

**UTILIZING NAIP AERIAL PHOTOGRAPHY
AND DIGITAL GLOBE SATELLITE
IMAGERY TO MONITOR DIFFERENTIAL
SETTLING ON RECLAIMED LANDS IN
NORTH DAKOTA**

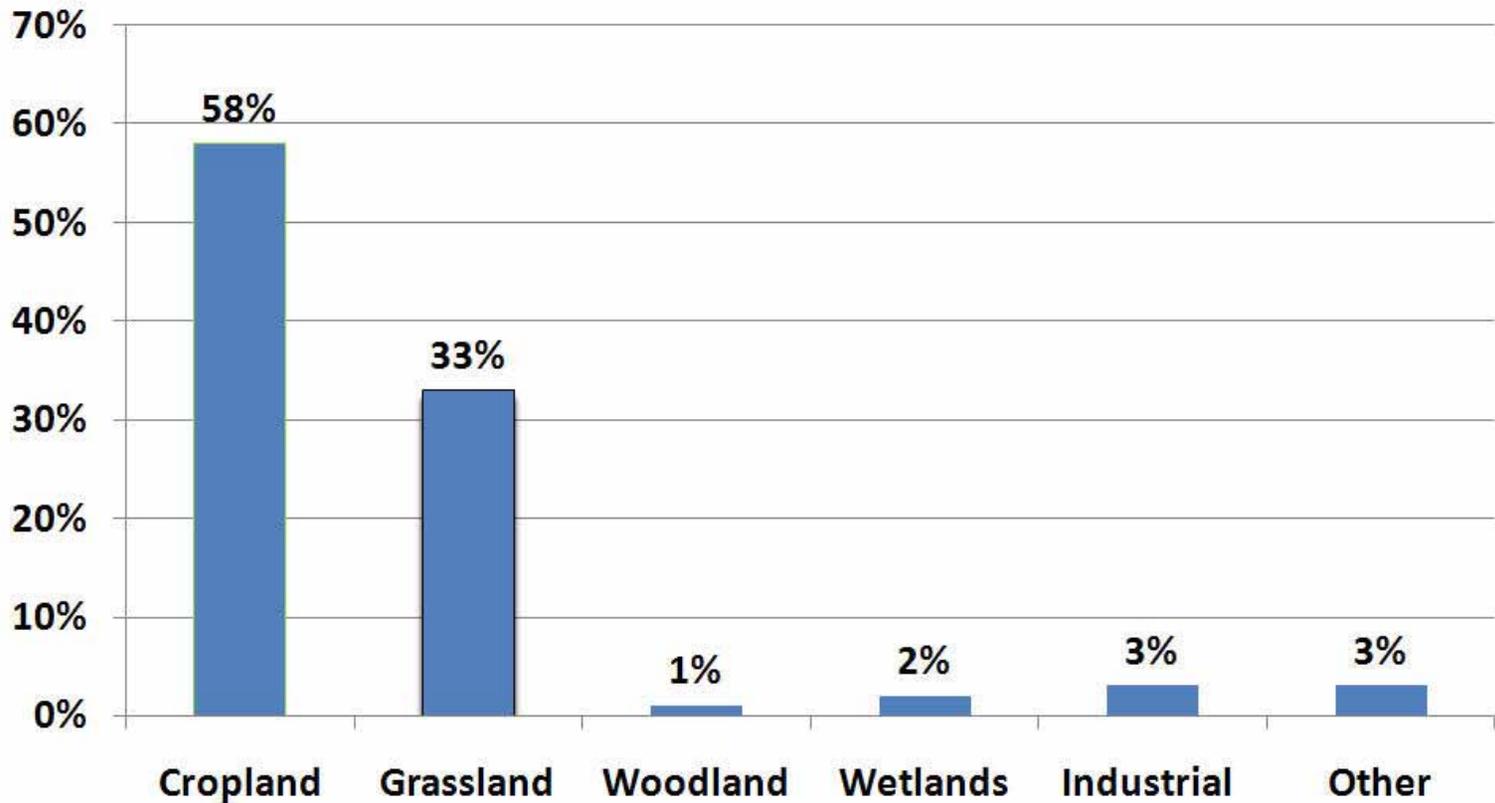
Guy Welch

ND Public Service Commission

The ND Public Service Commission regulates surface coal mining activities in North Dakota

