost could be very high)...Next, determine a recovery point objective (RPO) for information systems. The RPO is the amount of data that can be lost if a disaster destroys the information system...Recovery Point Objective (RPO) is the amount of data that can be lost if a disaster destroys the information system...³⁹

GTA's image below illustrates an example of a Recovery Time Objective (RTO) and Recovery Point Objective (RPO).

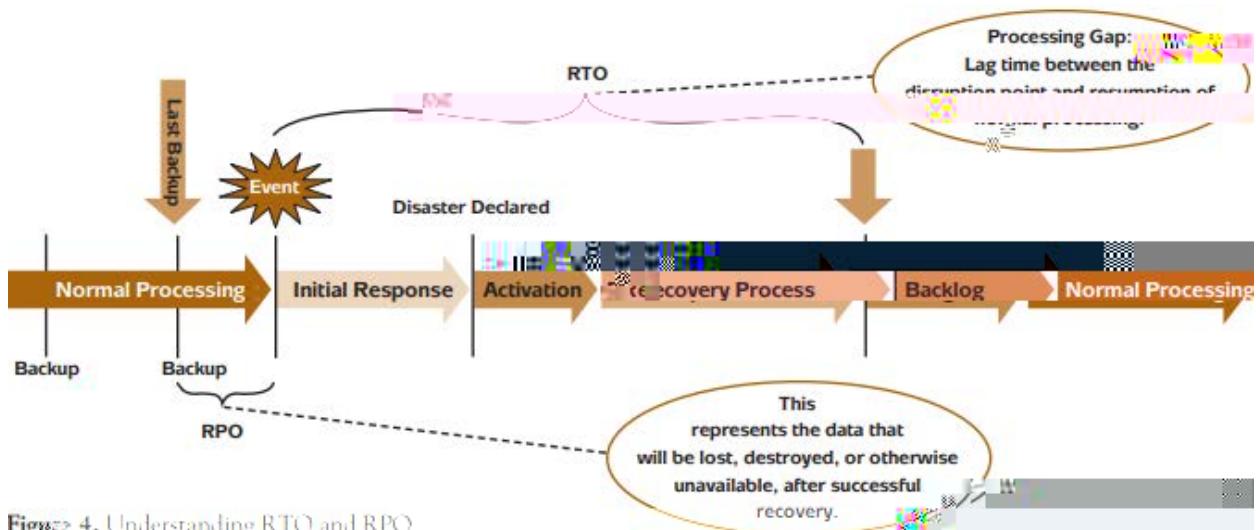


Figure 4. Understanding RTO and RPO

IMAGERETRIEVED FROM GTAGI0: BUSINESS CONTINUITY MANAGEMENT⁴⁰

Ready, states that “A BIA report should document the potential impacts resulting from disruption of business functions and processes. Scenarios resulting in significant business

OBSERVATIONS

interruption should be assessed in terms of financial impact, if possible. These costs should be compared with the costs for possible recovery strategies.

The BIA report should prioritize the order of events for restoration of the business. Business processes with the greatest operational and financial impacts should be restored first.

EFFECTA BIA should identify key elements, essential processes, basic functions, and necessary resources for the business continuity plan at various levels of the organization.

The BIA document titled “Business Impact Analysis and Infrastructure Update Plan (BIA/IUP)” was provided in place of the requested BIA report. The document was dated “December 2021”, the credited team was “TS Infrastructure and Architecture Teams”; it addressed “Upgrade PlanCloud Migration”.

The document was segmented into four categories, structured in an outline format; it contained minimal information with no analysis of the impact or duration of disruption to the list of items, no measured timing, or duration of disruption. Examples below:

Selected one out of the four items in the provided document by TS, titled “Business Impact Analysis and Infrastructure Upgrade Plan”

4. Recovery Systems and Resources



In order to preserve data and maintain continual business operations, it was determined to proceed with cloud migration to the Microsoft Azure platform for certain essential systems in Spring and Summer 2023.

Subsequent migration may follow based on need, quality assurance, testing and performance in the cloud of the systems listed below.

The list of systems included in the cloud migration in Spring & Summer 2023:

- 1) Active Directory (AD) and Azure Active Directory
- 2) Library Management System (LMS)
- 3) Printing management and Audit System (Universal Printing System)
- 4) Some Business Intelligence Systems (BI)
- 5) Email
- 6) Some Data Backups
- 7) Student Information System (SIS - Synergy)
- 8) Transportation System (Versatran)
- 9) TS Work Order Ticketing System (Trackit)

OBSERVATIONS

BIA reports are impact assessments that assist management in developing business continuity plans with identified activities to be prioritized, detected timing and duration of disruption, allocation of resources, and mitigation of risk.

TechTarget notes ⁴¹ “One of the basic assumptions behind a BIA is that every component of the organization relies on the continued functioning of all the others. However, some are more crucial than others and require a greater allocation of funds and operational resources in the event of a disaster”⁴³

Example: (Image below)

ELEMENTS OF BUSINESS IMPACT ANALYSIS (BIA), by TechTarget⁴⁴

CAUSE Not implementing the intended purpose and basic structure of a BIA report

RECOMMENDATIONS

- a. Identify and summarize anticipated impacts on the department's operations, such as
 - f Timing—The period in which an incident would have the most impact,
Begin

OBSERVATIONS

- f Financial Impact Additional cost due to damages resulting from the occurrence, such as, repairs or replacement of assets, data losses and recovery, etc.).
 - b. Provided references for images used in the documents.

