

IWAA 2024 – Geographic Information System (GIS) at SLAC

GIS System Summary

Brian Fuss / SLAC Geospatial Services / Metrology
8 October 2024

Outline

- SLAC GIS Overview
- Major SLAC GIS Systems and SLAC “Customers”
- Selected Additional GIS Projects and Systems

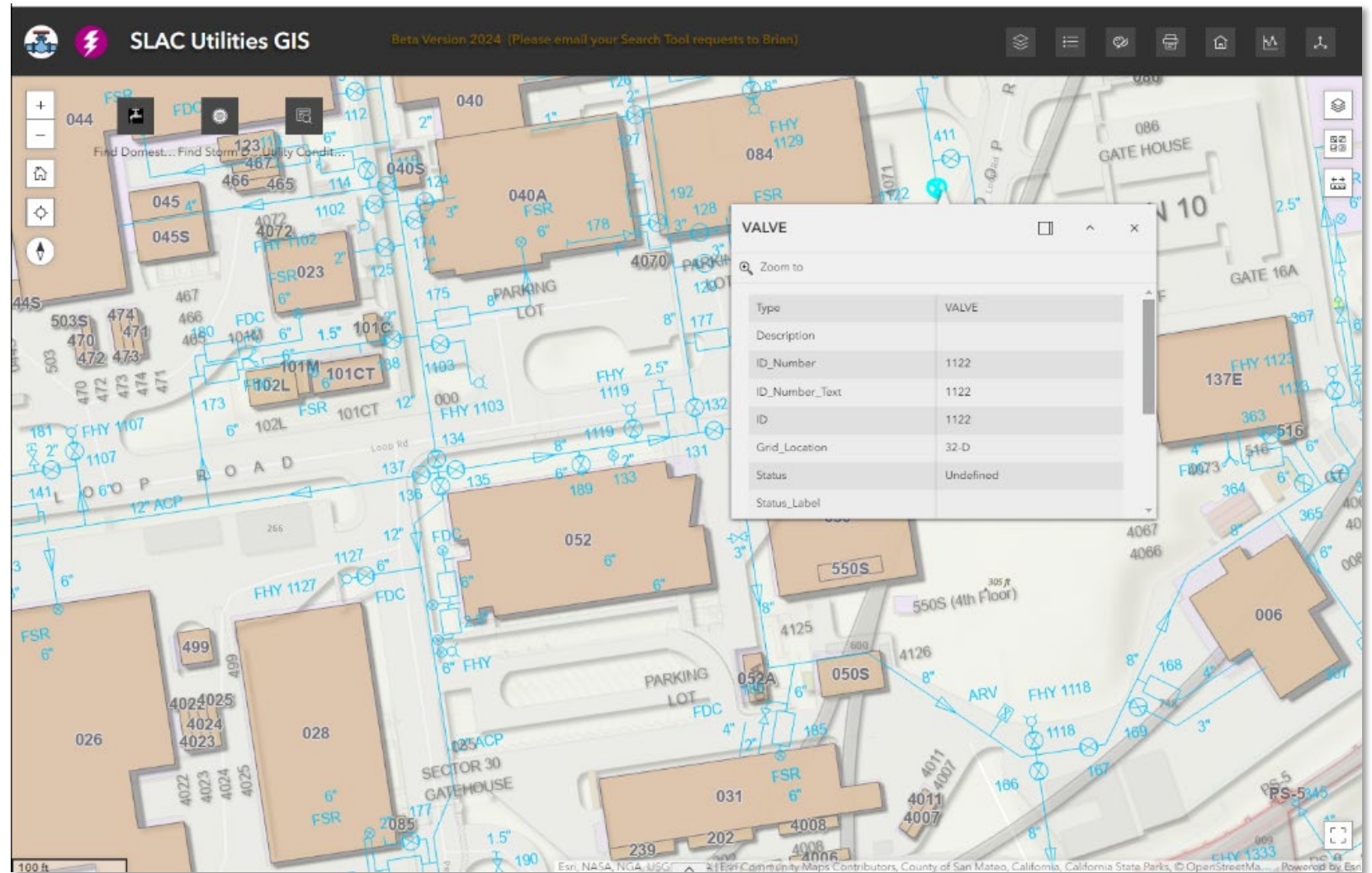
SLAC GIS Overview

Origins of GIS in SLAC's Metrology Department

- SLAC's Fire Chief and Deputy Fire Marshall (**Environmental Safety and Health Division**):
 - Discussed with SLAC field surveyors that we were doing GIS R&D
 - They wanted to discuss using GIS for various fire safety systems:
 - Fire Hydrants – GIS website and maps
 - Building Fire Extinguishers – GIS website and maps
 - Pre-Incident GIS website and maps
- Simultaneously **SLAC's Facilities Division** contacted myself and colleagues doing GIS R&D
 - Asked about us creating a GIS website for each of the system-wide utilities
- Complexity of the tasks, including finding, accessing and importing CAD into GIS was difficult
- Metrology engineers changed to state-of-the-art GIS system created by the international company ESRI

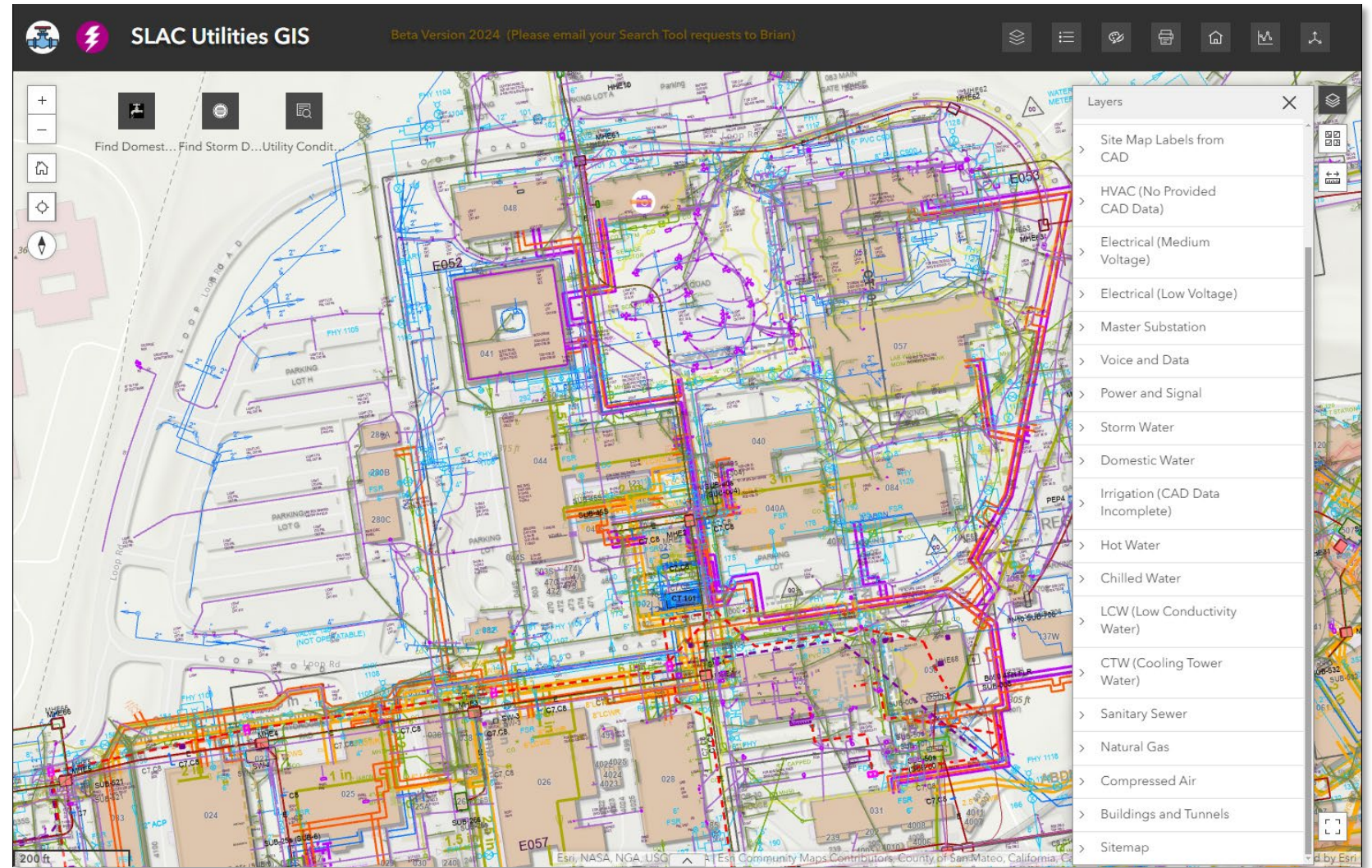
SLAC Utilities GIS - Beginning

- GIS Website began with Domestic Water
- Soon more and more CAD data was provided to Metrology to eventually add all major SLAC utilities



SLAC Utilities GIS - Expansion

- Over 15 additional utilities were added
- Over the years became widely used by both SLAC Facility field workers and SLAC management
- From GIS perspective:
 - Difficulties creating GIS database data from CAD labels
 - Difficulties getting Facilities users in deciding look (colors, etc.)