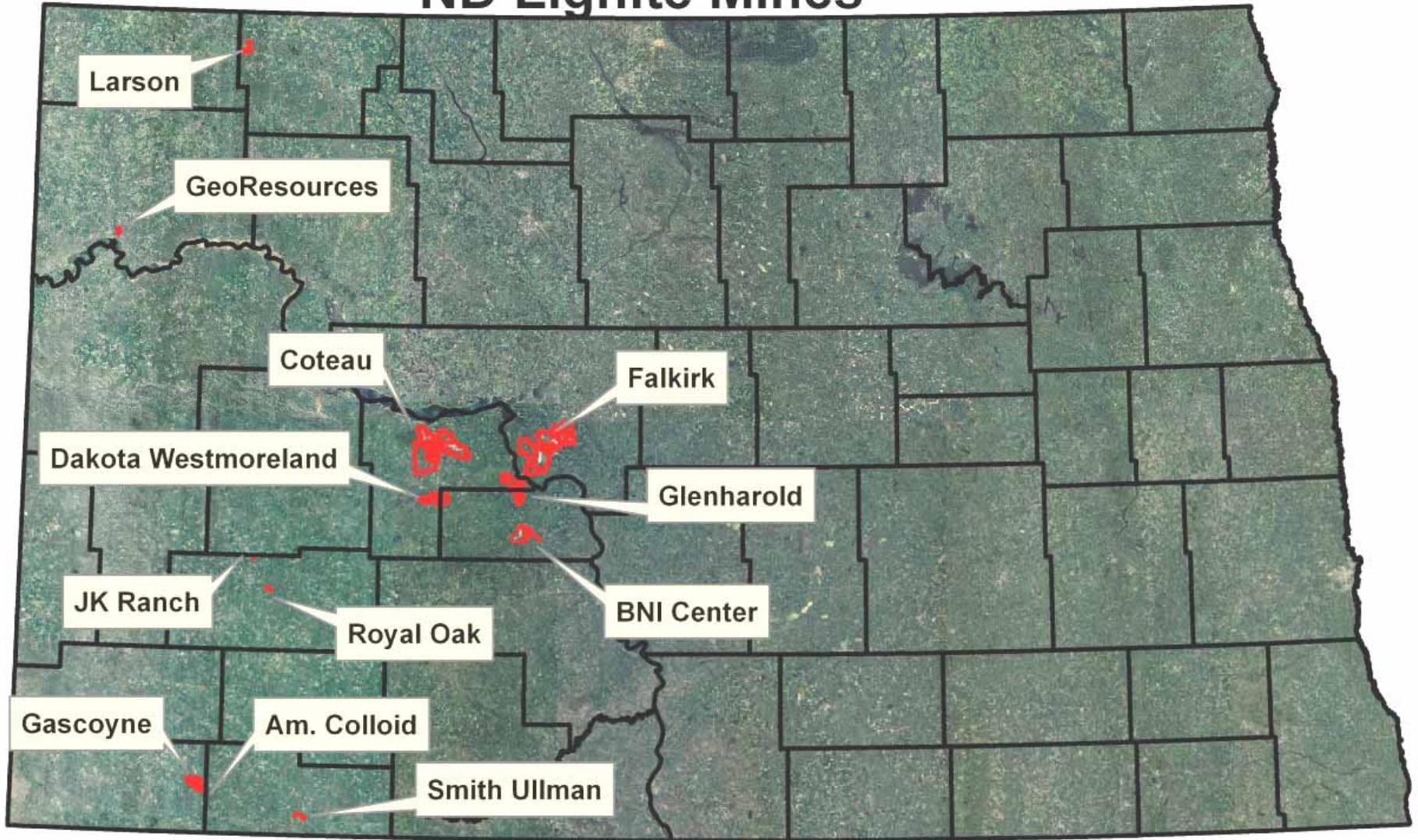


44,550 hectares (110,000 acres) permitted in ND



Most of the permitted acreage is within 4 large active mines

ND Lignite Mines



ND PSC
December 21, 2007