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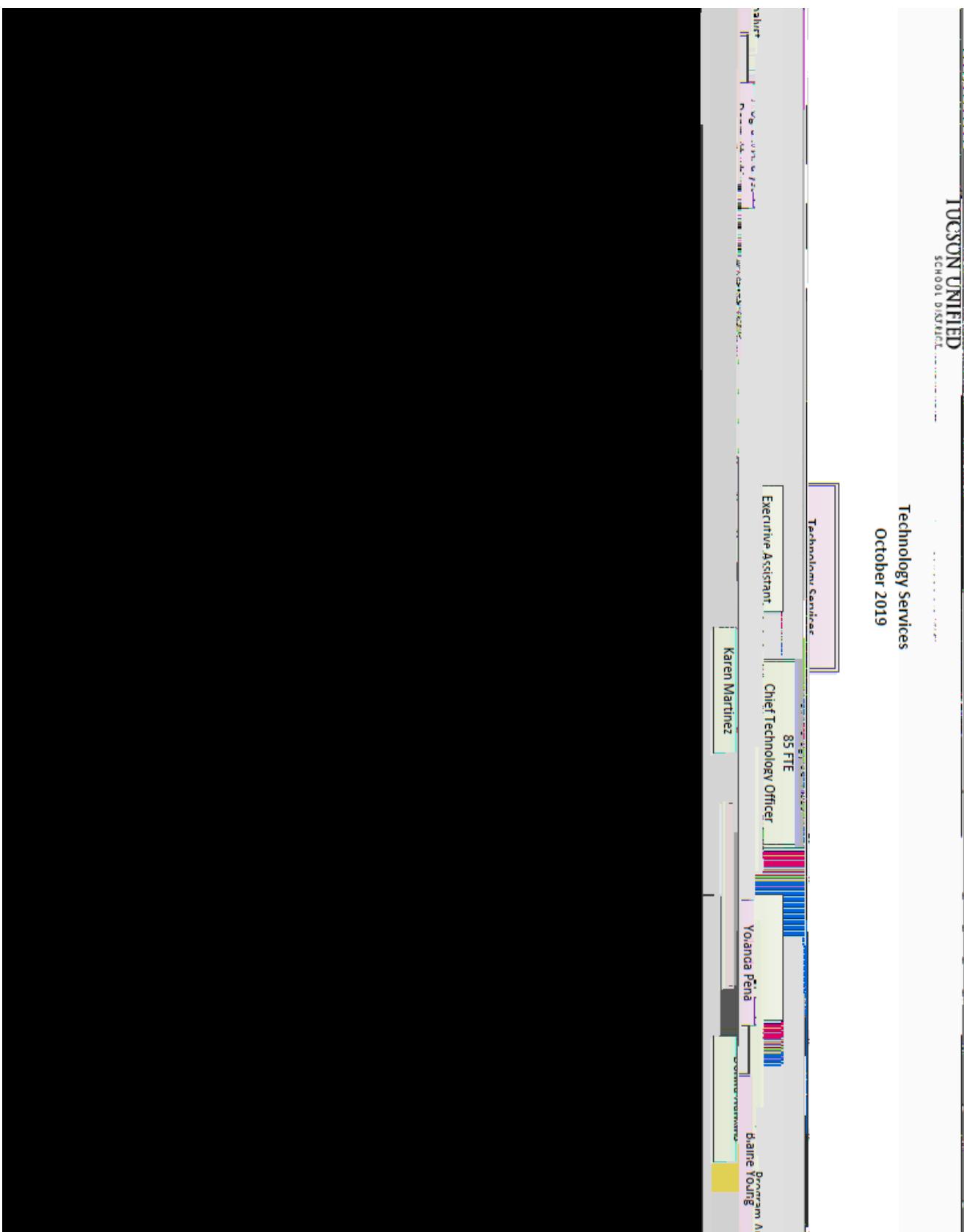
OBSERVATIONS

Criteria: Best practices,

Summary						
Iterations	Total Library	Fixes & Replications	Median File	Patched Objects	Unpatched Objects	Symbol Statistics
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CONCLUSION

FIGURE 8



APPENDIXB

font. Clarification questions are in **RED font**. Management's 1st set of answers are highlighted in **GRAY**. 2nd Clarification questions from auditor are in **GREEN front**. Management 33rds set of answers are highlighted in green.

15. The Arizona State Emergency Response and Recovery Plan (**ISERRP**) hazards plan addressing Arizona's hazard and threat environment, including natural, technological, and human

APPENDIXB

- xProcedures for regularly backing up systems and data, and regularly testing backups.
- xProcedures for activating the DRP, notifying appropriate parties, and assessing the severity of the disruption and the required response.
- xSteps and procedures for restoring systems to full functionality.
- xSupporting information as necessary to ensure a comprehensive plan as business impact analysis, vendor contract information, etc.”
<http://www.azauditor.gov/reports>

APPENDIXB

APPENDIXB

credible events that could disrupt the business. Typically, BIA meetings are performed

APPENDIXB

42. TS'slImage— “Business Impact Analysis and Infrastructure Upgrade Plan”. Page 3
Team Folder
43. **Tech Target**“One of the basic assumptions behind a BIA is that every component of the organization relies on the continued functioning of all the others. However, some are more crucial than others and require a greater allocation of funds and operational resources in the event of a disaster. By Paul Kirvan and Carol Sliwa. Tech Target: 2000-2022
<https://www.techtarget.com/searchstorage/definition/business-impact-analysis>
44. **Tech Target**Image Elements of Business (f a)2a8(me)3 (n)w. 9.96 72 54C6O (h)1 (.Tc -0.003 Tw 2

APPENDIXC

International Electrotechnical Commission(IEC)—Founded in 19060, the IEC is the world's leading organization for the preparation and publication of international standards for all electrical electronic, electronica and related technologies. These are known collectively as "electrotechnology"<https://www.iec.ch/who-we-are>

General Accepted Auditing Standards (GAAS)sets of standards against which the quality of audits are performed and may be judged. Several organizations have developed such sets of principles, which vary by territory.