SLAC Building and Space Management GIS

- The first GIS was just for single buildings
- Metrology surveyors measured the internal layouts of numerous bldgs. with inaccurate or missing layouts
- Evolved to connecting to SLAC's Oracle building database
 - Many meetings
 - Interfacing was completed

The screenshot displays the 'SLAC Building and Space Management GIS' application. The main view shows a 3D-rendered floor plan of the 1st floor, with various rooms color-coded and labeled, including 'Auditorium 102', 'Lobby 101', '114-N Office', '114-M Huddle Room', and several restrooms. A search bar at the top left allows for finding rooms by 'Structure Number or Name'. On the right, a 'Zoom to' panel is open for 'Rm 114P Office', displaying a table of room details and a photo of a man.

Rm 114P Office	
Room Name	Office
Department	COMM
Occupant Ext	2653
Space Category	Usable
Room Usage	OFFICE-WORK AREA
Room Category	Work Station
Usable (SqFt)	116
Usage Comments	

Below the table is a photo of a man with dark hair, smiling, with a 'READ ME' button underneath it.

SLAC Building and Space Management GIS

- Python code created to update the GIS database and maps every night
- Became very complicated and rigorous with 1000s and 1000s of lines of code
- SLAC's independent building database was full of inconsistencies including redundant database tables!

```
Automated_Usage_Update_April_2023.py - C:\GIS_Projects\Building_Keyplans\Python_Code\Automated_Usage_Update_April_2023.py (3.11.8)
File Edit Format Run Options Window Help
##print Bld_Common_Total_SqFt
##print "Bld_Other_Total_SqFt"
##print "Bld_Other_Total_SqFt"

print ("Using dictionaries to update All_Floor_Info_Merged and All_Building_Info.")
## Now to use these Python dictionaries to update All_Floor_Info_Merged using Usable_Total_SqFt[bld_no][floor_no],
## Common_Total_SqFt and Other_Total_SqFt and
## All_Building_Info using Bld_Usable_Total_SqFt[bld_no], Bld_Common_Total_SqFt and Bld_Other_Total_SqFt.

## All_Floor_Info_Merged: Loop through all keys in Usable, Common and Other dictionary
path_All_Floor_Info_Merged = r"C:\GIS_Projects\Building_Keyplans\Keyplans.gdb\All_Floor_Info_Merged"
arcpy.MakeTableView_management(path_All_Floor_Info_Merged, "Temp_All_Floor_Info_Merged")
path_All_Building_Info = r"C:\GIS_Projects\Building_Keyplans\Keyplans.gdb\All_Building_Info"
arcpy.MakeTableView_management(path_All_Building_Info, "Temp_All_Building_Info")

print ("\n")
floor_name = ('Floor1':'1', 'Floor2':'2', 'Floor3':'3', 'Floor4':'4', 'SubFloor1':'L1', 'SubFloor1_UP':'MEZZ')
for typeChoice in ['Usable', 'Common', 'Other']:
    (searchDict, bldDict) = Choice.get(typeChoice)
    for bld_key in searchDict.keys():
        print ("All_Floor_Info_Merged. Working on:", typeChoice, bld_key)
        for floor_key in searchDict[bld_key].keys():
            current_floor = floor_name.get(floor_key)
            bld_floor_expr = "\"Building_Number\" = '%s' AND \"Floor_Number\" = '%s'" % (bld_key, current_floor)
            print ("Bld_floor_expr is ", bld_floor_expr)
            try:
                arcpy.SelectLayerByAttribute_management("Temp_All_Floor_Info_Merged", "NEW_SELECTION", bld_floor_expr)
                MyCount_SelectLayer = int(arcpy.GetCount_management("Temp_All_Floor_Info_Merged"))
                if MyCount_SelectLayer > 0:
                    arcpy.CalculateField_management("Temp_All_Floor_Info_Merged", "%s_SqFt" % (typeChoice), searchDict[bld_key],
                    except Exception:
                        e = sys.exc_info()[1]
                        print ("Trapped Error:")
                        print ("bld_floor_expr = ", bld_floor_expr)
                        print ("bld_key = ", bld_key)
                        print ("floor_key = ", floor_key)
                        print ("current_floor = ", current_floor)
                        print (e.args[0])

## All_Building_Info: Loop through all keys in Usable, Common and Other dictionary
for bld_key in bldDict.keys():
    bld_expr = "\"Building_Number\" = '%s'" % (bld_key)
    print ("All_Building_Info. Working on:", typeChoice, bld_key)
    try:
        arcpy.SelectLayerByAttribute_management("Temp_All_Building_Info", "NEW_SELECTION", bld_expr)
        MyCount_SelectLayer = int(arcpy.GetCount_management("Temp_All_Building_Info"))
        if MyCount_SelectLayer > 0:
            arcpy.CalculateField_management("Temp_All_Building_Info", "%s_SqFt" % (typeChoice), bldDict[bld_key], "PYTHON")
    except Exception:
        e = sys.exc_info()[1]
        print ("Trapped Error:")
        print ("bld_expr = ", bld_expr)
        print ("bld_key = ", bld_key)
        print (e.args[0])

print ("Updating Inside_Gross_SqFt in both All_Floor_Info_Merged and All_Building_Info")
## Compute updates Inside_Gross_SqFt
arcpy.SelectLayerByAttribute_management("Temp_All_Floor_Info_Merged", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("Temp_All_Building_Info", "NEW_SELECTION")
inside_gross_expr = "!Usable_SqFt! + !Common_SqFt! + !Other_SqFt!"
MyCount_SelectLayer = int(arcpy.GetCount_management("Temp_All_Floor_Info_Merged"))
if MyCount_SelectLayer > 0:
    arcpy.CalculateField_management("Temp_All_Floor_Info_Merged", "Inside_Gross_SqFt", inside_gross_expr, "PYTHON")
arcpy.SelectLayerByAttribute_management("Temp_All_Building_Info", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("Temp_All_Building_Info", "NEW_SELECTION")
inside_gross_expr = "!Usable_SqFt! + !Common_SqFt! + !Other_SqFt!"
MyCount_SelectLayer = int(arcpy.GetCount_management("Temp_All_Building_Info"))
if MyCount_SelectLayer > 0:
    arcpy.CalculateField_management("Temp_All_Building_Info", "Inside_Gross_SqFt", inside_gross_expr, "PYTHON")
```


2

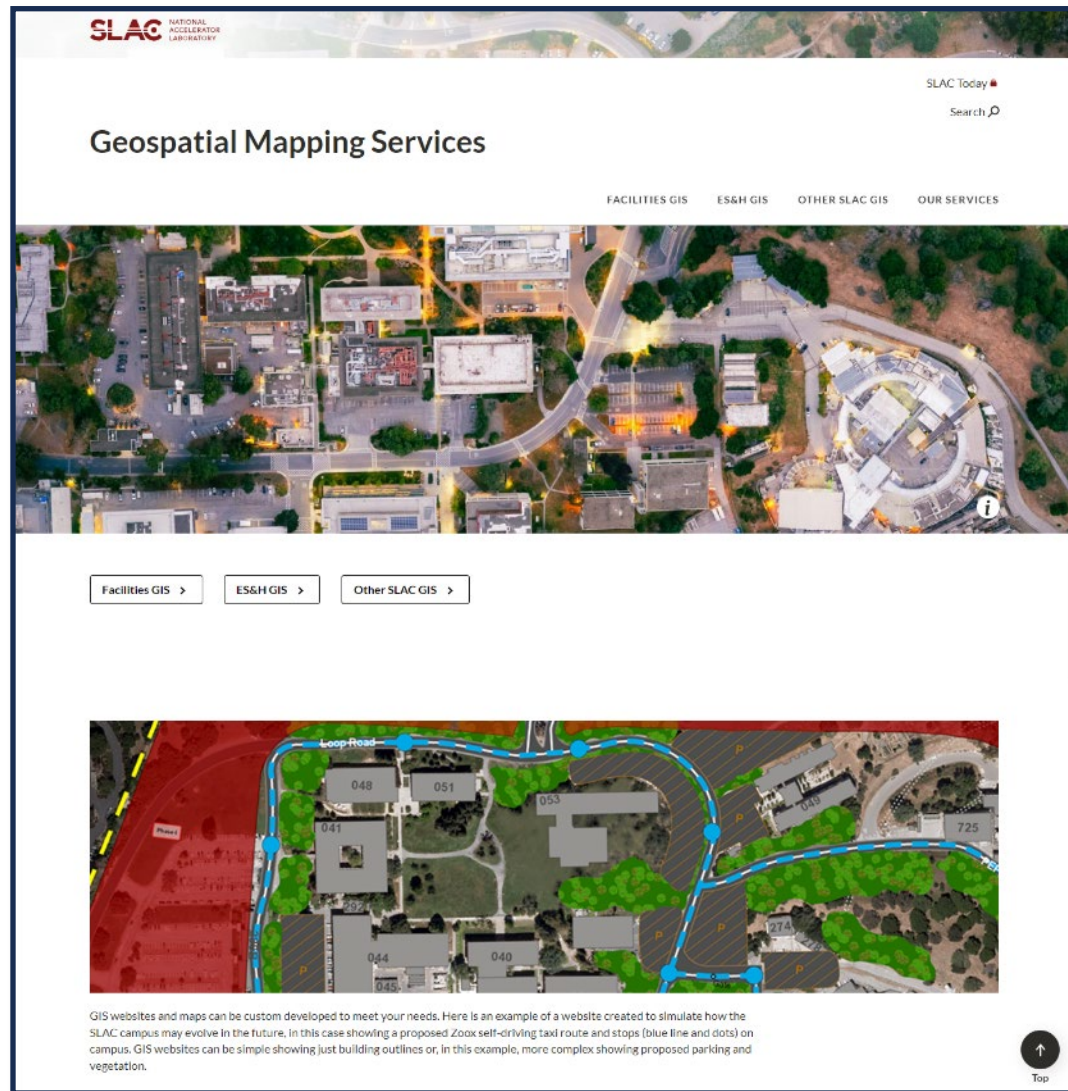
Metrology GIS Expanding Growth

Metrology's GIS – Growth of SLAC Users and Customers

- During the past 10 to 15 years the **Space Management GIS** and **Utilities GIS** became more ubiquitous, and soon was used by almost everyone at SLAC
- Requests for new GIS websites became more and more frequent each subsequent year
- Our GIS printed maps were being made for almost all SLAC departments and began showing up everywhere including conference rooms, emergency management such as building evacuation maps at each building entrance

