

Using Geospatial Technology to Design and Manage Reclamation of the Mabel New-Superior Mine

Jon E. Brandt, P.G.
Texas AML Program



Geospatial Technology

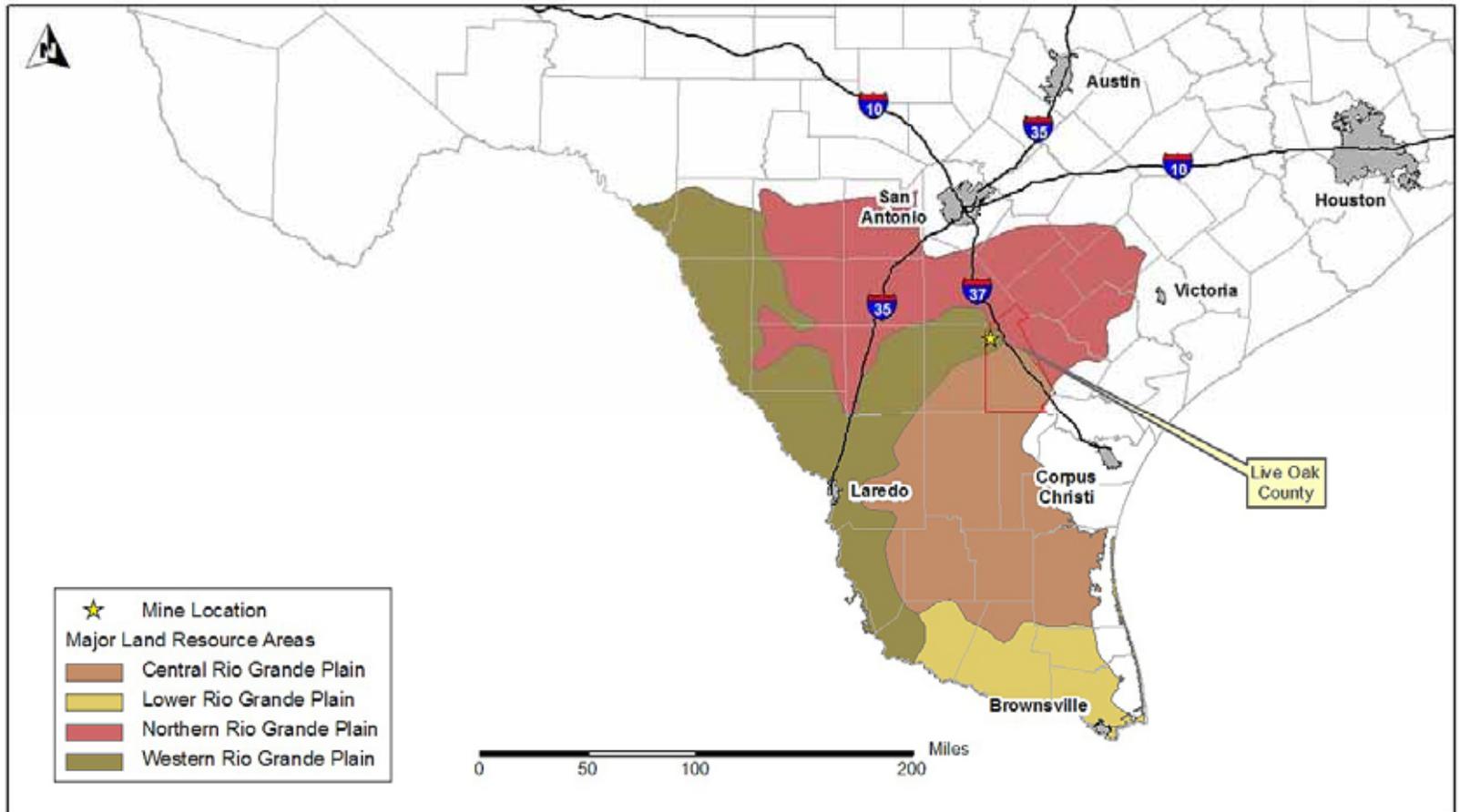
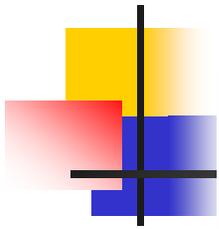
- Mabel New-Superior U Mine
- Site assessment - mapping
- Project design
- Project management



Site Information

- Western Rio Grande Plain MLRA
- Mining conducted from 1961 to 1963
- Semi-arid open grassland with scattered trees and brush







Site Assessment - Mapping

- Topographic contour data already collected
- Preliminary radiation data collected in 1999 – relatively high radiation values
- 1 m height gamma radiation survey and subsurface radiation profiles



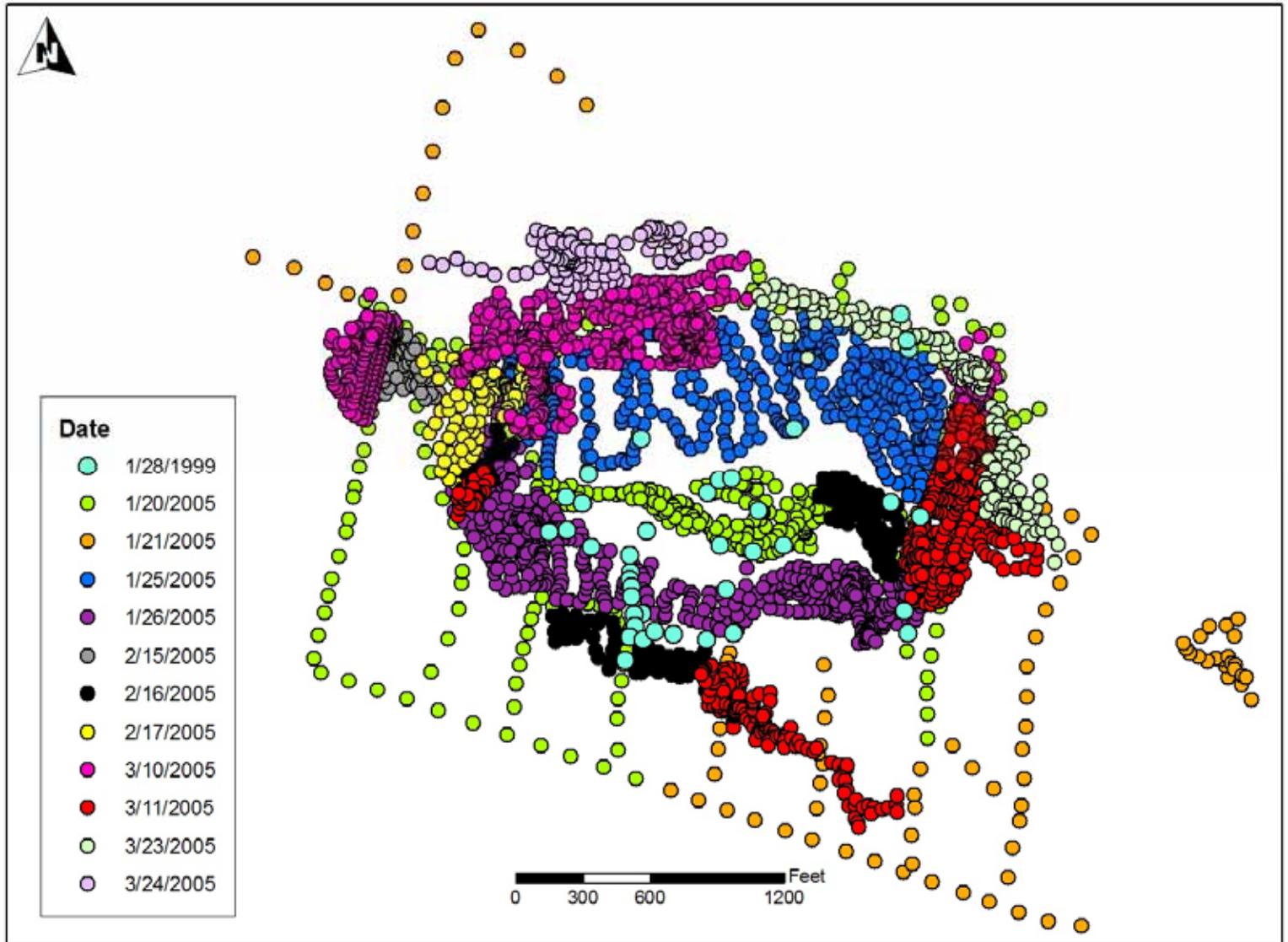
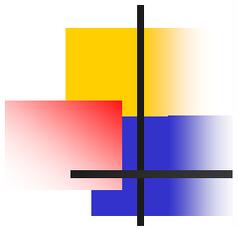
GPS Equipment Used