APPENDIXC

simplest, internal audit involves identifying the risks that could keep an organization from achieving its goals, making sure the organization's leaders know about these risks, and proactively recommending improvements to help reduce the risks." Additionally, "Internal auditors are explorers, analysts, problem solvers, reporters, and trusted advisors. They bring objectivity and a variety of skills and expertise to the organization." <https://global.theiia.org/about/about-internal-auditing/pages/about/internal-auditing.aspx>

Internal Control- "A plan of organization under which employees' duties are arranged, and records and procedures are designed, to make it possible to exercise effective control over processes. Internal control procedures which call for proper authorizations by designated officials for all actions performed that must be specified and followed." <https://global.theiia.org>

APPENDIXC



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Date: Jan 2022

Audit Scope: July 1, 2021 to June 30, 2022

Initial Documents Requested:

1. Copy of TS manual for Discast Plan (Part of process).
 2. Copies of TS's physical files using the DRP/BCP.
 3. Copies of TS's IT report.
 4. Copy of the most recent data backup log for the physical.
 5. Most recent Business Impact Analysis (BIA) Report.

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Policies for Disaster Recovery and Business Continuity

Date: July 2022

Technology Services Policies for Disaster Recovery and Business Continuity

The Technology Services (TS) Department has created and adopted a list of policies, processes and procedures in the Disaster Recovery Plan (DRP) and Business Continuity Plan (BCP).

The TS Department will be recommending the adoption of E&I RC policies to the TUCO on October 1, 2013.

The TS Department will also be recommending and leading, or playing a major role in, a district-wide DRP and BCP during SY22-23, with a target completion date during SY22-23 or SY23-24.

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R Q O \ L Q D Q H Q F U \ S W H G I R U P D W I R U V H F X U L W \ U H
 - x 7 K H O L V W S R I Q W L D P I D Q W H D S H Q H M L D E O M K Z U H O H Y D Q W L Q I R
 - x 7 K H O L V W L V F R Q V W D Q W O \ F K D H Q Q J Y Q U R A K P H T Q W L V Q R U
I D F W R U V D I I H F W L Q J W K G H X S Q R L Q F D W D L Q R M Q H F K Q S Q U H D / G D I V H
E D F N X S V F R D Q C M P H E S H D A Q F D B 5 U a Br•Z4CC 7 • €
 - x 7 6 Z # f P O N O X S J Q H M R L H Z D W C H I D X G L W U H F R P P H Q G D W L R Q V D Q



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Contents

3	II. Document Maintenance and Update Requirements
3	III. Disaster Event Declaration
IV. Disaster Recovery Plan Components	
8	A. Definitions
8	B. Site-to-Site Backups
8	C. Branch Site Virtual Private Network (VPN)
11	D. Firewall Configuration
11	E. Application Replication and Failover Structures
11	F. Domain Controller Failover
11	G. Applications Failover Conditions and Requirements
11	H. Assessments and Disaster Recovery Drills
11	I. Monitoring and Configuration During Disaster Recovery and Recovery Testing
13	J. Team Assignment and Logistics of DR & Recovery Testing



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, 2YHUYLHZ
7HFKQRORJ\ V\VWHPV DQG VHUYLFHV DUH YLWD O WR
EXVLQHVV SURFHVVHV DQG RRIOLFYDPLUSXRVH\QVWLWKF\WLDVQ
3ODQ '53 DQG %XVLQHVV &RQWLQXLW\ 3ODQ %&3 D
'LVDVWHU 5HFRYHU\ DQG %XVLQHVV &RQWLQXLW\ RI WK
OD\HUHG DUHDV VKRZQ LQ)LJXUH
7KLV GRFXPHQEW\HWKH VWHSV WR EH WDNHQ E\ WKH 7H
DQG DSSURSULDWH 786' VWDII WR UHVWRUH DQG UH
RSHUDWLRQV LQ WKH HYHQW RI D GLVDVWHU RU UHJLR
GDWDVF MOKW\HUVXSSRUW WKH 'LVWULFW 7KH SODQ IRFX
QRUPDO PRGH RI RSHUDWLRQ WR D EDFNXS PRGH RI RS
D QHHG PD\ H[LVW WR VXVSHQG FHUWDLQ 'L\RW\ULF\ EX
HQVXUH WKDW FULWLFDO 'LVWULFW IXQFWLRQV FDQ F
PDQXDO ZRUNDURXQG DFWLRQV LQYROYHG LQ KDQGOLO
GRFXPHQW LV UHYLHZHG DQG XSGDW\HQ DQQRWD\O\HDWQ
DQQXDOO\ E DQ\H\QHRUQ LQ\HSQ\HLVDVWHU 5HFRYHU\ '5 D
%& SODQLQJ VFKHGXOH IRU WKH UHVSHFWLYH \HDU



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5HYLHZ 'L\W\W\W\Q\FF\W ,FQRVYHUD,JH ,7 DQG QRQ
&KHFN VHFXUH ORFDWLRQV UHJXODUO\ ,7 DQG QR
&RPPXQLFDWH '5 DQG %& SODQ ZLWK DOO VWDNHK
&RVW \$QDODQ\WLI\ WKH SRWHQWLDO GRZQWLPH RU
QR,Q
&RVW\DS\\$IVHVV WKH FRVW RI GRZQWLPH SHU KRX
GHSDUWPHQW VLWH, RU VFKRRO ,7 DQG QRQ
&RVW \$QDHOLJKLWKH FRVW RI GRZQWLPH YHUVXV W
,7 DQG 7QRQ