Subsidence can be a problem on reclaimed land in ND

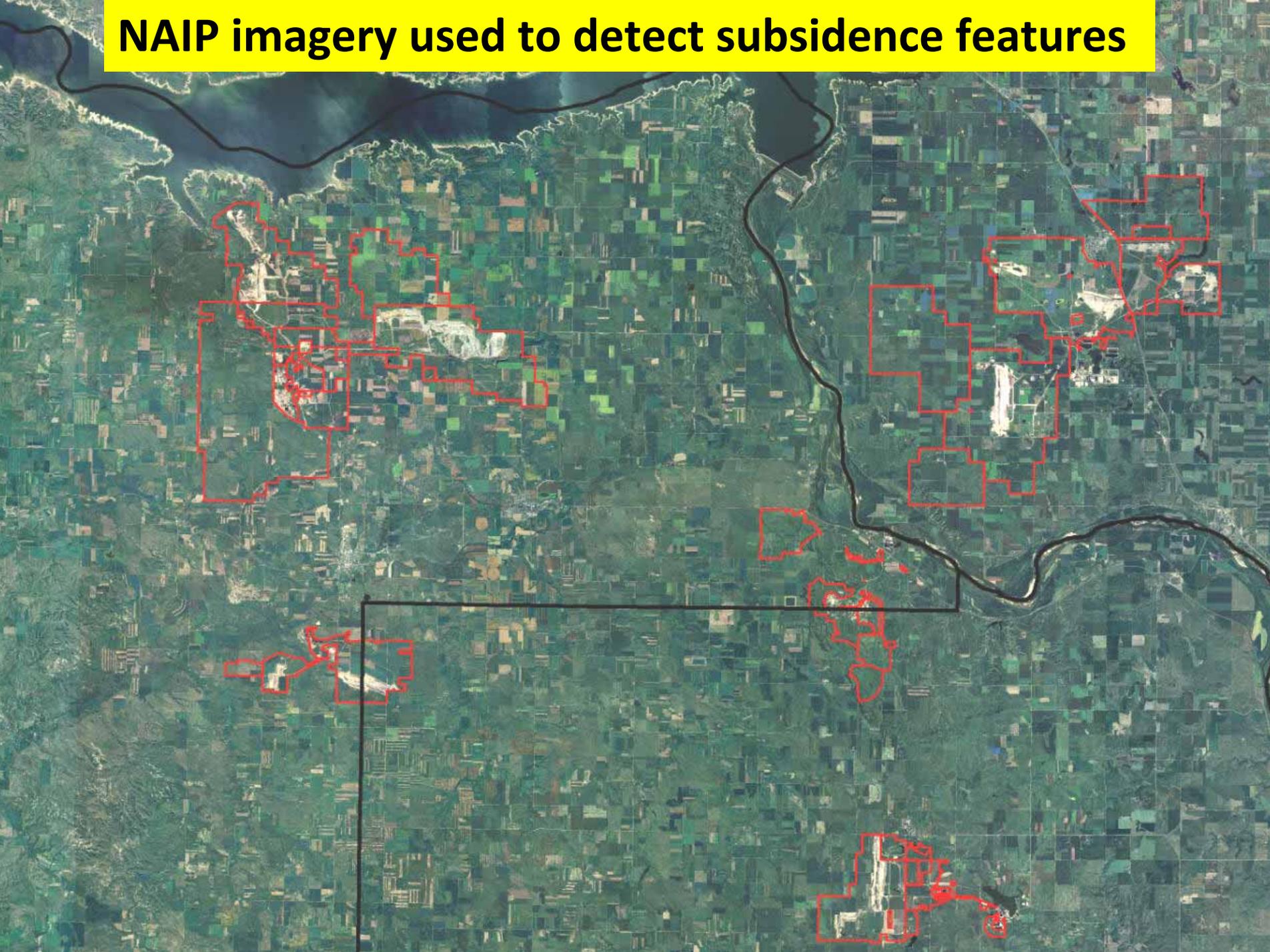


ArcGIS was used to help determine the extent of differential settling on reclaimed lands in ND