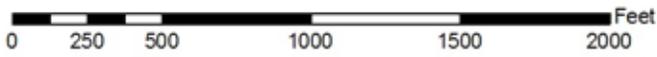
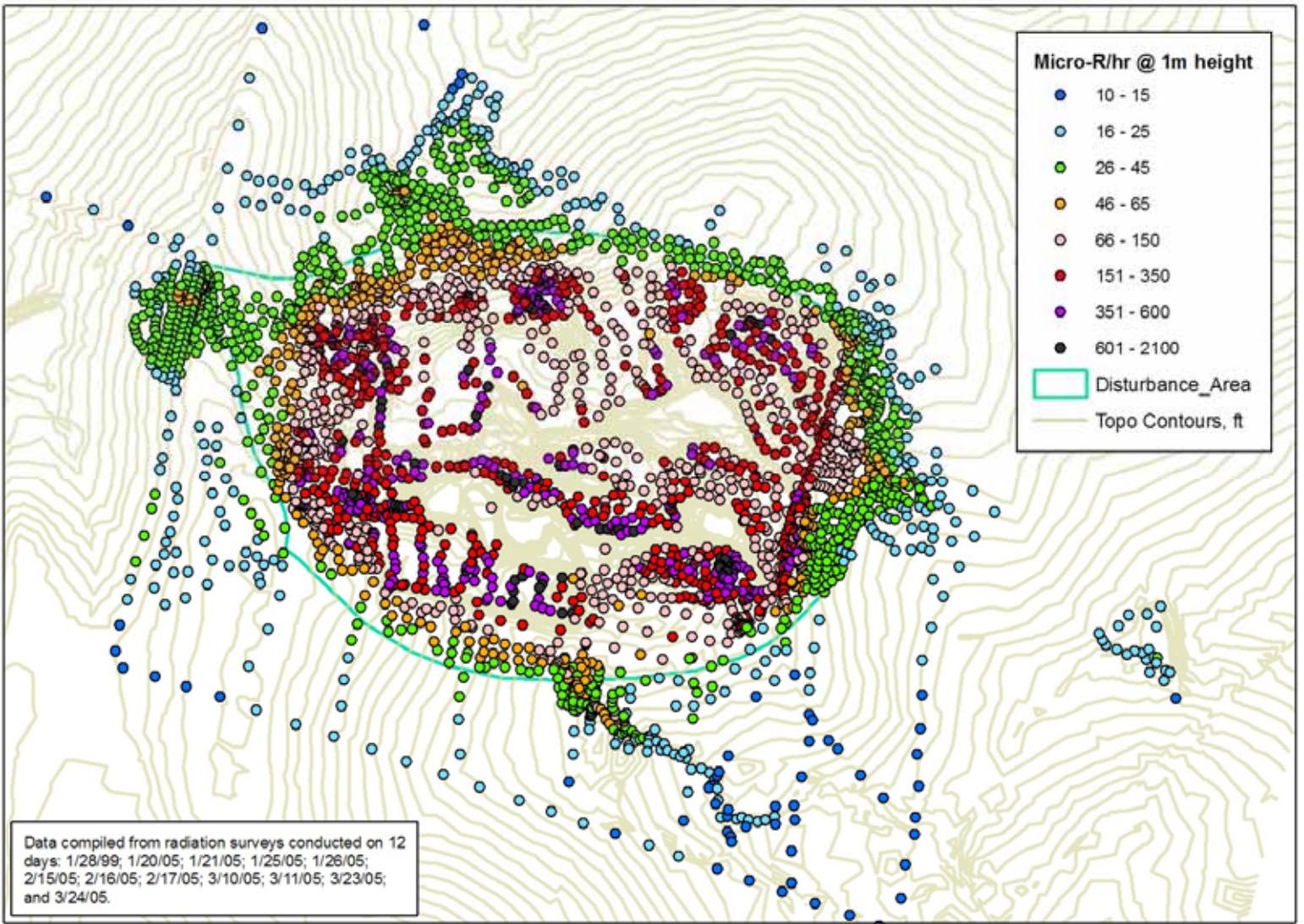
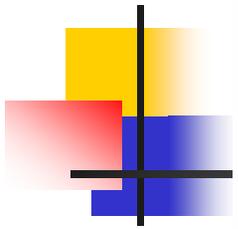
- Trimble ProXRS –
acquired in 1999
- Asset Surveyor 5.27
- OmniStar Satellite
Corrections
- 1-m accuracy
- Trimble GeoXT
acquired in March
2005



Field Conditions



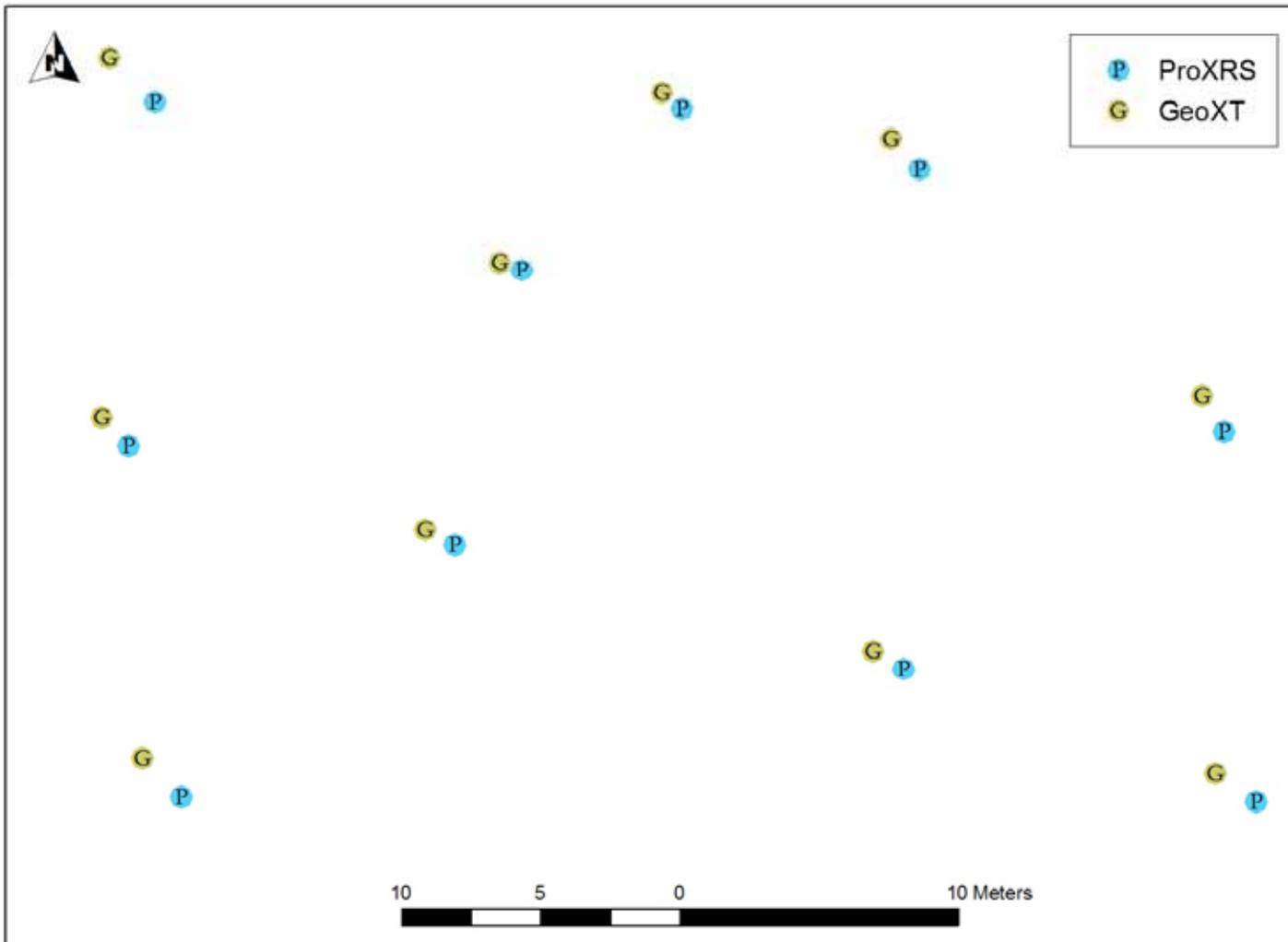
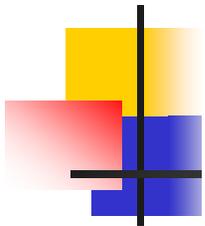




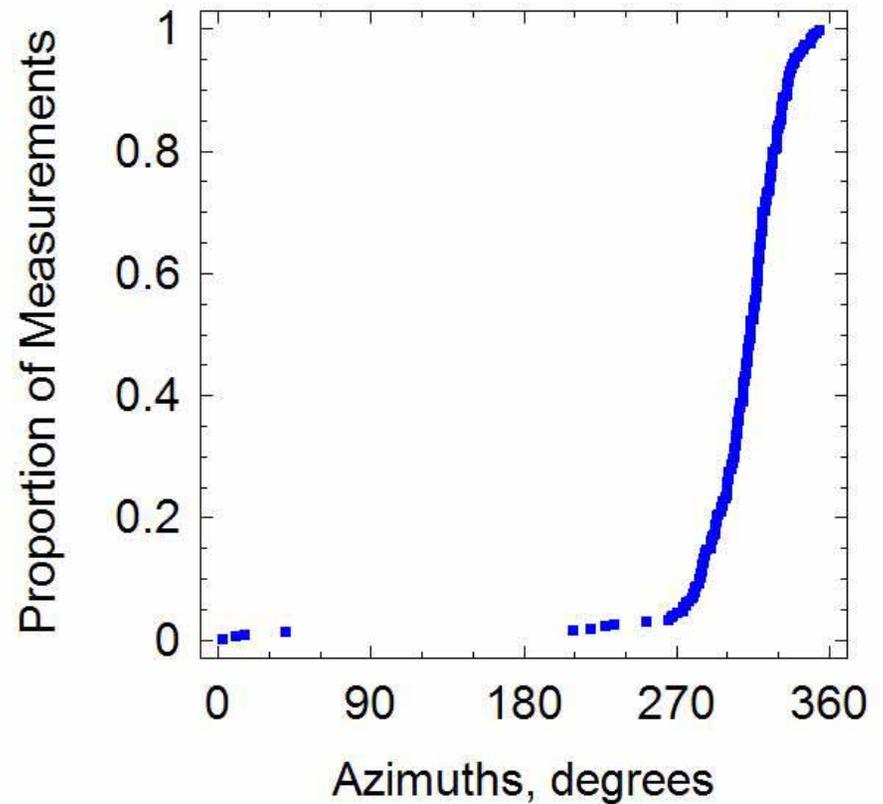
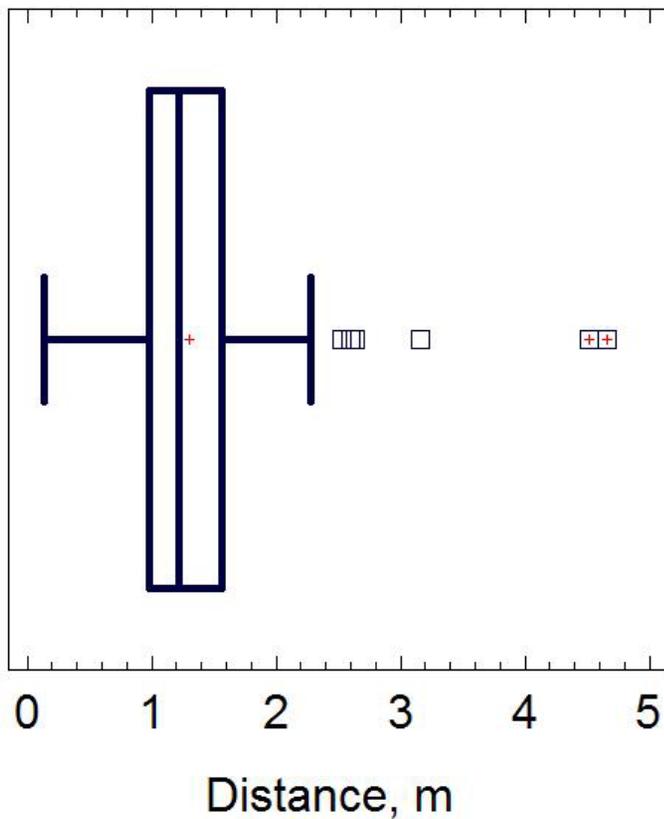
Trimble GeoXT