,,, 'LVDVWHU (YHQW 'HFODUDWLRQ
)DLORYHU WR WKH '5 %& VLWH FDQ RQO\ EH SHUIRU
GHFODUHG D GLVDVWHU HYHQW :KHQHYHU WKH ([HFXV
2IILFHU &72 EHFRPH DZDUH RI DQ HYHQW ZDUUDQ
UHFRPPLHQWDWLOO EH PDGH WR WKH 6XSHULQWHQGHQ
*RYHUQLQJ %RDUG 3UHVLGHQW FDQ PDNH WKLV GHFODU
IURP DQ H[LVWLQJ GLVWULFW H[WHQG ZHOO EH\RQG W
V\WWV \$FWLRQV FRXOG LQFOXGH SURYLGLQJ WHPSRUD
DQG LQLWLDWLQJ HPHUJHQF\ HYDFXDWLRQ SURFHGXUH
DUH SDUW RI DZDQHJ\ 'L%&\BULFW
)ROORZLQJ D GLVDVWH\YGHFLQDHFDWRIURQ U WKHH (&KEKW7H
ZLOO OHDG WKH H[HFXWLRQ RI WKLV '53 %&3 E\ HQJD.
LQWHUQDO DQG H[WHUQDO UHVRXUFHV

,9 '5 %& 7HDP OHPEHUV DQG (VFDODWLRQ /LVW
7DEOHV DQG OLVW WKH '5 %& 76 7HDP 'L



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5 H F 5 H F R U G 1 D P H

6 W D R U H / R F D W L R Q

' L V D V W H U 5 H F R Y H U \ D Q G (O H F W U R Q L F 1 \$ e ñ h ^ W p 1

3 O D Q W K L V G R F X P H Q W D

' H Y L F H / L V W



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DOWHUQDWH GDWD FHQWHULWQG 7KHDFUNHX SVWDD \$IRWMQWRUD
GDWD 572 LV EHWZHHQ PLQXWHV DQG KRXUV 5HF
EHJLQ DIWHUSSDOQODMHRJQVDDUH RSHUDWLRQDO
7LHU 2SHUDWLRQDO EHWZHHQ +RXUV DQG 'DVIP
7LHU DSSOLFDWLRQV ZLOO EH RSHUDWLRQDO EHWZHH
HYHQW 7KHVH DSSOLFDWLRQV KVDYUHQ QWHVGDQWQERHQDWG
RIWKH GLVDVWHU ZH ZLOO SODFH DQ HPHUJHQF\ RUGH
LV QRW UHSOLFDWHG DW WKH DOWHUQDWH GDWD FHQW
WDSHV VWLRUWHH QRIDIQQLHQGRQEXDDVMSHDVLV 7KHUH LV D
FRQVLGHUDEOH ORVV RI GDWD 572 LV EHWZHHQ KRXU



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7KH :HVW 5LQJ XSOLQN LV /RFDWHG DW WKH ORUURZ \$
7HQWK (OWK ORFDWLRQ KDV WZR FRUH 5RXWHUV WKDW
HDFK ULQJ ZSLFWKL \$HFWLYK \$YDLODELOLW\)RU ORUH LQI
'LDJUDP

7KH 'LVDVVWHU 5HFRYHU\ DQG %XVLQHVW & RQDWWQXHW\ S
FRQQHFWLRQ DQG WKH UHGLUHFV RI WKH IORZ RI WUD
1RUPDO RSHUDWLRQ WKH IRXU FRUH URXWHUV WHVW S
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3DOR 9HUGH KR XVHV WZR &KLDVFRL & DWDQW KW FRUH URXW
QHWZRUN 7KHVH URXWHUV FRQQHFW WR WKH =D\R QHV
FRORFDWLRQ ,QYROWD =XDS\QL&LNU D\ \$B 5U XQ VUW KWIRXJK

0RUURZ 'DWDFHQWHU KR XVHV &KZDRV &LVFIR U&DWKBIOFRWH U
=D\R QHWZRUN 7KHVH URXWHUV FRQQHFW WR WKH =D\R
7KH ,QYROWD XSOLQN DOVR UXQ'R XWKHURXJK =D\R &

7KH 0RUURZ 'DWD &HQWHU FRQQHFWV WR WKH &RUH UR
(DFK 5DFN PDLQWDLQV 'XDO 1H[XV N 7RS RI 5DFN)LEH
VZLWFKHV

7KH ,QYRQFDW&LRQ 'DWD &HQWHU KR X &HKD WWZLRV &JLXQFQL &
D VLQJOH YLUWXDO\WRQWUFLRQQ DLQJ\&UDFWMLRYQH IRU FRUH
8&6 1LPEOH YLUWXDO HQYLURQPHQW DUH FRQQHFWHG

\$OO 6ZLWFKHV DQG 5RXWHUV SU(RQSKDDJODFHG WQWHUW LURUXW
5RXWLQJ 3URWRFRO (,*53 ZLWKLQ WKH VDPH GRPDLQ

% %UDQFK 6LWH 9LUWXDO 3ULYDWH 1HWZRUN 931
%UDQFK VLWHV FRQQHFW WR WKH 786' QHWZRUN WKUR
: 5RXWHU DQG WHUPLQDWHG DW D VLQJOH &LVFR \$65

&)LUHZDOO &OLHQW 931 /RDG %DODQFHU
7UDIILF IORZV WR WKH LQ\WWLQHHWILW\WWLQHJXJK FDRQQ DLFJW UDY
WZR &LVFR \$6\$ ILUHZDOOV 7KHVH OH\HGP\WW HWKH &
DFFHVV 931 FRQFHQWUD\WW\WW BGQXDEO \$6\$ K DYQLODELOL
'`FWLVFR \$657q 6U €XU@À°0 « DFWLYH