- Present day extent of GIS website and users...(next slide)

Metrology's GIS Growth – Present Day Shared GIS Websites



- GIS Home Website
- Main Categories:
 - Facilities GIS
 - ES&H GIS
 - Other SLAC GIS
- Over 18 different themed GIS websites for **Facilities**
- Over 17 different themed GIS website for **Environmental Safety and Health** (including Emergency Management)
- Half a dozen **Other** GIS websites

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Metrology GIS Growth – Facilities GIS Websites

Metrology's GIS Growth – Facilities Related GIS Websites

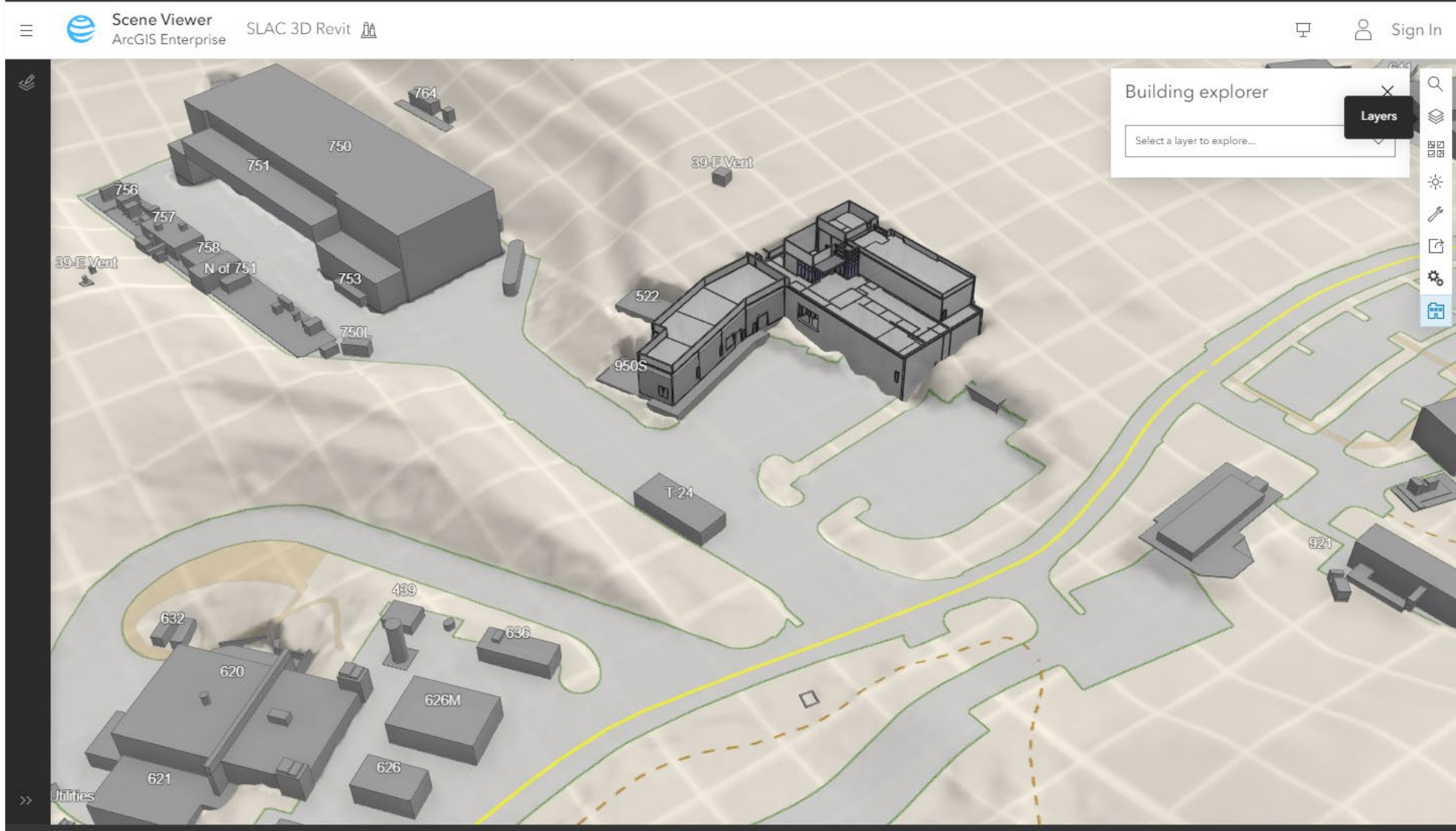
FACILITIES GIS ES&H GIS OTHER SLAC GIS OUR SERVICES		
GIS website	Description	Contact
SLAC Building and Space Management GIS	Building and Office Tool - serves the needs of SLAC Facilities Building & Space Management group	A.Rao, W.McKissi
SLAC 3D GIS	3D Building and Office Tool - Detailed 3D GIS of SLAC Facilities Building & Space Management GIS floors and Building Keyplan Floors	A.Rao, W.McKissi
SLAC 3D Utilities GIS	3D Utility Pipes - with exaggerated and true diameter versions	R.Radau
SLAC Revit BIM 3D GIS Demo	3D GIS with Revit Structures Embedded - Examples of CAD supplied revit structures including B003, B005, B018 and the NEH (B950)	B.Fuss
SLAC Building Readiness GIS Dashboard	Building readiness status for operations and occupation (COVID-19 Recovery) - Under continuing update [2020/21]	J.Bentz
SLAC COVID-19 Recovery Worker Distribution GIS Map	COVID-19 Recovery Worker Distribution Site Map - Under continuing update [2020/21]	B.Fuss
SLAC Construction Projects GIS (User version)	Current Construction Projects Overview Tool - serves the needs of SLAC Facilities Design and Construction Services group	R.Radau
SLAC Utilities GIS	Utility Search and Display Tool - serves the needs of SLAC Facilities with copies of major site utilities	R.Radau
SLAC Building Utility and Road Outages GIS (User version)	Building Utility Outage Dashboard Tool - utility and road outage status for SLAC buildings and roads	R.Radau S.Vetter
SLAC FIMS (Facilities Information Management System) GIS	FIMS Asset Tool - used in conjunction with SLAC Facilities site compliance plan for real property asset management	L.Fangupo
SLAC Building Condition Assessment Reports GIS	FIMS/CAIS Assessment PDFs - interactive SLAC GIS map used to access F&O SharePoint Property Assessment Reports	B.Fuss
SLAC Roof Asset Plan GIS	Roof Asset Tool - current and planned SLAC roof conditions	P.R.Sharma
SLAC LINAC Roof Drone Images GIS	Hi-res drone photos of LINAC Klystron Gallery Roof summer 2023	N.Zontos
SLAC Rollup Doors GIS	Rollup Door Asset Tool - SLAC Rollup Door GIS Info	D.Toews, (FOC x5357)

– Other Facilities Sites - used as internal planning and working tools –		
SLAC Summer or Winter (Seasonal) Shutdown Planned Outages GIS	Summer or Winter Shutdown Planned Building Outages	R.Radau S.Vetter
SLAC Electrical Operations During Abnormal Events GIS	Load Status Tool for SLAC F&O Specialists	A.Krishna R.Aitieri
SLAC Generator Location GIS	Generator Position Edit and Display Tool - GIS app displaying SLAC Facilities edited generator positions	R.Radau S.Vetter
SLAC Domestic Water Leak Valve Isolation Trace GIS	Interactive Leak Tracing Tool - serves the needs of SLAC Facilities in leak tracing & valve isolation	R.Radau