- Received from OSM
- Compared to ProXRS for 1 afternoon of data collection
- 0.7 kg vs 6.7 kg
- No cables
- Longer battery life





ProXRS versus GeoXT



Mabel New-Superior: Planned Work



0 200 400 800 1200 1600 Feet

03/14/2005

GeoXT Data Collection

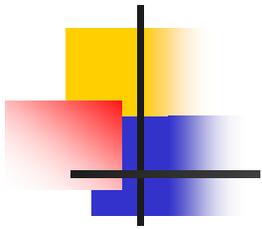


Pocket Excel 11:18 ok

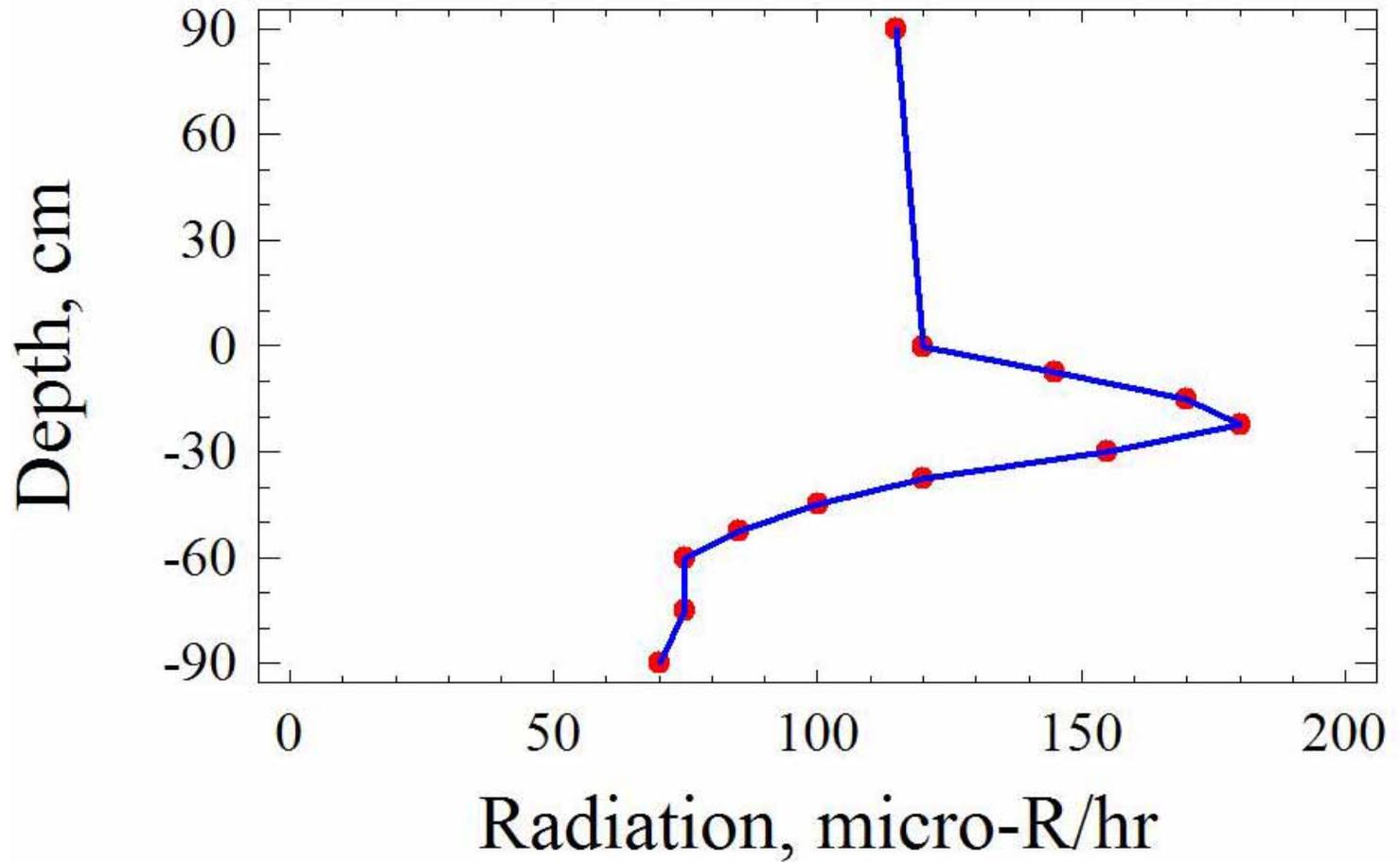
	A	B	C
1	Core	Depth	Micro-R
2	R57	3	80
3	R57	0	170
4	R57	0.25	280
5	R57	0.5	200
6	R57	0.75	130
7	R57	1	70
8	R57	1.25	60
9	R57	1.5	35

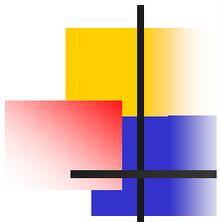
Ready Sheet1 Sum=0

New Edit View Format Tools



Core R3

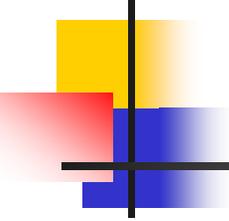




Project Design

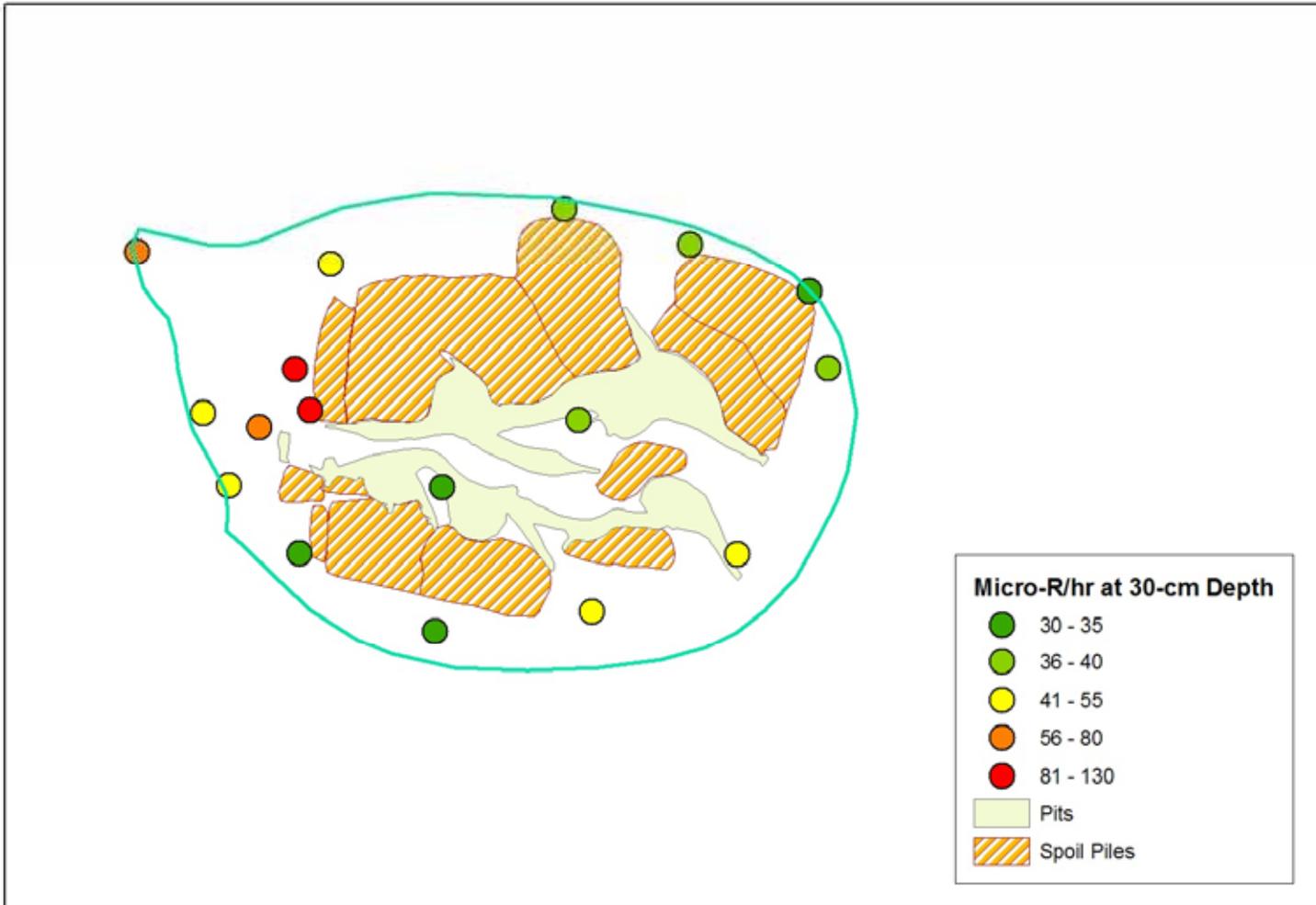
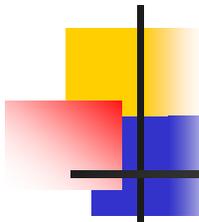
- Estimating Pre-Mine/Background Gamma Radiation Levels
- Quantification of Radioactive Materials