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GLVWULFW VLWHV VR WKUH LV QR QHHG WR Xvh GRPD
RI WKH 'RPDQ 1DPH 6\VWHP '16 ZLOO DOORZ WKH FOL
VLWH ZKHQ IDLORYHU WW LSHWU ORWYPLFH V\$DOUHDG\ SRLQW
DW WKH '5 %& VLWH
% \$SSOLF DWLRQV)DLORYHU &RQGLWLRQV DQG 5HTXLUHP
7KH GLVWULFWV FULWLFDO V\VWHPV DUH DGPLQLVW
UHTXLUHPHQWV WKDW IFQHQDEWHSWUHWRS\ODEOWLRIQRU
VXPPDU\ DQG WR 5%&H' HDWLWHFRUKM\ WHPV DQG \$SSOLF
FODVVILFDWLRQ DQG (VHVQWLDO ,QIRUPDWLRQ

7DEO\$SSOLF DWLRQV 5HSOLF DWLRQ DQG)DLORYHU
\$SSOLF DW 6SHFLILF)DLO



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- o ,QIUDVWUXFWXUH VHUYLFHV LQFOXGLQJ 5RXWH DYDLODEOH IURP DOWHUQDWG GDWD FHQWHUV
 - o \$ UHJLPHQWHG DXGLWLQJ PRHQLWRQOQRZH@QGDV DQG ZHHNV SULRU
 - o '5 %& V\vwHP LV DFWLYH DQG FDQ EH DFFHVV
 - o \$SSURSULDWH SDVVZRUGV IRU V\vwHP DGPLQLV %& VLWH
- f \$OO SUHUHTXLVLWHV OLVWHG EHORZ KDYH EHHQ H[HFXW
- o &ULWLFDOO\ QHHGVNWSRVLQIFG@QHD@D@VH%DIFXOO G WUDQVDFWLRQ ORJV DUH VXFFHVVIXO DQG ILOH

3UHUHTXLVLWHV

- o 7KH '5 %& WHDP PHPEHUV LQFOXGLQJ V\vwH PHDQV WR FRQQHFW WR WKH DSSURSULDWH QH
- o '5 %& QHWZRUVWIDSLVORKYDHYUH EHHQ FRPSOHWHG QHWZRUN KDV WDNHQ RYHU SURGXFWLRQ ,3 DG FRRUGLQDWG ZLWK WKH QHWZRUN DGPLQLVWU
- o \$GPLQLVWUDWLYH ,V DQG 3DVVZRUG DUH DYDL
- o \$OO 5HSOLFDWLRQH&KEHHNOX\$RPSOHWKQ SHULRG WHDP DQG DW OHDVW D IHZ GD\V SULRU WR WH
- o \$OO 'DLO\ :HHNO\ DQG 0RQWKO\ 6ZLWFK 5HDG EHHQ FRPSOHWHG SHULRGLFDOO\ E\ WKH ,7 WH WKH IDLORYHU
- o \$OO UHSOLFDWLRQ SUREOHPV KDYH EHHQ UHVR
- o \$OO YLWDO UHFRUGV DUH PDGH DYDLODEOH WI

; (YDOXDWLRQ DQG)DLORYHU 6WDWXV &KHFN

\$)DLORYHU 5HSRUW
8SRQ FRPSOHWLQJ WKH IDLORYHU SURFHGXUH WKH WH LQ FLOQJGWKH DFKLH@H@R@H@Q@H@PR@Q@W@R@Q@I 532 DQG 572 IRU DSSOLFDWLRQV WR WKH 76 OHDG DQG FRRUGLQDWU VWDWXV UHSRUW DQG SURYLGH D VXPPDU\ WR FRUSR LQFOXGH



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% 0HDVXULQJ 572 DQG 532
572 LV WKH PHDVXUHPHQW RI WKH WLPH **QHQGHQWWRKE**
HQG XVHUV WR XVH DQG EXVLQHVW WR IXQFWHLRQKH, I DS
DGPLQLVWUDWRUV EURXJKW LW EDFN RQOLQH WKHQ W



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VHH LQR Q\KTHWS\LRQ V\VVHPV 6RPH IXQFWLRQDOLW\ PDI\ Q
DQG 7LHU DSSOLFDWLRQV 7KHUHIRUH LW LV LPSRU

;,, '5 % & 3HULRGLF 7HVWLQJ
'5 % & IDLORYHU DQG UHODWHG VDIOVQWV\ OODA\HDSQHGU DRUQ
EDVHG RQ HYH\QHWW &DEOHQ GDU IRU 6FKRRO ZHHVWV DUH
FRRUGLQDWHG E\ WKH DSSURSULDWH 76 WHDPV 7HVW
SUHSUHG EHIRUH WKH WHVW WDNHV SODFH \$ SODQQL

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& R S \ R I 7 p R I @ & @



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'DWHHFHPEHU

7HDP6 , QIUDVWUXFWXUH DQG \$UFKLWHFWXUH 7HDPV

8SJUDGH &OORDXQG 0LJUDWL RQ

2YHUYLHZ DQG 6FRSH

7KH VFRSH IRFXVHV RQ WKH GHTDILRXLRQ LSIIDRSHDRVQM FRU WI
UHFRPPHQGDWLRQV E\ WKH 7HFKQRORJ\ 6HUYL FHV 'HS
V\VWHPV LQ QG 6<