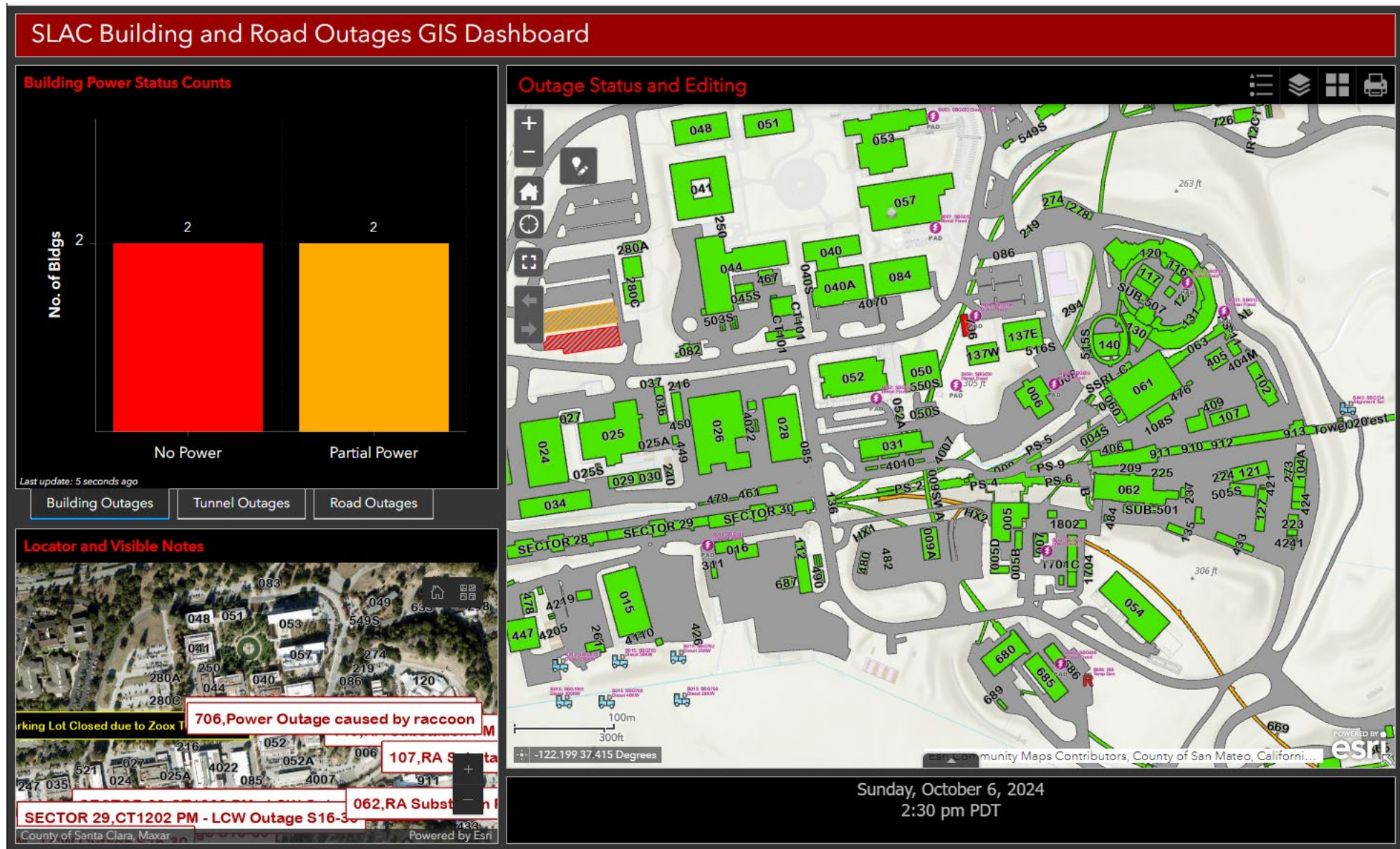
- Diverse set of subdivisions in SLAC Facilities who have custom GIS website made for them and/or their users at SLAC
- Most GIS websites rely on and reuse existing GIS base layer services such as buildings and tunnels

Metrology's GIS Growth – Facilities Related GIS Websites

SLAC GIS Demo - BIM / Revit Structures



Metrology's GIS Growth – Facilities Related GIS Websites



Metrology's GIS Growth – Facilities Related GIS Websites

SLAC FIMS GIS [SEDA] [Condition Assessments GIS] [Condition Assessments] [DOE Information Systems]

Property Information Popup:

- Property Name: PSLB/ASC
- Inspection Date: 8/30/2019
- Functionality Assess Date: 8/2/2021
- Name: Missing (057) PSLB/ASC

Roof info (if available):

TRESCO

Layer List:

- SLAC Grids
- FIMS Layers - - Expand to Select Layers
- Condition Assessment Reports - - Turn FIMS Layers Above Off for Viewing

Map Controls: +, -, Home, Refresh, Full Screen, Print, Measure, Link, Share, Window Management

Map Legend:

- Fence Type
- Site
- Security Fence
- High Radiation Fence
- Wood Fence

Summary:

Item	Value
Site	SLAC
Project	SLAC FIMS
Product	SLAC FIMS
Version	1.0
Author	SLAC
Created	8/30/2019
Modified	8/2/2021
Published	8/30/2019
Expires	8/30/2019
URL	SLAC FIMS

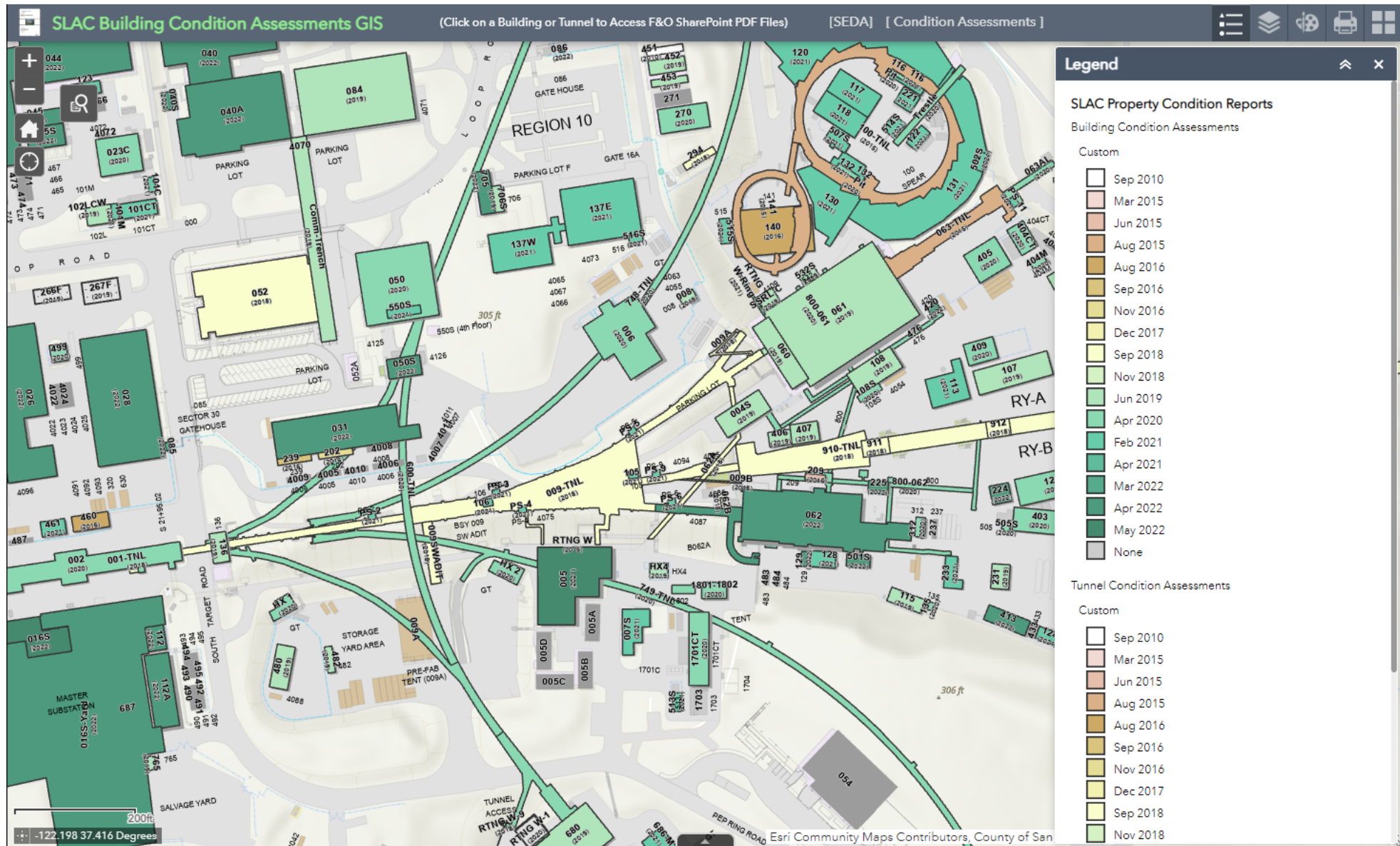
SLAC GIS: Project ID: 66763, Site: 66763, Site Area: 66763, Site Area Unit: Linear Feet

SLAC FIMS: Project ID: 66763, Site: 66763, Site Area: 66763, Site Area Unit: Linear Feet

Scale: 100m, 300ft

Coordinates: -122.195 37.419 Degrees

Metrology's GIS Growth – Facilities Related GIS Websites



Metrology's GIS Growth – Facilities Related GIS Websites

SLAC LINAC Roof Drone Images GIS August 2023 Flight

Locate Drone Photo by LINAC Sector

Tasks Results

Select LINAC Sector

Query criteria

Select LINAC Sector

SECTOR 25

Apply

Legend

- Drone Photo Locations
 - Drone Photo Location
- Point Count
 - Low
- Drone Flight Path
 - Drone Flight Path
 - Drone Flight Path Far
- Buildings and Tunnels
 - Linac Sectors