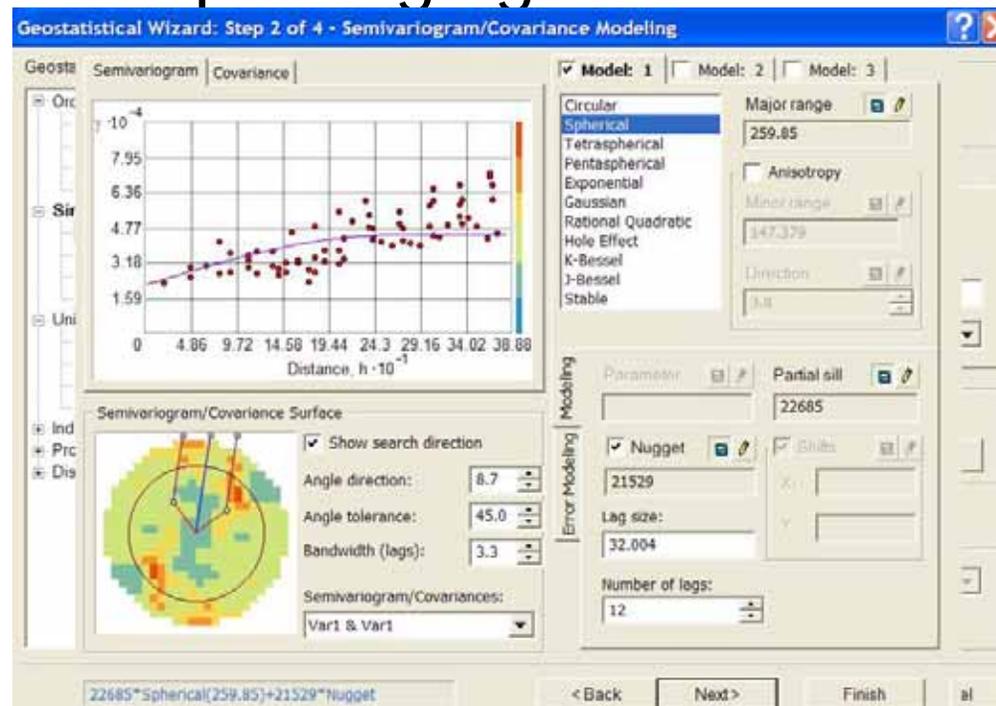
Background Radiation

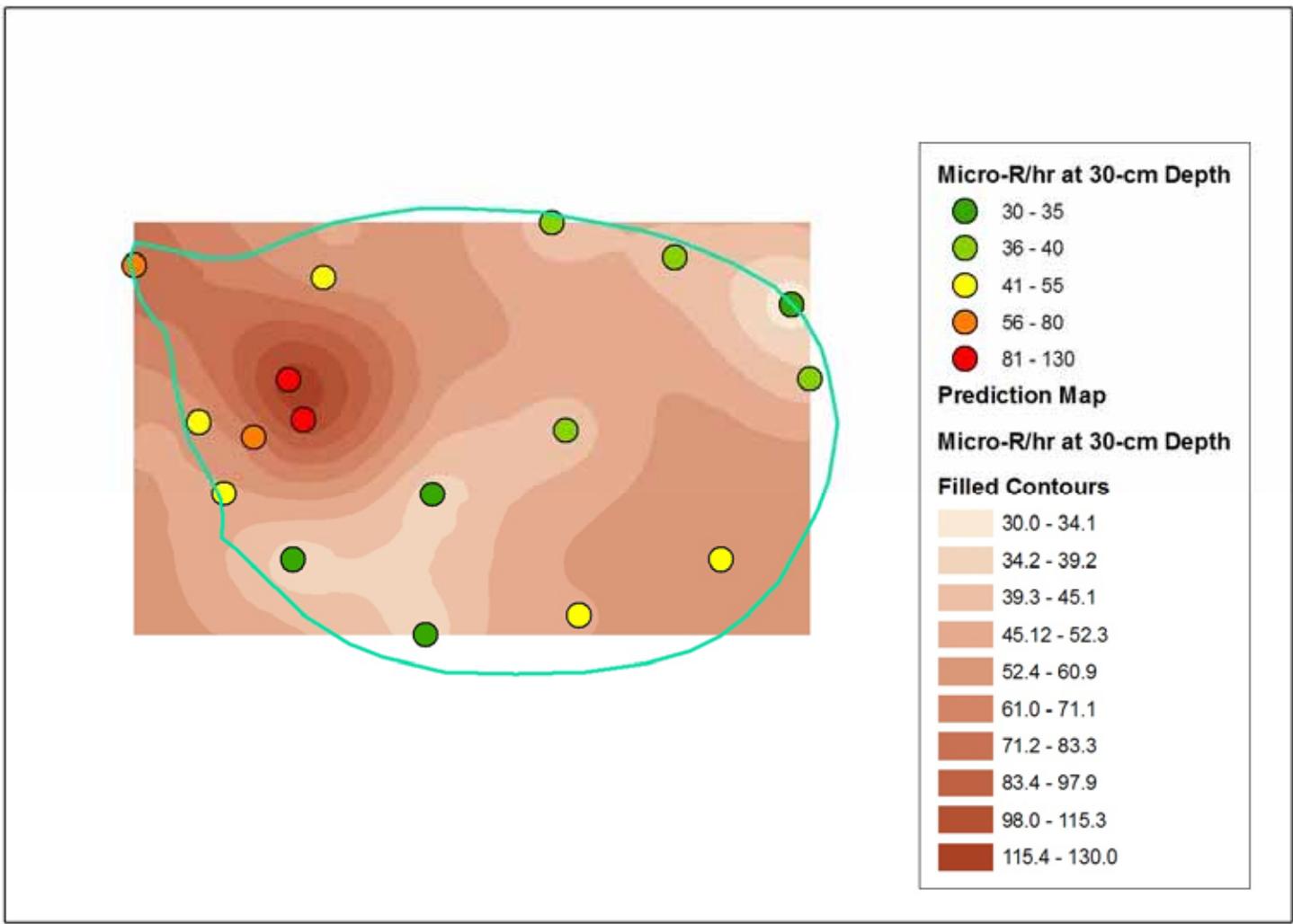
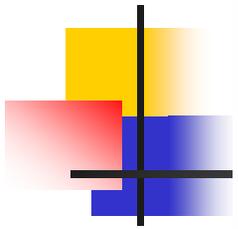
- Radioactive spoil exaggerated ambient radiation levels – used subsurface readings
- 30-cm depth observations used



Geostatistical Analyst

- ArcMap extension
- Several interpolation methods offered
- Used simple kriging





Micro-R/hr at 30-cm Depth

- 30 - 35
- 36 - 40
- 41 - 55
- 56 - 80
- 81 - 130

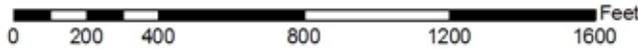
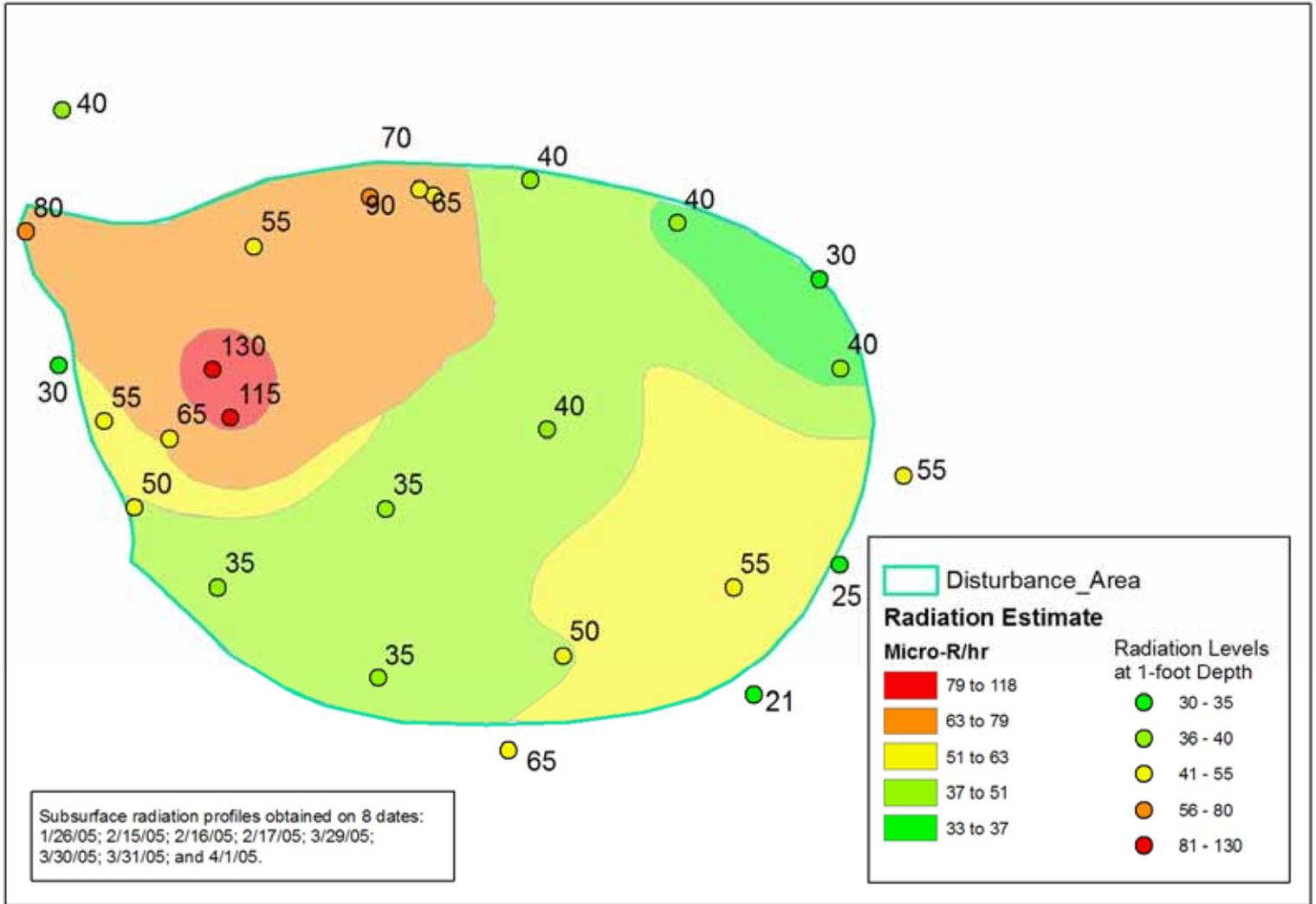
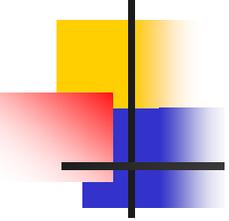
Prediction Map