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'DW+K0\

6WDQGDUG 2SHUDWLQJ 3URFHGXUHV IRU 'LVDVWHU 5HFRYH

7KH 7HFKQRORJ\ 6HUYL FH V 6D '0IS\W WR H\QWD Q Q D UFGU HR IS WHD
'LVDVWHU 5HFRYH U '5 DQG %XVLQHV &RQWLQXLW\ % &

7KH OLVW LV UHYLHZHG DQG XSGDW HG UHJXODUO\ E\ NH\ C
'LWULFW WHDP ZKHQ UHOHYDQW\ XSRQW\ DRQH VHW\ UWLHPHQW
UHTXLUHG V\VWHPV XSJUDGHV IRU H[DPSOH &29, HYHQWV
RWKHU

7KH SURFHGXUHV DUH EDVHG RQ WKH LQIRUPDWLRQ DQG S
3ODQ '53 DQG %XVLQHV %&QWSQRYWG HG DQG DGRSWHG E
6HUYL FH V 'HSDUWPHQW

7KH OLVW RI VWDQGDUG RSHUDWLQJ SURFHGXUHV IRU '5

3ULPDU\ 'RFKPHQW % & 3 LV WKH SULPDU\ GRFXPHQW D
76 LQFOXGLQJ SURFHGXUHV\ \$HQA\ H\QWD UHJXODUO\ DQG DV Q
UHOHYDQW LQIRUPDWLRQ FRQWDLQHG LQ WKH '53 % &
8SGDW\ V'53 DQG % & 3 GRFXPHQW\ XDOXOS GDDQGHZKEHQ UHTX
RQ QHHG HYHQWV FKDQJHV RU XSJUDGHV
0HHWLQJ \$5 H\QWD % & WGRSLF\W\ H\B UHJXODUO\ DQG DV Q
GHSDUWPHQW PHHWLQJV 3ODQV RU FKDQJHV WR SURF
RI WKH UHJXODU PHHWRQ\ QRPLWQHG XGRH EXW DUH