(1 of 3)

Date & Time 8/17/2023, 12:16 PM

X -122.210477

Y 37.415702

Z 112.890000

LINAC Sector SECTOR 26

Photo Path [More info](#)

SECTOR 26 PHOTO

A002C0312_230817_E0P2.jpg

[Zoom to](#)

Esri Community Maps Contributors, County of San

SLAC

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Metrology GIS Growth – Environment Safety and Health (ES&H) GIS Websites

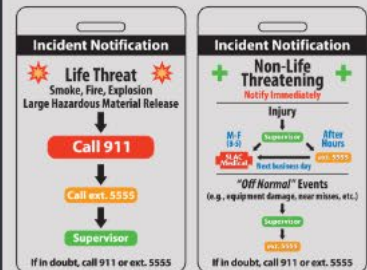
Metrology's GIS Growth – ES&H Related GIS Websites

SLAC Emergency Evacuation GIS



EMERGENCY EVACUATION Geographic Information System (GIS)

Click for [SLAC Current Status](#) page.
The SLAC Information Hotline is 1-877-447-7522



In case of an emergency:

Fire:

- Evacuate: Be aware of building exits
- Follow building residents to the assembly area
- Do not leave until you are accounted for and have been directed to leave

Earthquake:

- Remain in building: Duck, cover, and hold position
- When shaking stops: Evacuate building via a safe route to the assembly area

Click on beige building for Building Evacuation PDF Maps or on cloud for Emergency Assembly Area PDF Maps

Southwest Region - Main Campus

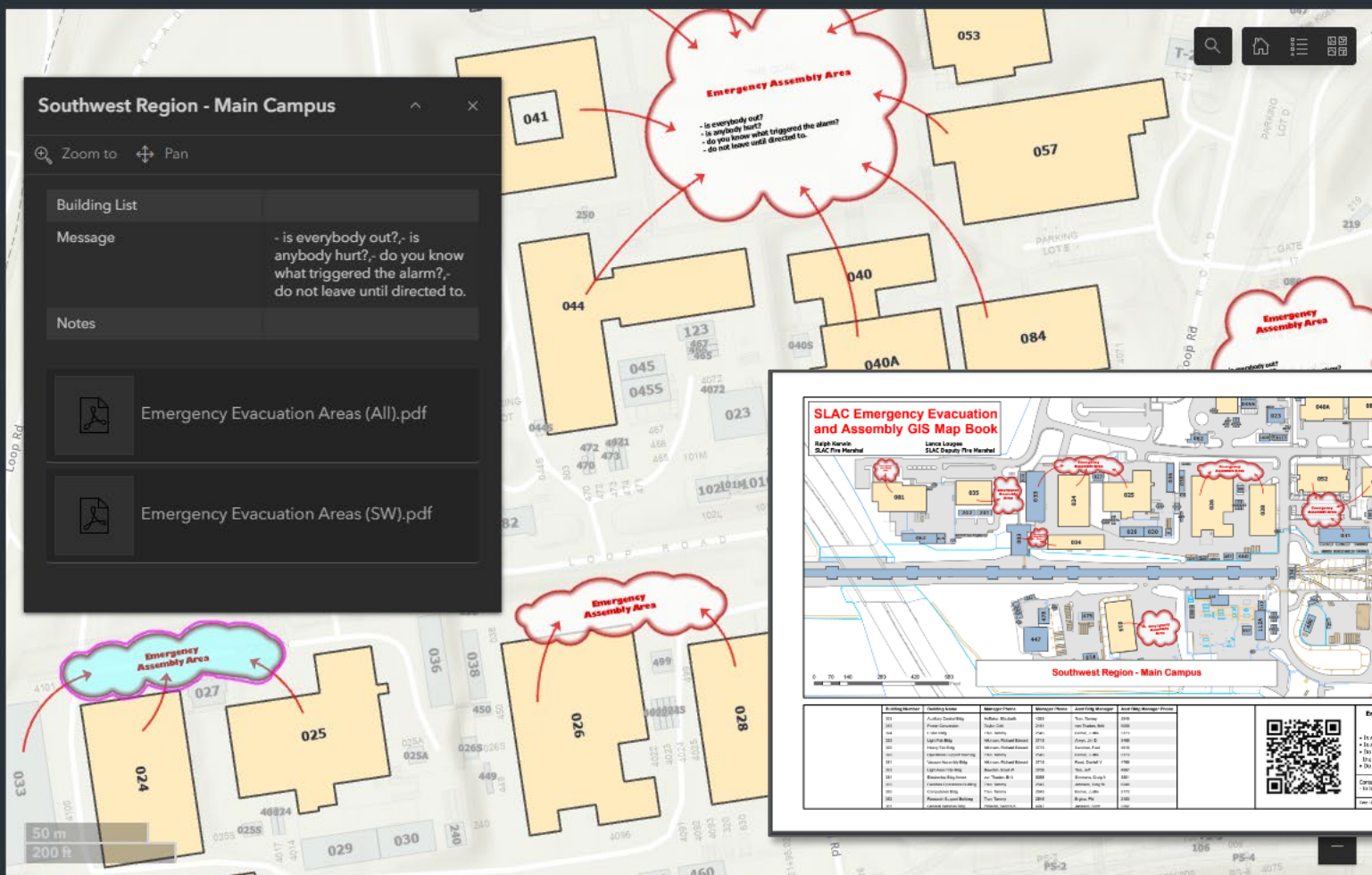
Zoom to Pan

Building List

Message
- is everybody out?,- is anybody hurt?,- do you know what triggered the alarm?,- do not leave until directed to.

Notes

- Emergency Evacuation Areas (All).pdf
- Emergency Evacuation Areas (SW).pdf



SLAC Emergency Evacuation and Assembly GIS Map Book

Ralph Varian
SLAC Fire Marshal

Luca Longo
SLAC Quality Fire Marshal

Southwest Region - Main Campus

Building Number	Building Name	Manager Name	Manager Phone	Area Bldg. Manager	Area Bldg. Manager Phone
001	Public Courtyard	John Doe	5555	John Doe	5555
002	Power Distribution	John Doe	5555	John Doe	5555
003	Control Room	John Doe	5555	John Doe	5555
004	Sign/PA Bldg	John Doe	5555	John Doe	5555
005	SLAC Main Building	John Doe	5555	John Doe	5555
006	SLAC Main Building	John Doe	5555	John Doe	5555
007	SLAC Main Building	John Doe	5555	John Doe	5555
008	SLAC Main Building	John Doe	5555	John Doe	5555
009	SLAC Main Building	John Doe	5555	John Doe	5555
010	SLAC Main Building	John Doe	5555	John Doe	5555
011	SLAC Main Building	John Doe	5555	John Doe	5555
012	SLAC Main Building	John Doe	5555	John Doe	5555
013	SLAC Main Building	John Doe	5555	John Doe	5555
014	SLAC Main Building	John Doe	5555	John Doe	5555
015	SLAC Main Building	John Doe	5555	John Doe	5555
016	SLAC Main Building	John Doe	5555	John Doe	5555
017	SLAC Main Building	John Doe	5555	John Doe	5555
018	SLAC Main Building	John Doe	5555	John Doe	5555
019	SLAC Main Building	John Doe	5555	John Doe	5555
020	SLAC Main Building	John Doe	5555	John Doe	5555