Micro-R/hr at 30-cm Depth

Filled Contours

- 30.0 - 34.1
- 34.2 - 39.2
- 39.3 - 45.1
- 45.12 - 52.3
- 52.4 - 60.9
- 61.0 - 71.1
- 71.2 - 83.3
- 83.4 - 97.9
- 98.0 - 115.3
- 115.4 - 130.0

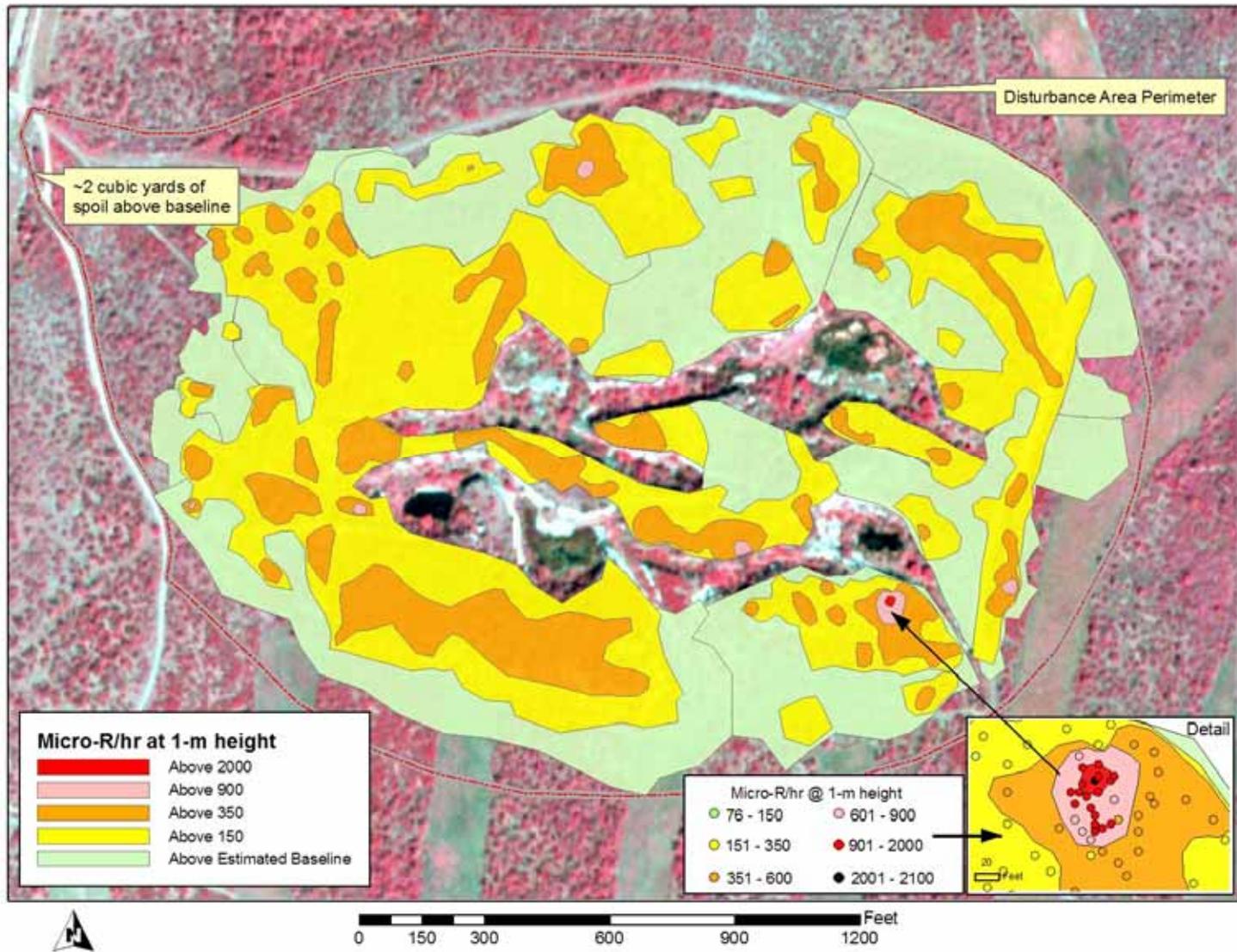
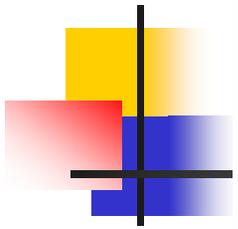


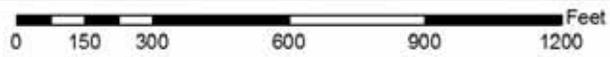
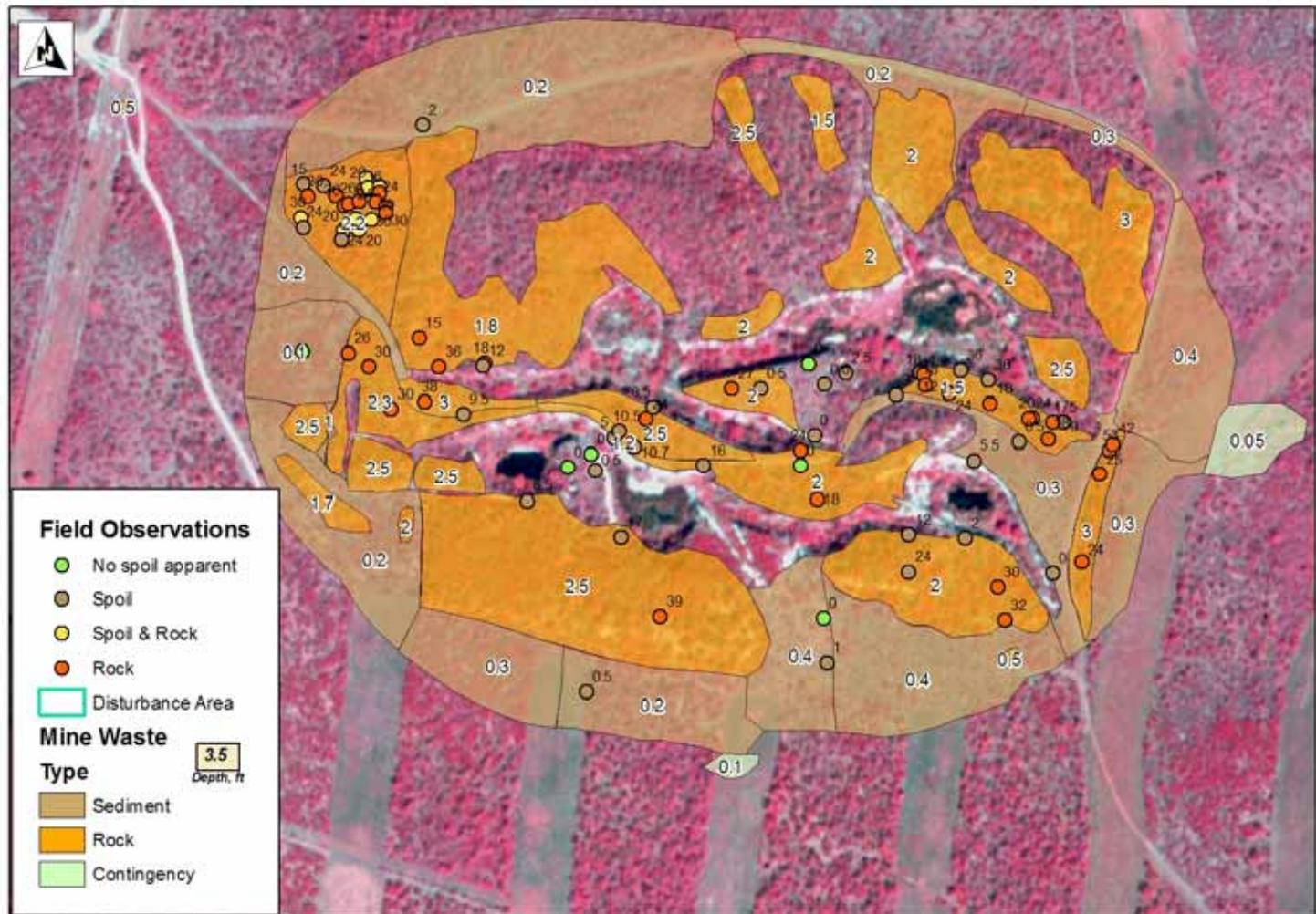
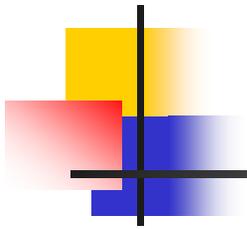


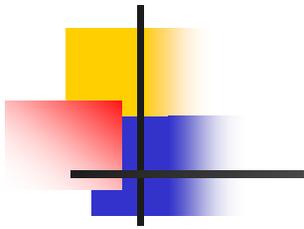
Radioactive Material Quantities

- Based on contiguous areas showing similar radiation levels
- Depths of materials measured and estimated