06.14.2006

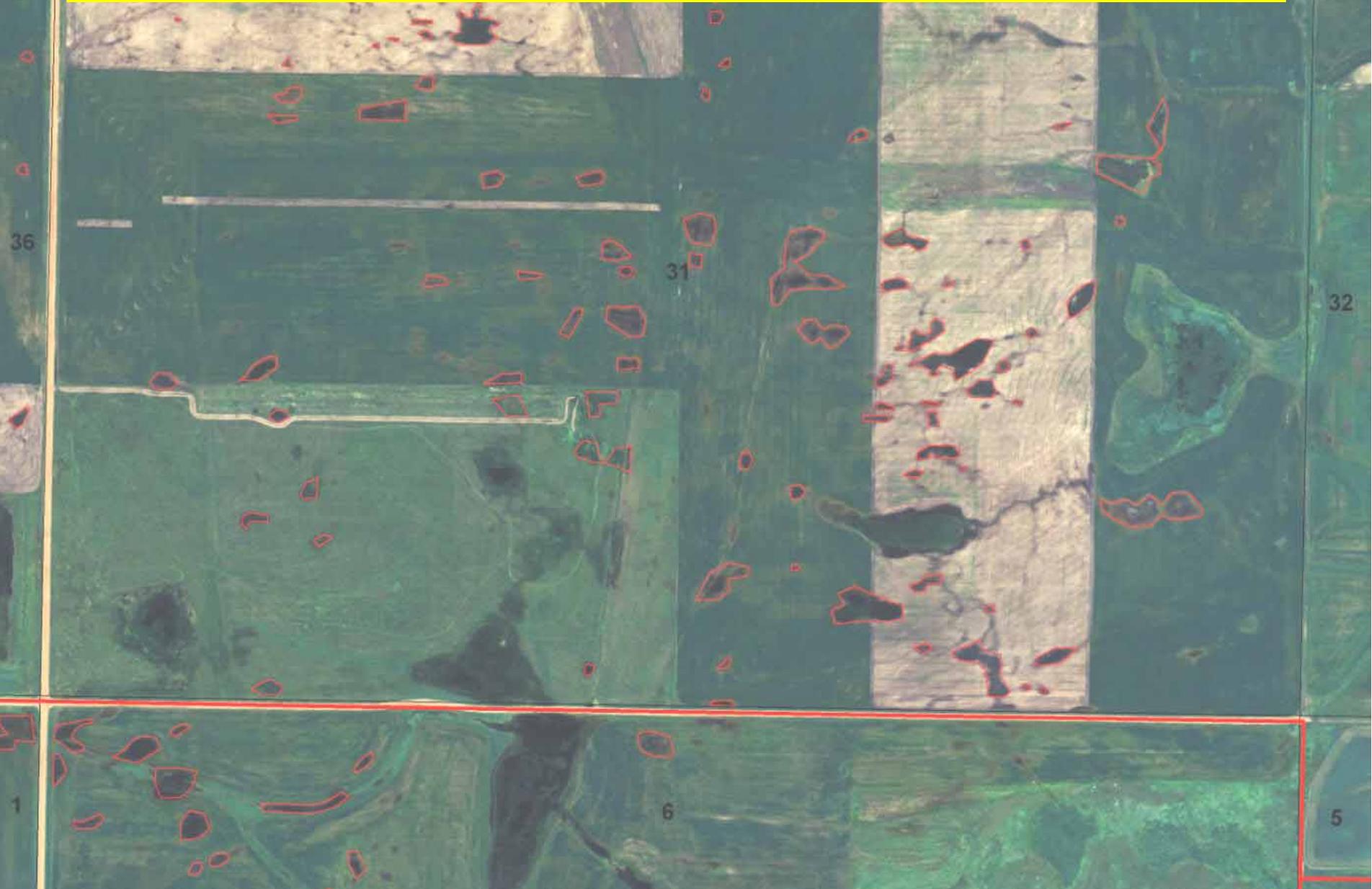
NAIP imagery used to detect subsidence features