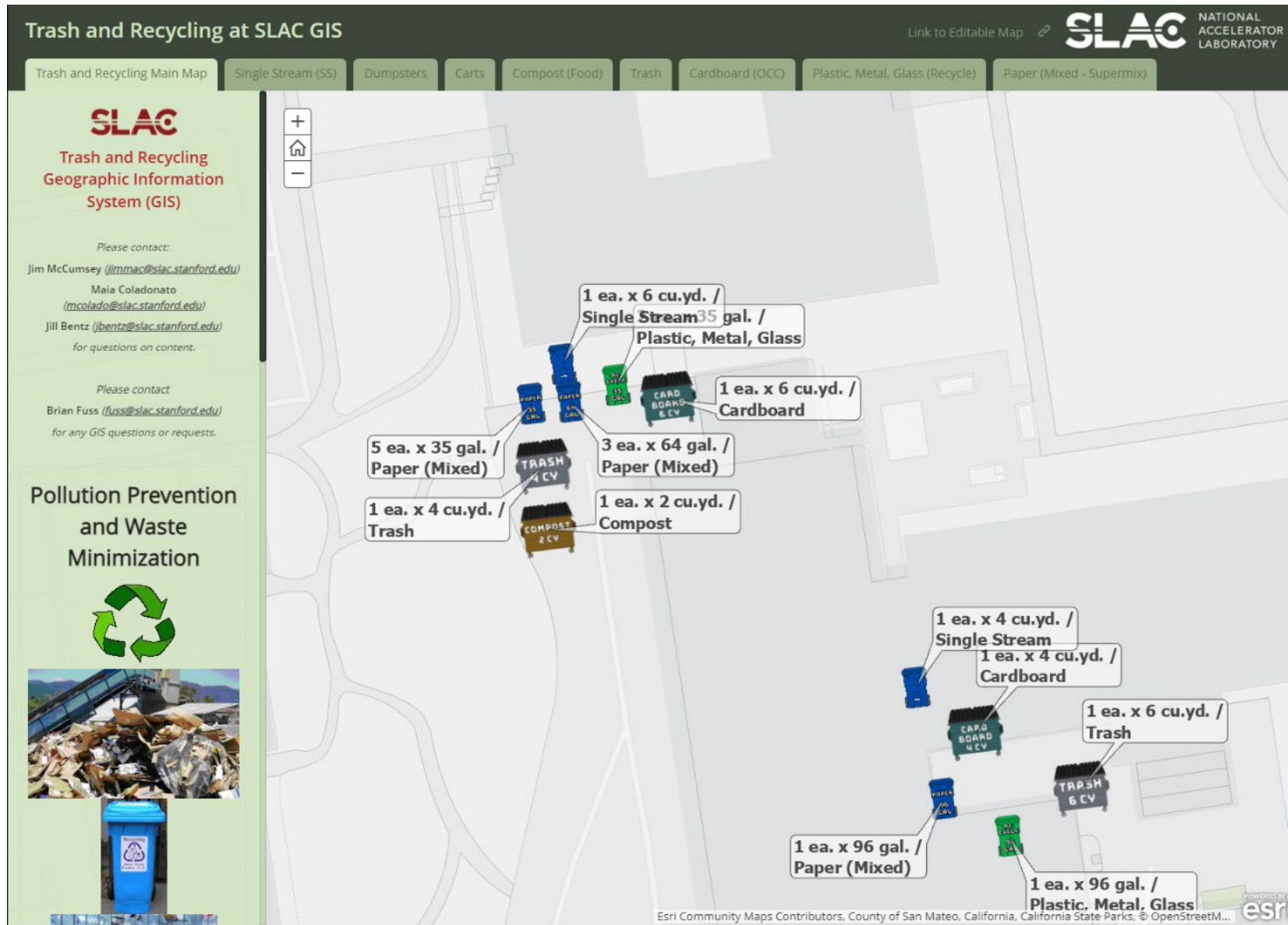
Emergency Assembly Area Checklist

- Is everybody out?
- Is anybody hurt?
- Do you know what triggered the alarm?
- Do not leave until directed to

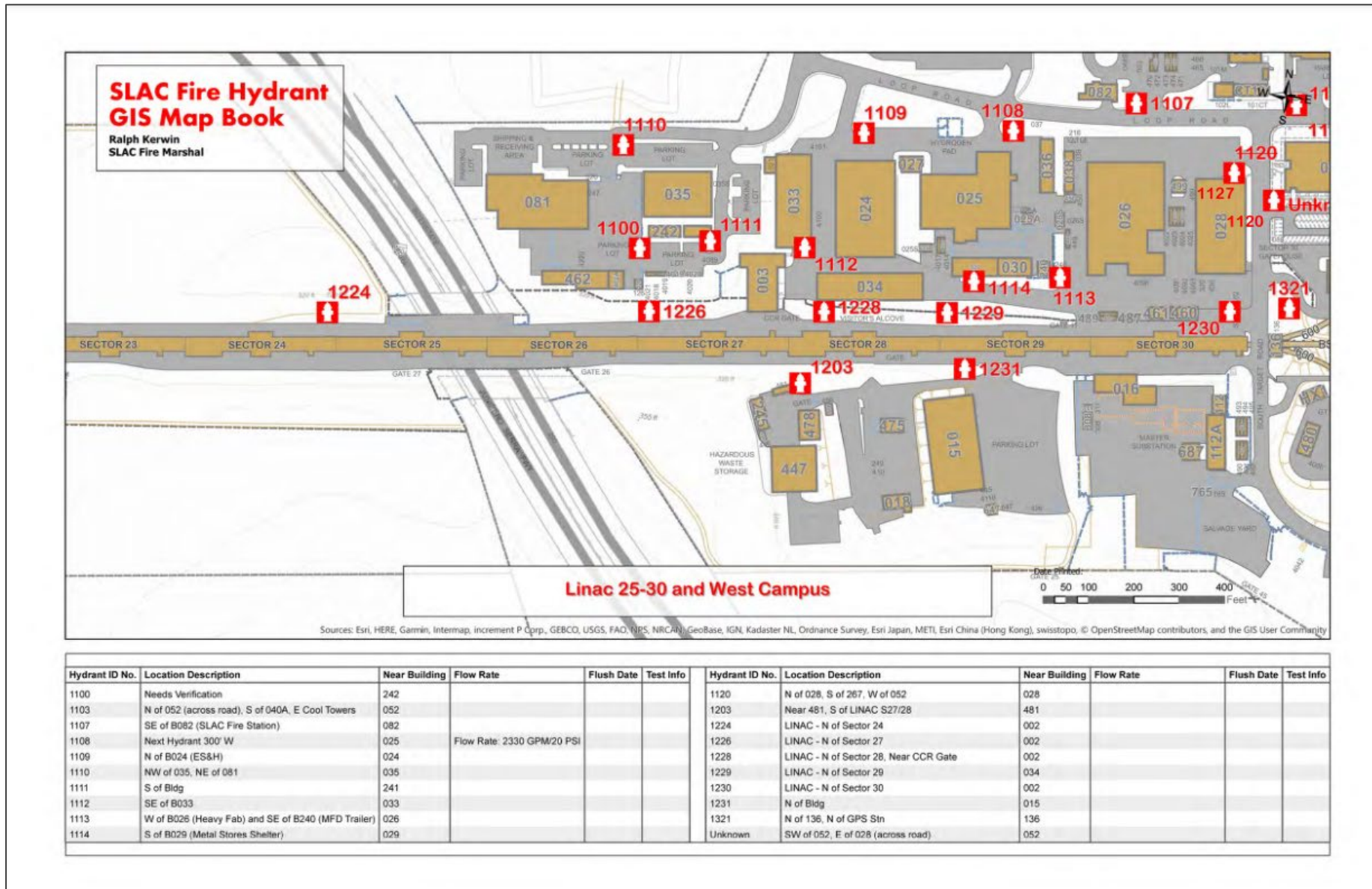
Contact Numbers
SLAC Main Building: 5555
SLAC Main Building: 5555
SLAC Main Building: 5555

QR Code

Metrology's GIS Growth – ES&H Related GIS Websites



Metrology's GIS Growth – ES&H Related GIS Websites



Metrology's GIS Growth – ES&H Related GIS Websites

The screenshot displays the SLAC Fire Barriers GIS interface. The main map shows a building layout with various rooms and fire barriers highlighted in red. A search window is open, and a detailed view of a specific barrier is shown.

Search Fire Barriers

Tasks Results

Search by Barrier Type

Query criteria

Select barrier type

Door

Barrier may be on another floor

Apply

(2 of 2)

Fire Barriers: Elec and Tel/Data - 1 hour

Bldg No	053
Name/ID	Elec and Tel/Data - 1 hour
Note	Elec and Tel/Data - 1 hour
Type	Fire Wall
Task Type	
Location	
Title	
Description	

Zoom to ...

6m
20ft

37.420 -122.204 Degrees

SLAC Fire Barriers GIS

Click Here for SLAC GIS Home Page

1012B Tel/Data

1012A Elev Ctr Rm

STAIR-NW

1200 Exhibit Hall

1300 Community Rm

1330 AV Projection Rm

1330A Conference Rm

1330A Tel/Data

1330A Tel/Data

1370 Panorsky Auditorium

1310 Stage

1310A Storage

STAIR-SE

053

STAIR-S

1032 Control Rm

1022 Cryo Tem 3

1034 Calibration

1028 Metrology Lab

1012 EE County of San Mateo, California, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, EPA,...

Metrology's GIS Growth – ES&H Related GIS Websites

SLAC CERS GIS Click on Green Bldgs for PDFs / Zoom in for Details incl. Fire Extinguishers

Structure Number or Name

120 : SSRL North Arc Building West

Zoom to

Bldg	120
Name	SSRL North Arc Building West
Alt Number	120
Completed	Yes

SSRL (B120, B130, B131, B117, B118).pdf

Location	Chemical	Hazard/state	Units	Largest Container	Avg Daily Amt	Max Daily Amt
B131	DIESEL	Flammable liquid	gal	138	70	138
B120	DIESEL	Flammable liquid	gal	138	70	138
B140	SONTEX X-RAY OIL (klystron)	Toxic liquid	gal	75	150	150
B132	SONTEX X-RAY OIL (klystron)	Toxic liquid	gal	75	150	150
B130	HYDRAULIC OIL (elevator)	Toxic liquid	gal	75	75	75
B120	HYDRAULIC OIL (elevator)	Toxic liquid	gal	170	170	170
507	TRANSFORMER OIL	Toxic liquid	gal	253	253	253
514	TRANSFORMER OIL	Toxic liquid	gal	2600	5200	5200
532	TRANSFORMER OIL	Toxic liquid	gal	518	518	518
5075	LEAD ACID BATTERY BANK	Corrosive liquid	Gal	4	80	80