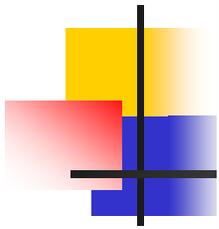
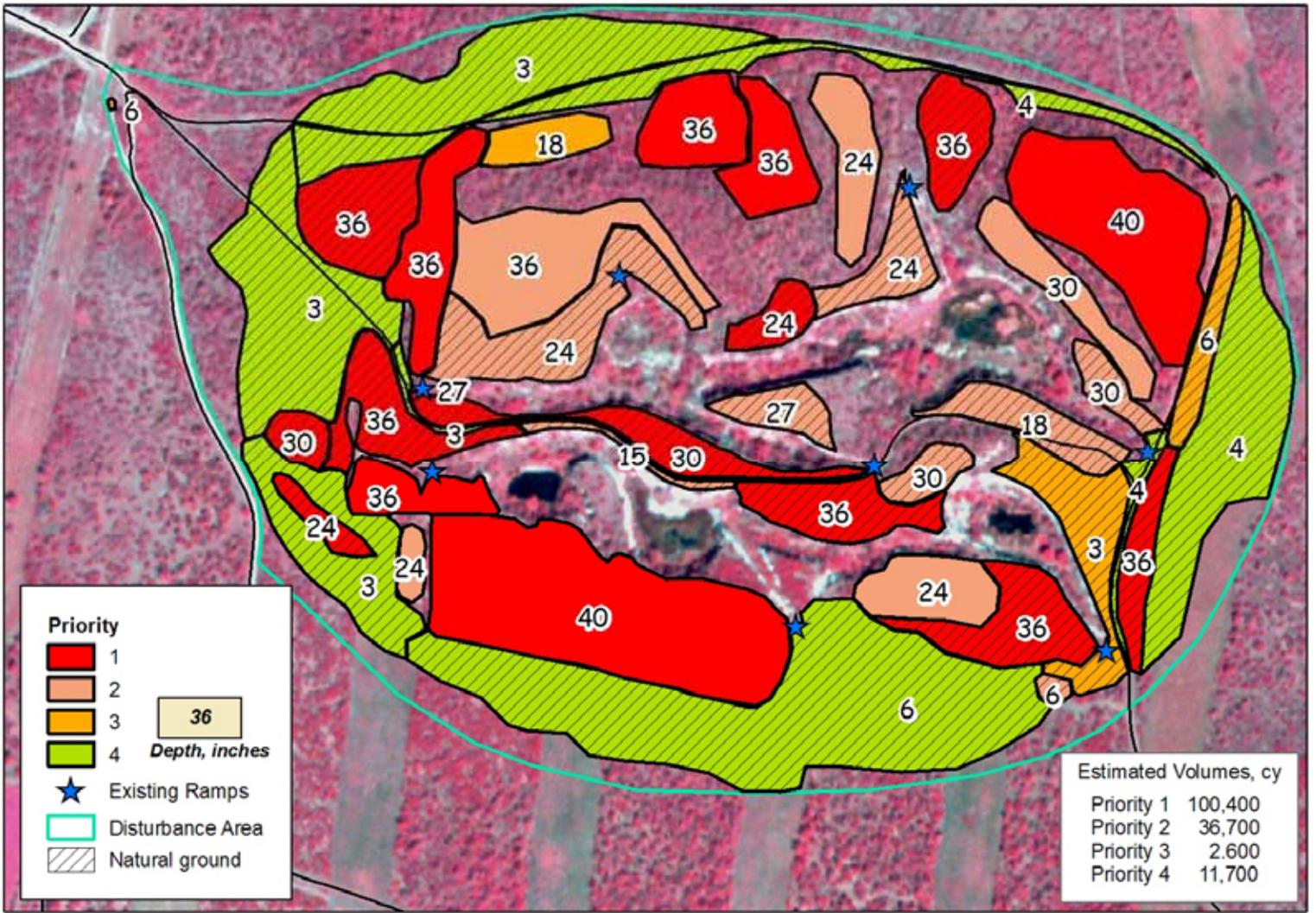


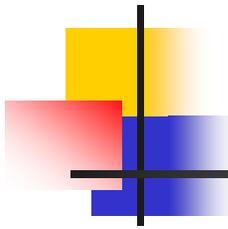






Gamma Radiation Range	Area Priority for Clean Up Efforts	Estimated Area	Proportion of Non-Pit Area	Estimated Volume
(micro-R/hr)		(m² (acres)	(%)	(m³ (cubic yds)
>= 2001	Very High	45 0.01	0.015	44 57
>=901 and <2001	High	795 0.19	0.29	711 930
>=351 and <901	Medium	36,164 8.94	13.8	37,233 48,696
>=151 and <351	Low	93,397 23.07	35.6	82,139 107,428
<151 to >Baseline	Very Low	103,422 25.54	39.4	13,529 17,694
<= Baseline (Variable)	At Estimated Baseline or Below	28,692 7.09	10.9	N/A
	Total	282,515 64.84	100.0	133,656 174,805





Project Management

- Used Trimble GeoXT
- Windows Mobile
- ArcPad – easy to create new shapefiles for different datasets
- Color-coded points, based on values (symbolology exported from ArcMap)

Survey Control



Leica Geosystems SR530 RTK DGPS – Base Station

Progress of Reclamation Efforts

- Field observations
- Document work progress
- Delineate areas needing attention
- Interim project status maps



GeoX1

Pocket PC

ArcPad 11:15

hot window

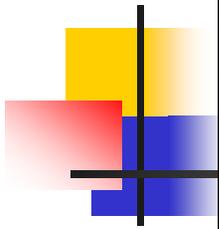
flagged 3/22/06 hot spot - [redacted] ed 3/28/06

50 ft

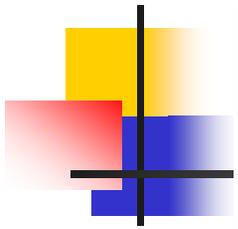
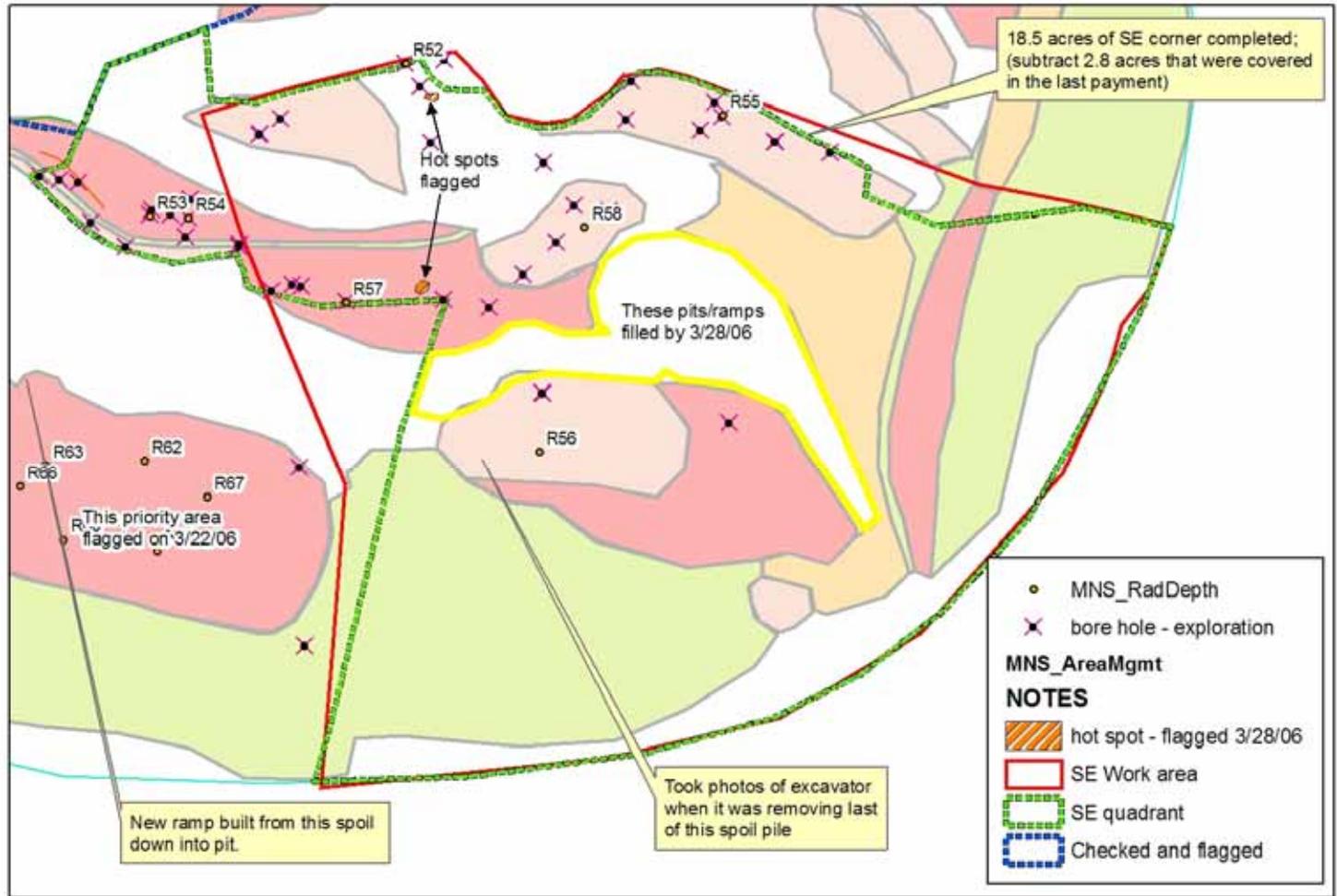
Locker 569580.7 3159313.9 1:1033 Z

The image shows the ArcPad software interface on a handheld device. The top status bar displays the application name 'ArcPad' and the time '11:15'. Below this is a toolbar with various icons for navigation and editing. The main display area shows a map with a red boundary line and several colored data points (red, green, blue). A text label 'hot window' is placed over a cluster of points, and another label 'flagged 3/22/06 hot spot - [redacted] ed 3/28/06' is placed over another cluster. A scale bar in the bottom right of the map area indicates '50 ft'. At the bottom of the screen, a coordinate display shows 'Locker 569580.7 3159313.9 1:1033 Z'. A bottom toolbar contains icons for locking, navigation, and other functions.