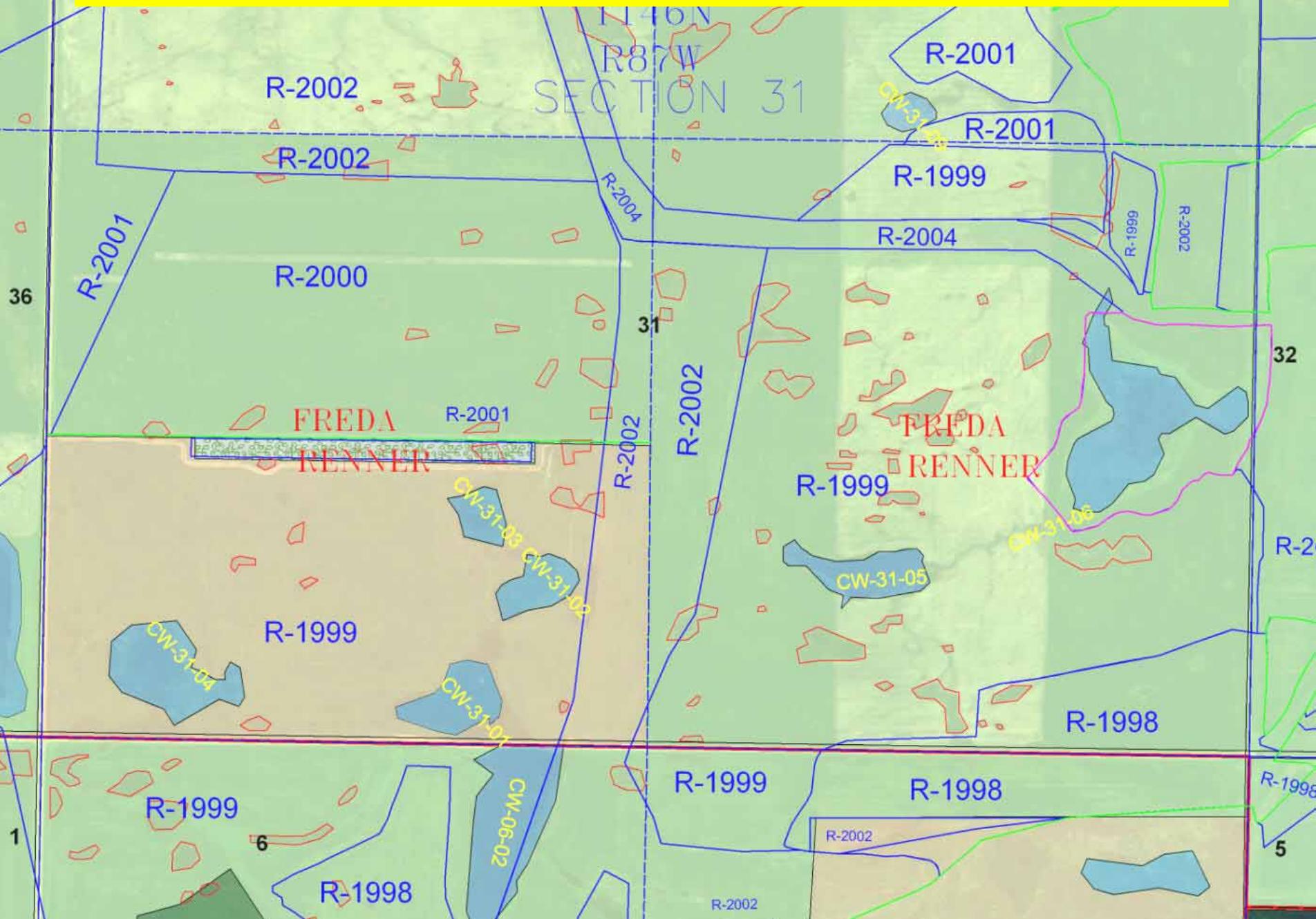
Settling features were digitized in ArcMap



While digitizing it was important to know the mining disturbance boundary and postmine land use