Hazardous Materials
SSRL
Transformers
Generators
Klystrons

Elevators
Battery bank
Klystrons
Transformers
Generators

057 ARRILLAGA SCIENCE CENTER

274 278 219 218 217 216 215 214 213 212 211 210 209 208 207 206 205 204 203 202 201 200 199 198 197 196 195 194 193 192 191 190 189 188 187 186 185 184 183 182 181 180 179 178 177 176 175 174 173 172 171 170 169 168 167 166 165 164 163 162 161 160 159 158 157 156 155 154 153 152 151 150 149 148 147 146 145 144 143 142 141 140 139 138 137 136 135 134 133 132 131 130 129 128 127 126 125 124 123 122 121 120 119 118 117 116 115 114 113 112 111 110 109 108 107 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

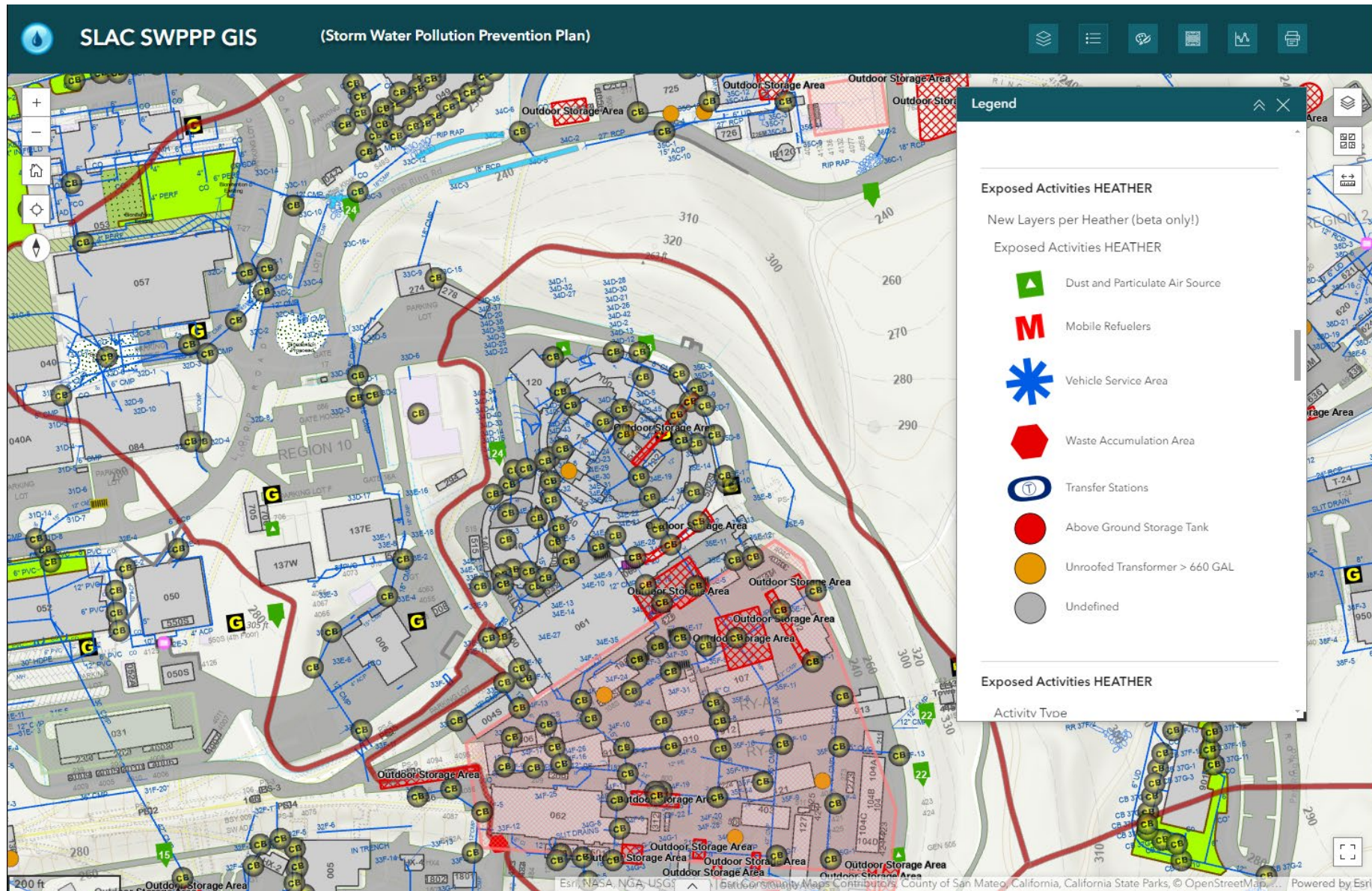
200 ft

Esri, NASA, NGA, USGS | Esri Community Maps Contributors, County of San Mateo, California, California State Parks, © OpenStreetMap, ... Powered by Esri

Metrology's GIS Growth – ES&H Related GIS Websites



Metrology's GIS Growth – ES&H Related GIS Websites



Metrology's GIS Growth – ES&H Related GIS Websites

SLAC SPCC GIS (Spill Prevention Control & Countermeasure)

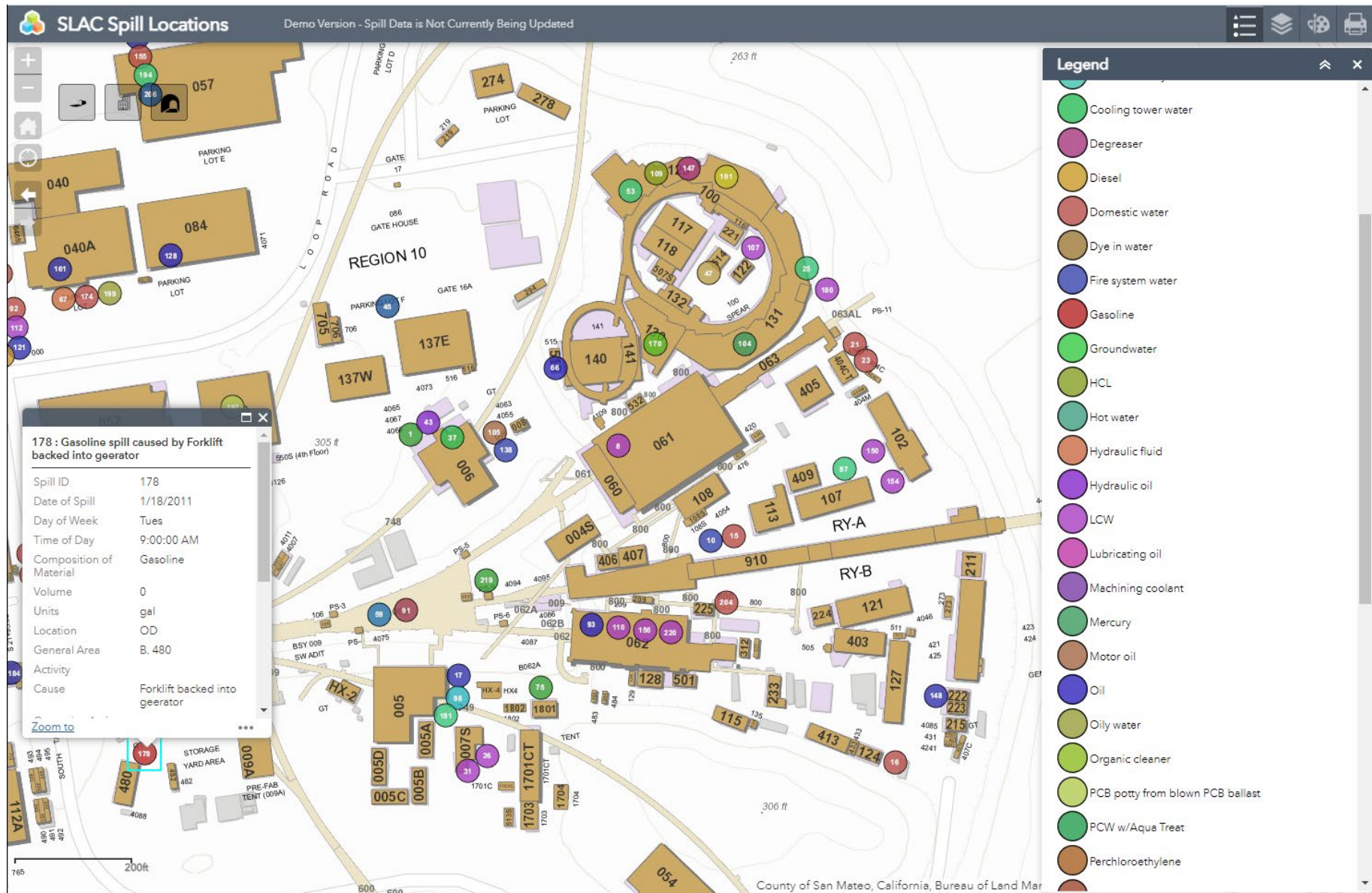
Waste Accumulation Area (SWPPP)

Number	10
Name	
Notes	For CT1701 (Located SW Corner of B062)
SWPPP Type	Waste Accumulation Area

200 ft 300

Esri, NASA, NGA, USGS | Esri Community Maps Contributors, County of San Mateo, California, California State Parks, © OpenStreetMap... Powered by Esri