F1
F2
F3
F4
?
⚙



Interim Project Maps



Progress of Work



Vantage Point Photographs

Mabel New-Superior Project: Vantage Point Photos

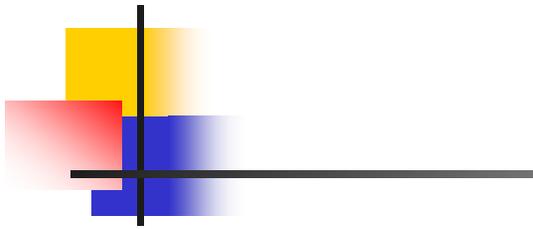


Photo Point	True Direction
1	18 (N18E)
2	156 (S24E)
3	240 (S65W)
4	96 (S84E)
5	97 (S83E)
5	150 (S30E)
6	239 (S59W)
7	223 (S43W)
8	61 (N61W)
9	57 (N57W)
10	17 (N17E)
11	5 (N5E)

Photos Taken on:



0 150 300 600 900 1200 Feet



01/25/2006



02/09/2006



03/22/2006



Vantage Pt. 4 - Sequence



June 13, 2006

Field Estimates of Spoil Volumes

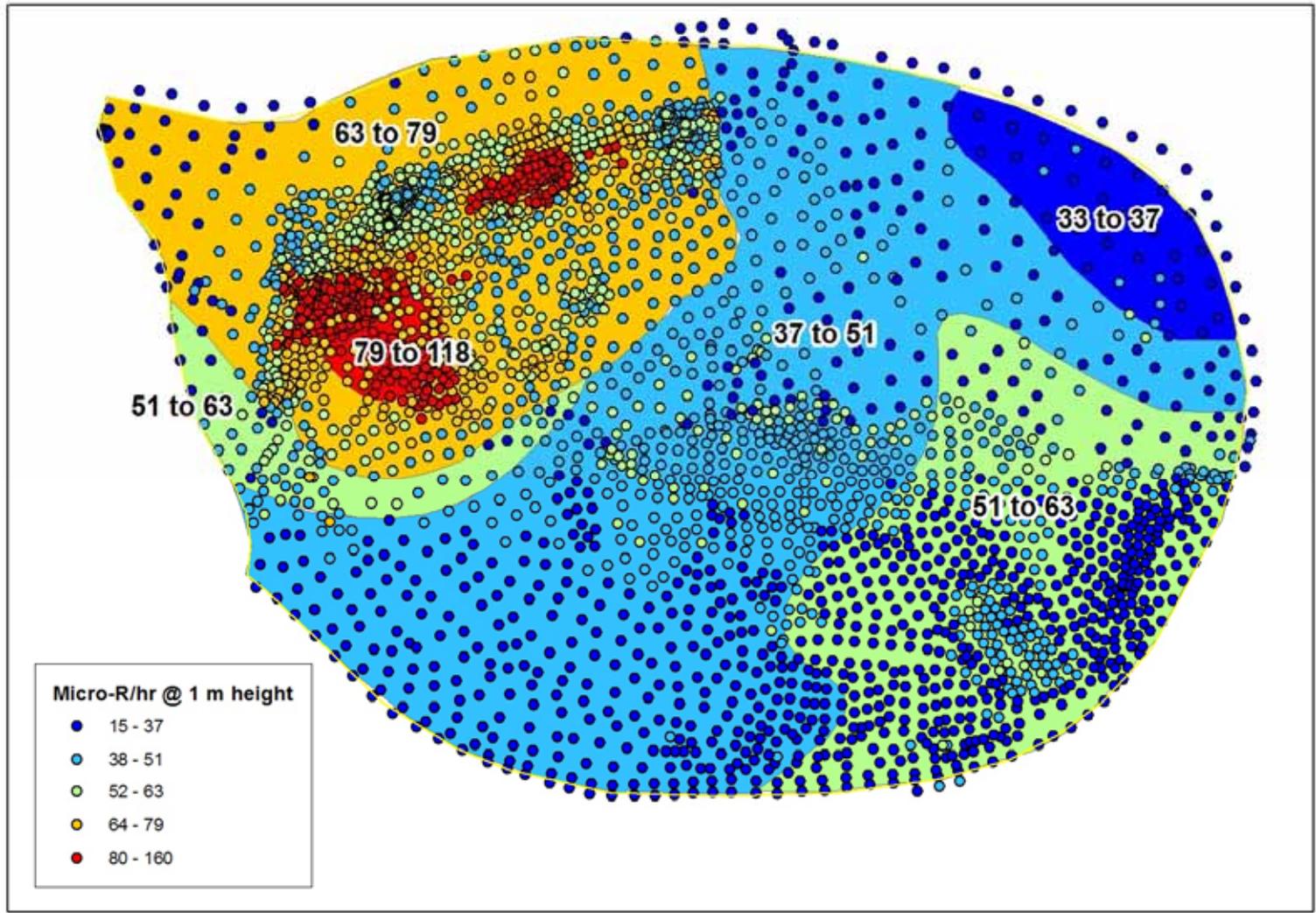
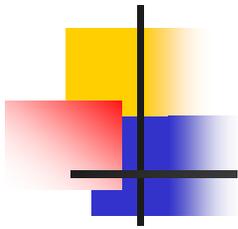
- Polygon features in the field encompassing elevated radiation levels
- Area X depth provided estimate of volumes



Verification of Radioactive Material Clean Up

- Plotted radiation observations on predicted radiation level map
- Clean up radiation levels ~70% lower than estimated

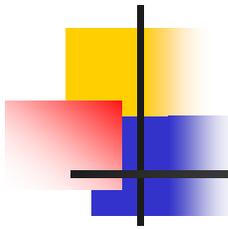




Work Payment Quantities

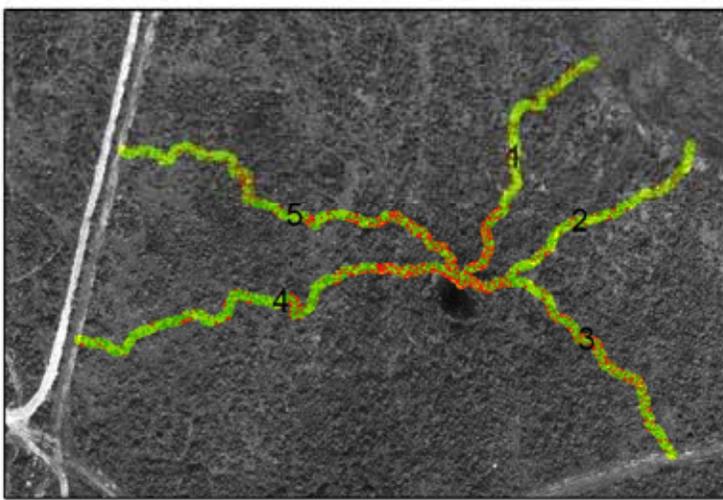
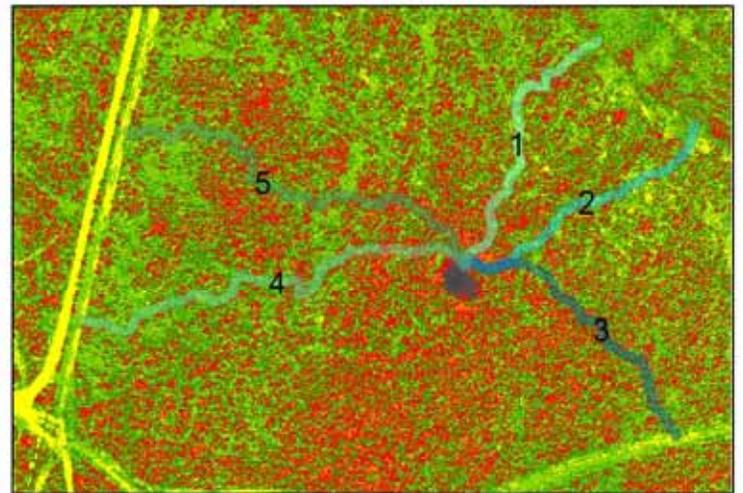
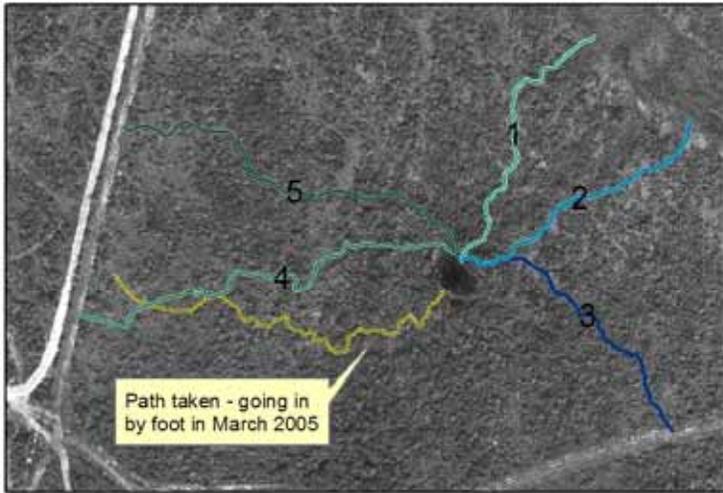
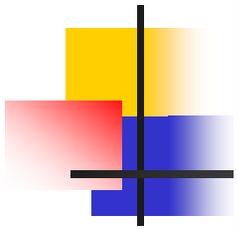
- Verification that clean up levels attained
- Delineation of cleaned up areas
- Payment quantities facilitated – areas routinely documented

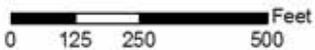




Other GIS-Related Tools

- ERDAS Imagine
- Image Analysis extension – ArcMap
- Evaluation of vegetation cover from aerial photographs
- Spatial Analyst
 - Raster to vector conversion



Note: north arrow and scale bar are related to all three maps.

Sorted pixels from B&W aerial photograph (taken in 2003) into five ground cover classes, using Spatial Analyst. The description of each class was based on an evaluation of the photograph (classification data have not been ground-truthed).

-  Brush / Trees
-  Brush / Trees
-  Grasses / Forbs
-  Grasses / Forbs
-  Bare Ground

Tabulated the areas of each class intersected by 10-foot wide trails (enough to allow passage with a pickup truck) and estimated the length of each trail.