7HFKQRORJ\ 6HUYL FH



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7HFKQRORJ\ 6HUYLFHV



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\$SSHQGL[) FRQWDLQV D JURXS RI FRQILGHQWLDO GRFXPHC

7KH GRFXPHQWV ZHUH SURYLGHG IRU WKLV DXGLW XSRQ UH

)RU VHFRXVWKH V H GRFXPHQVRQ DSROQEUDISORVHOG HQFU\SWHG
IRUPDWPIRWHDQ OMPLPH

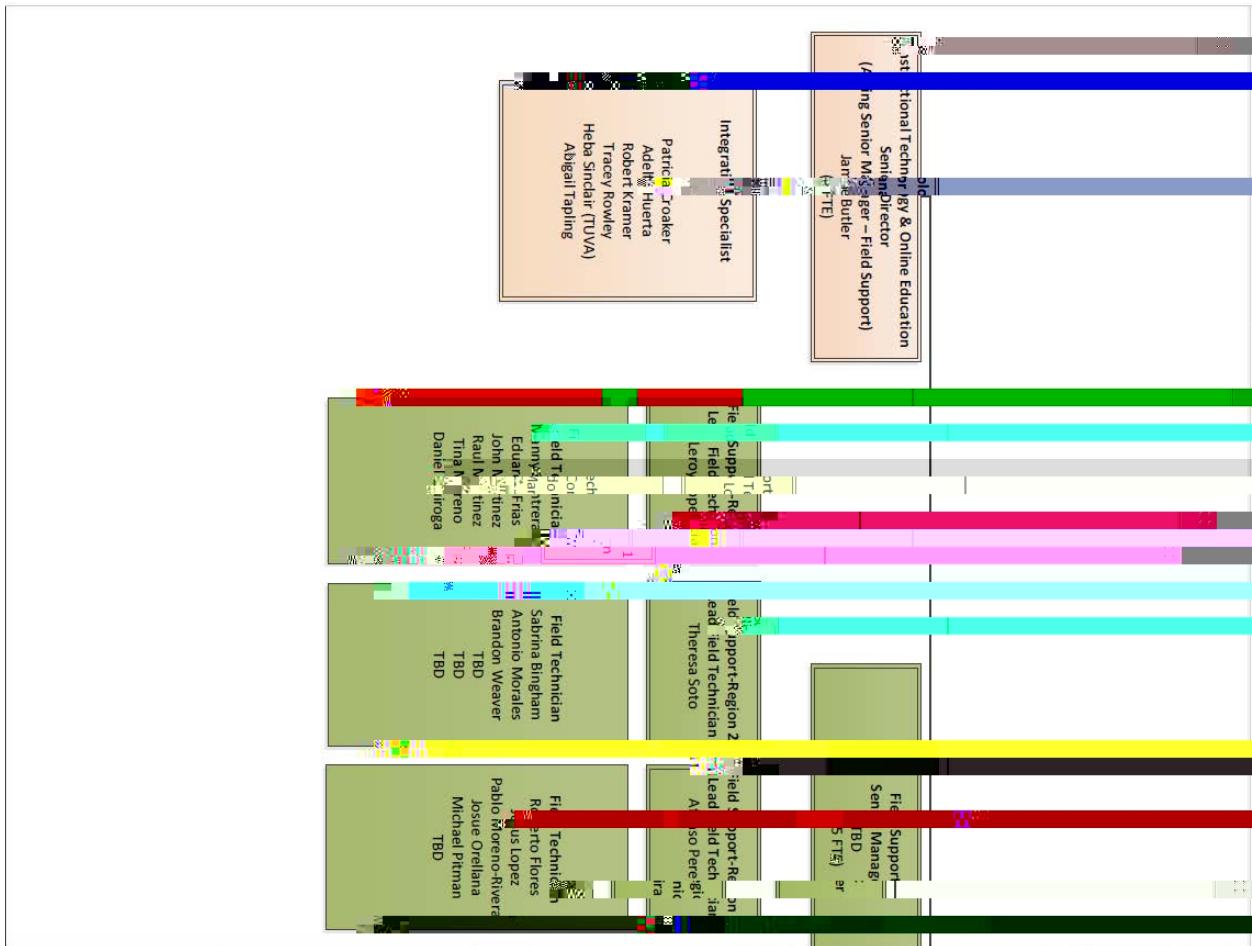
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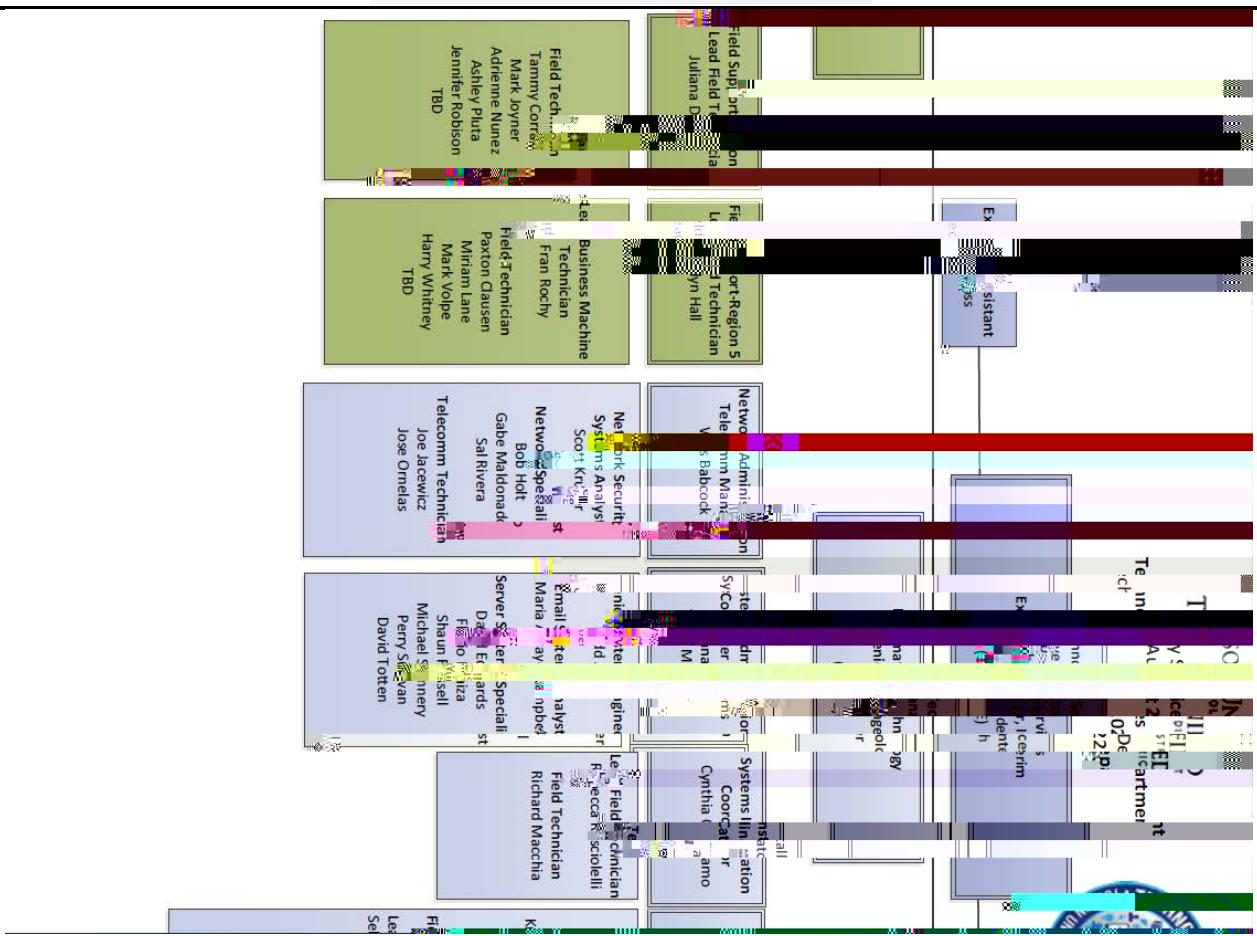
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7HFKQRORJ\ 6HUYLHV 2FU\$JDQXW\ WLRQ