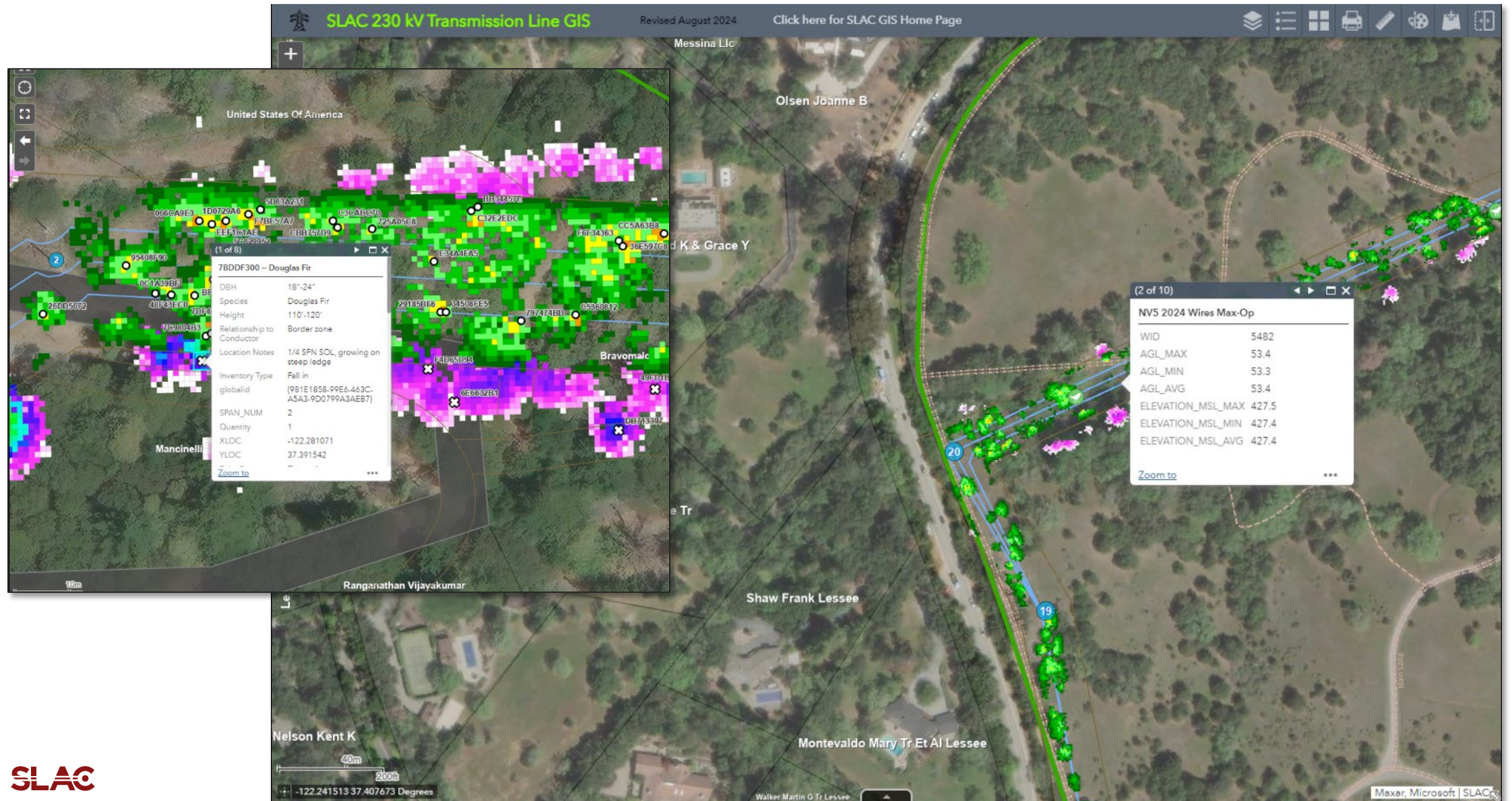
Metrology's GIS Growth – ES&H Related GIS Websites



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Metrology GIS Growth – Other GIS Websites

Metrology's GIS Growth – ES&H Related GIS Websites



Metrology's GIS Growth – ES&H Related GIS Websites

SLAC Power Transmission Corridor Pre-Plans Fire Safety GIS

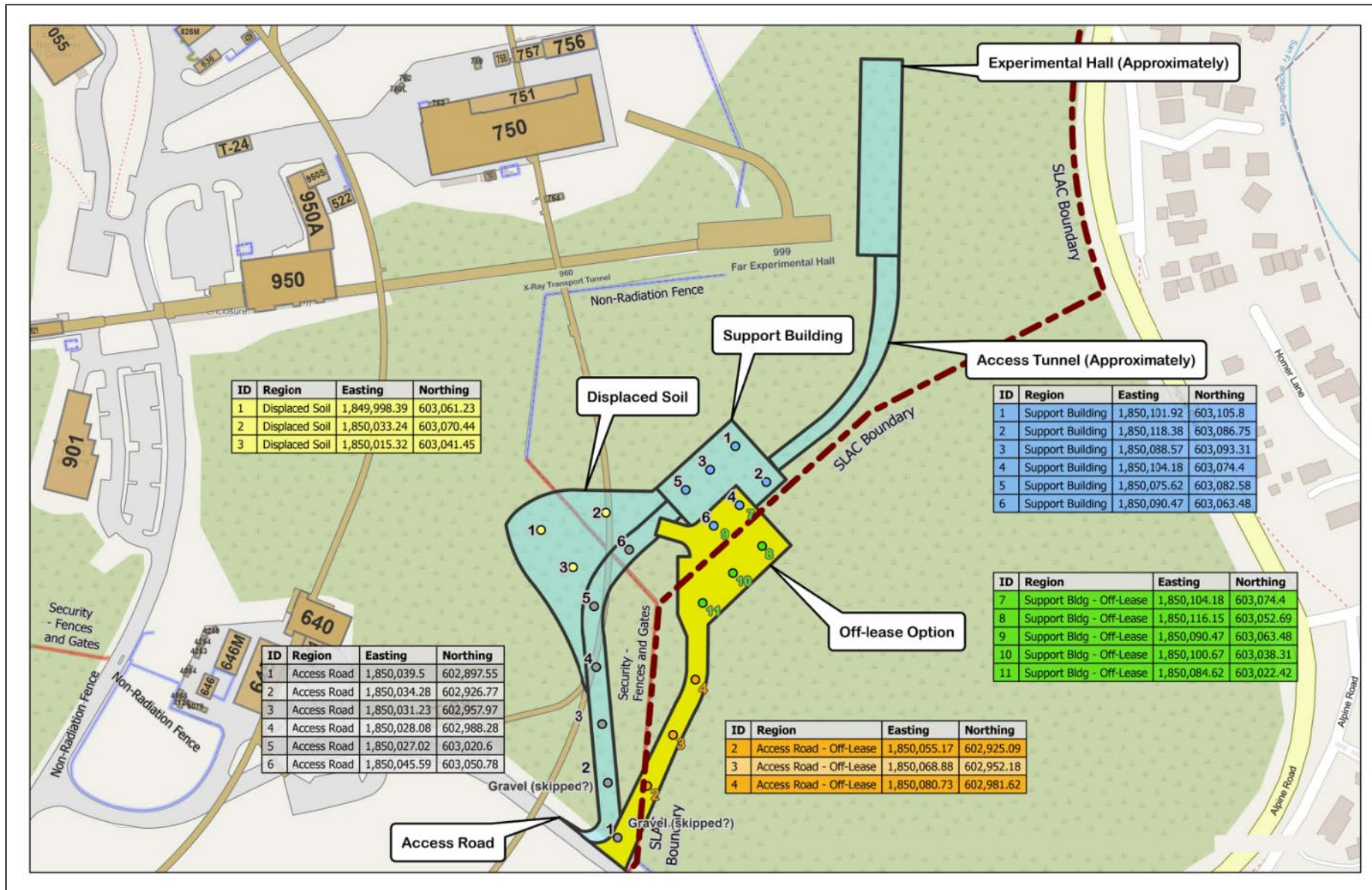
Layer List

- Operational layers
 - SLAC Grids
 - Fire Boundaries
 - Moderate
 - High
 - Very High
 - LRA
 - Moderate
 - High
 - Very High
 - SRA
 - Moderate
 - High
 - Very High
 - Towers and Infrastructure
 - Transmission Corridor
 - Trails, Parks, etc.
 - County Parcels (30s load, zoom in for less)
 - Stanford Aerial Photo (2013)
 - Base Map

Span Number	Span Type	Clearance Issue	Description	Extent Vert Violation GO 95 Reduced	Extent Vert Violation GO 95 Full	Span Thermal Rating	Ampacity per MVA	Notes
2-3	Clearance Issue	Ground	Clearance to ground over heavily vegetated area	5.16 ft	0.9 ft	110 F	0 Amps / 0 MVA	Ampacity values from Span Thermal Ratings (Power Engineers Doc SAN 149-

6 features 0 selected

Positioning Soil Sampling Locations (SLAC MEC-U)



6

3D GIS – Discussion and Videos

[IWAA24 GIS Videos](#)

Thank you!