Access Trail	Length, ft	Total Area, sq. ft.	Estimated Brush/Trees, sq. ft.	Proportion of Trail Swath
1	599	12,248	2812	23.0%
2	580	11,903	2227	18.7%
3	626	12,751	3404	26.7%
4	940	18,869	3786	20.1%
5	894	17,920	4221	23.6%

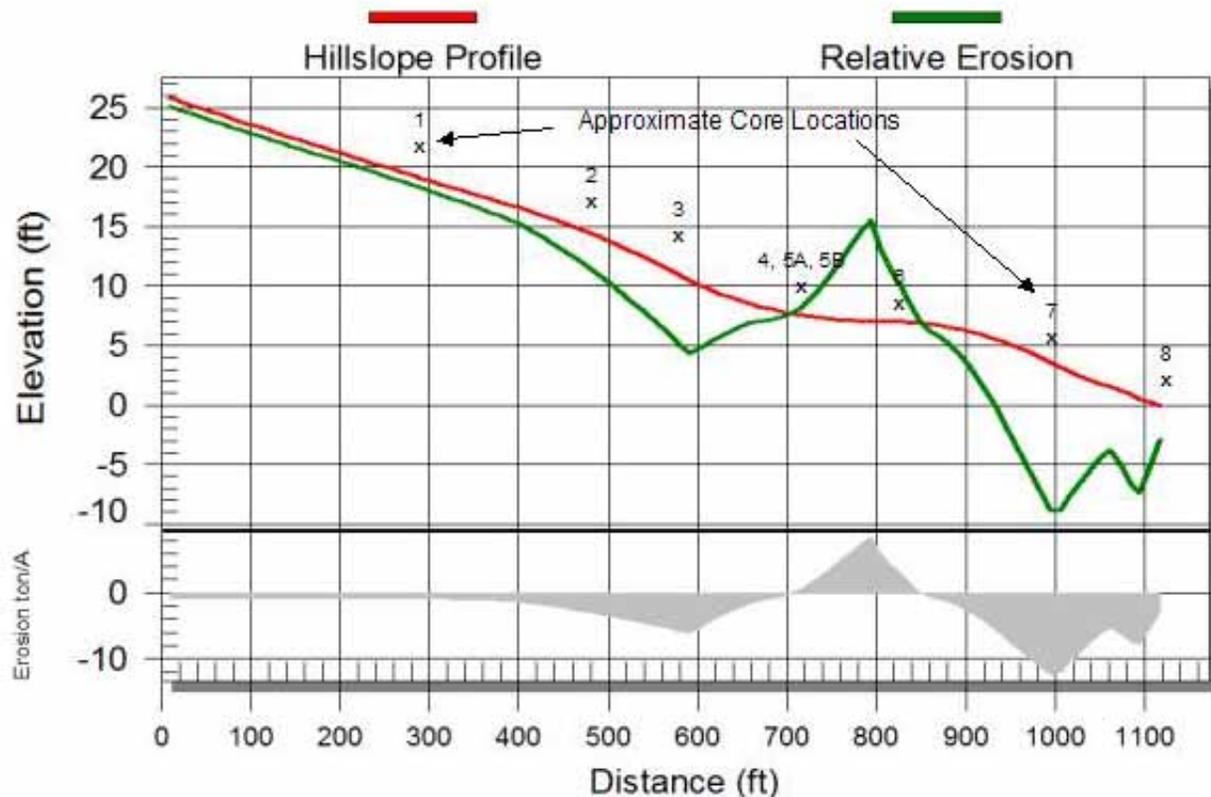
Access Trail #2 looks like the best option - shorter and less clearing needed. Final choice of trail will depend on site conditions (gullies, obstacles, etc).

GeoWEPP

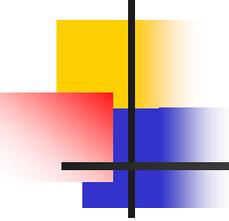
- WEPP – Water Erosion Prediction Project
- Interface with ArcMap



Sediment Transport and Deposition



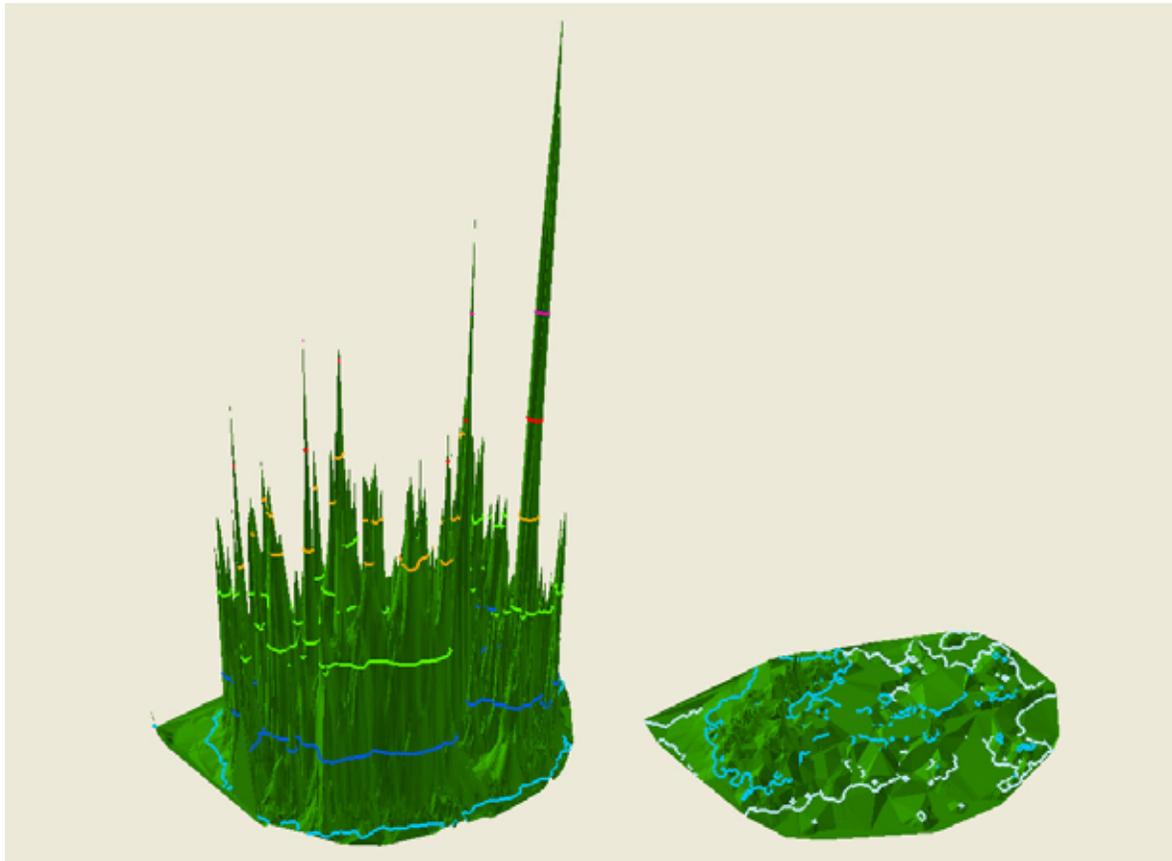
Same soil for entire slope – Bryde fine sandy loam
Climate from Nixon, TX station
Ran simulation for 44 years
28% shortgrass prairie



Summary and Conclusions

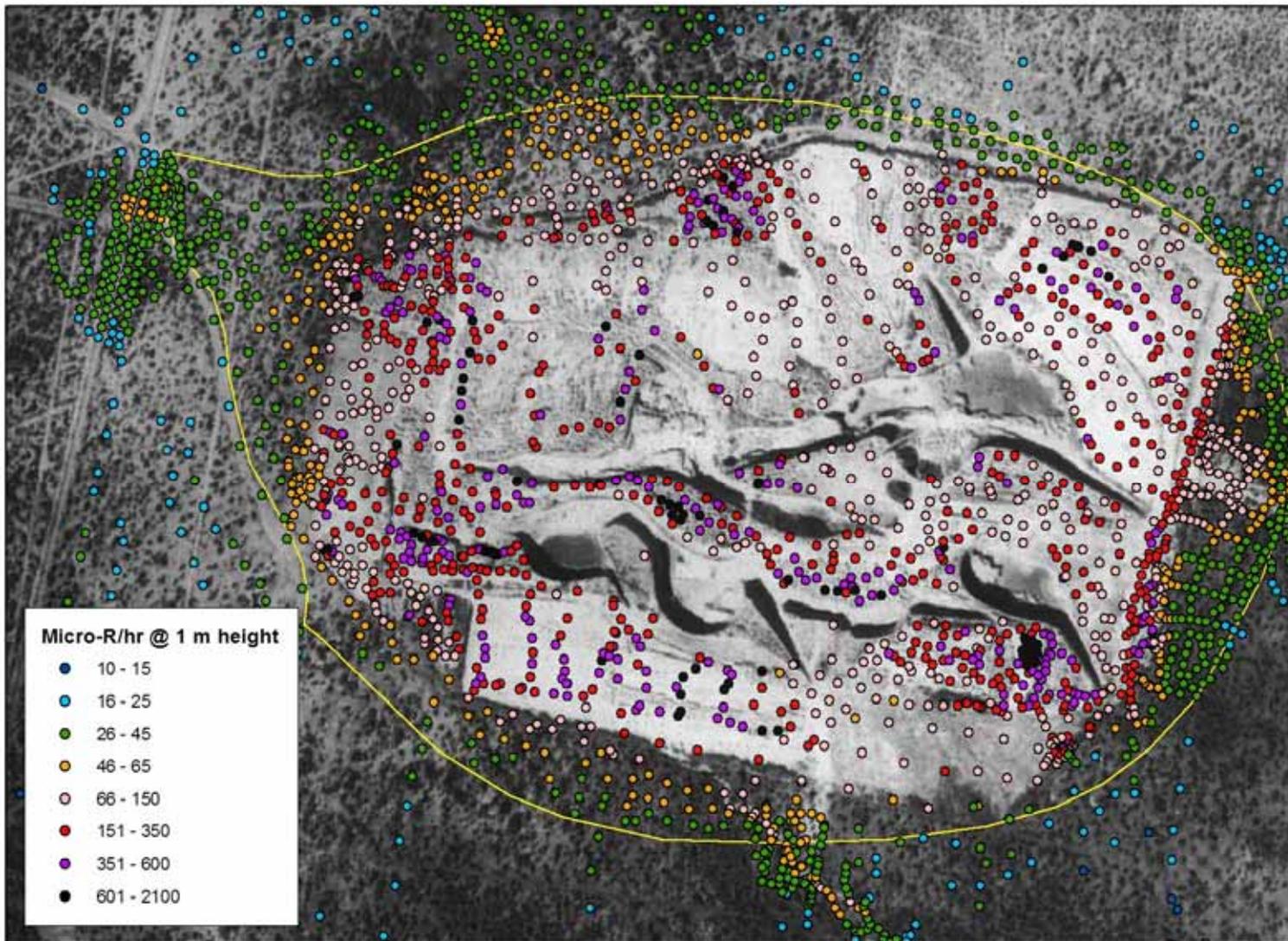
- 18 months from data collection to completion of the earthwork
- Every phase of project utilized data collected or displayed with GPS
- Mobile and desktop GIS used to analyze, interpret, and display data
- Tasks accomplished accurately and quickly

Gamma Radiation Reduction



Before

After



Micro-R/hr @ 1 m height

- 10 - 15
- 16 - 25
- 26 - 45
- 46 - 65
- 66 - 150
- 151 - 350
- 351 - 600
- 601 - 2100

0 150 300 600 900 1200 Feet

Aerial photograph obtained from TNRIS, taken by the USGS on February 19, 1964 (Frame 2-6).

Thank You

- Acknowledgments:
 - Reviewers
 - OSM – Providing GeoXT