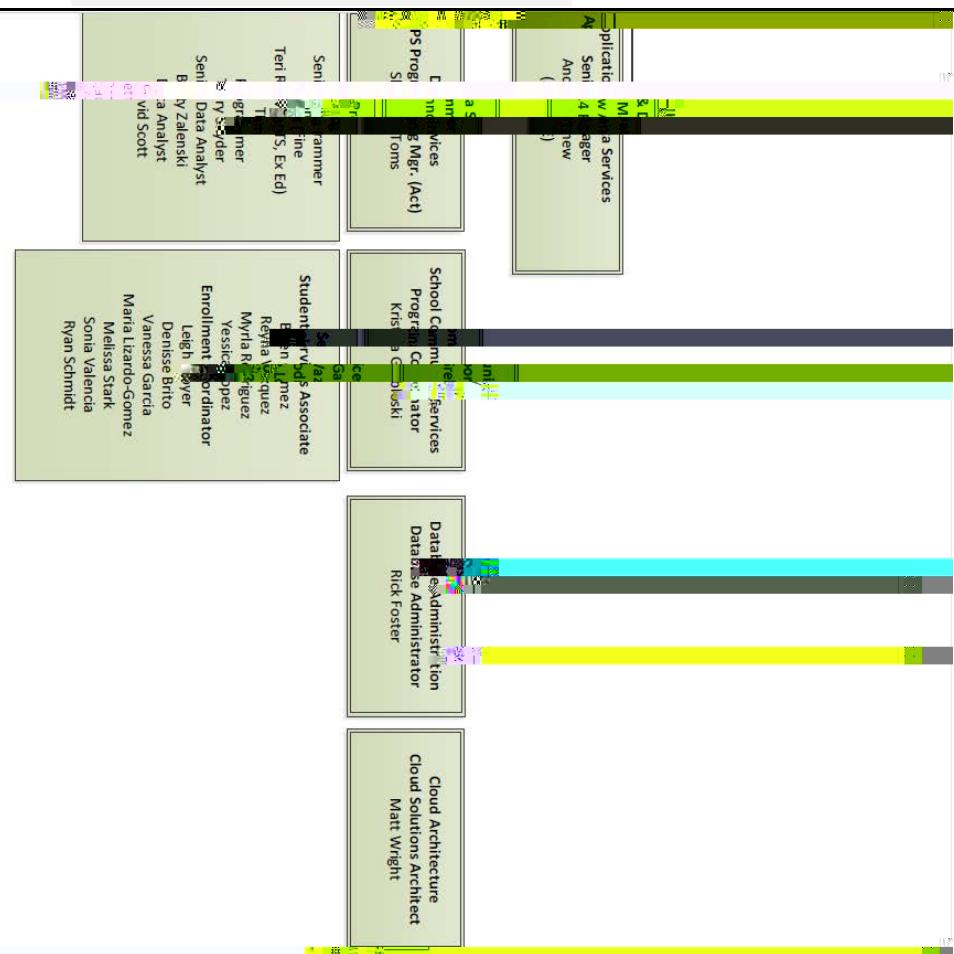


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DQG QHHGV WR EH VS QIB QUQHVS HDFQNL VHH GHE\$ DUWPHQWV RZ
IXQFWLRQV

,W LV LPSRUWDQW WR UHFRJQL]H WKDW WKH 'LVWULFW
DQG LQVWUXFWLRQDO GHOLYHU\ LQ D EXVLQHVV FRQW
ODUFK LQGXMKH & QGHPLF ,QVWUXFWLRQDO GHOLY
RFFXU UHPRWHO\ IRU D ODUJH SRUWLRL RI WKH VWXGH
7KHVH DFFRPSOLVKPHQWV FOHDUO\ GHPRQVWUDWH WK
GHSDUWPHQWV RQDQPSXVHV FDQ DQG KDYH DFKLHYHG V
H[HFXWLRQ :H GR DFNQRZOHGJH WKDW WKH 'LVWULFW
GRFXPHQWV IRU %XVLQHVV & RQWLQXLW\ 3ODQQLQJ

2YHUYDH\WKRGRORJ\ SDJH \$JUHHGKX\$IRFDQDRIRPQPHDFW
LQ SHUVRQ PHHWLQJV QR VLWH YLVLWDWSBQGHLWFF «

2EVHUYDW\W\QHSDUWPHQWDO 3ROLFLHV 7DKHG73U'BHGXU
GRHVGRHFQIPHQW ZKHQ DQG KRZ WKH S\BHQ DW\KPHDGHDQG
2WKHU WHFKQRORJ\ SROLFLHV DQG SURFHGXUHV DUH L
DXGLW

2EVHUYDW\QPSOHWH ,QIRUPDWLRQ 7HFKQRORJ\ 'LVD
\$ '53 FDQ KDYH PDQ\ IRUPDWVLDQ\ W\RI PXS\PHQWV:K,D
DXGLW UHSRUW FDWHJRUL]HG DV LQFRPSOHWH LQIRUP
GLIIHUhQW IRUPDWV DQG FRQWH[WV XVLQJ YDULRXV W
GHYHORSHG WKH GLVWULFW '5 SODQH\ZHG H\QOMORD E\K\BMMW
UHFRYHU WKH GLVWULFW\ V\WHPV '53 LV DQ LPSRU
RXU 76 WHDP UHJXODUO\ UHVSRRQGV VXFFFHVVIXOO\ WR
DQG SURIHVVLRQDO EDVLV \QK,L7V RW\BQ\QV\DG\WLPQQ,WW\DJBLW
UHVSRRQG WR RXWDJHV RI DOO VL]HV WKDW LPSDFW WK

2EVHUYDW\W\QGRU 5HOLDELOLW\ DQ\BQ\GFS\VR\\$WRYS\QJHHF
LQIRUPDWLRQ WKDW WKH\ GHHP QHFHVVDGURU\6DQHJRW
QHHGHG LQ WKH HYHQW RI D GLVDVDWHU RU IRU JHQHUD
WKURXJK D WLHUHG SURFHVV WKDW LGHQWLILHV WKH F
DQG VXSSRUW OHYHO DJUHHPHQWV ZILM\WLYH\QOG RDW\W\W
V\WHPV

2EVHUYDWLRQ 31R ,QIRUPDWLRQ 7HFKQRORJ\ %XVLQ
VFRSH RI WKH DXGLW SHU WKH \$XGLW /HWWHU RI ,QWH
3ODQ %&3 3OHDVH UHIHU WR UHVSRRQVH DERYH

2EW\W\DW\ER1Q 'LVDVWHU 5HFRYHU\ IRU (VHVQWLDO 'LW
7KH IROORZLQJ VWDWHPHQW H[WUDFWHG LQ WKH LQWH
RYHUYLHZ 3:KLOH WKH 'LVWULFW GRHV FXUUHQWO\ KD
UHFURYRI GLVWULFW V\WHPV EDVHG RQ D UHFHQW DXC
IRUPDOO\ GRFXPHQW D FRPSUHKHQVLYH DSSURDFK IRU