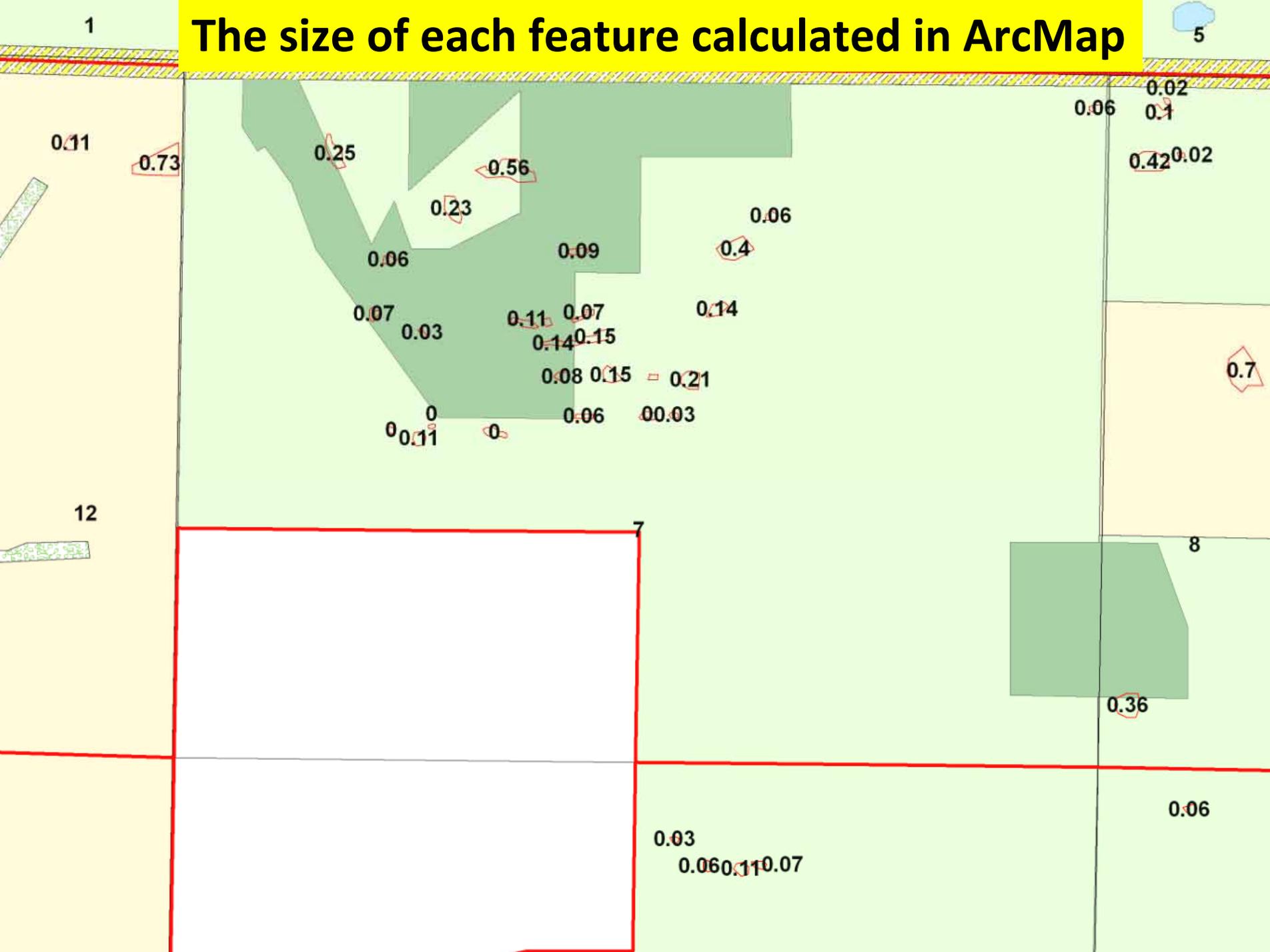
AutoCAD Mine Annual Map and postmine land use



Information pertaining to each feature was recorded

OBJECTID *	ID	PERMIT_NO	SECTION_NO	ACRES	COMMENTS	FEATURE_NO	LANDUSE	DEPTH	Shape *	SHAPE.area	SHAPE.len
174	0	NACT-8601	8	0.1		8-8	Cropland	0	Polygon	4352.28901	327.298213
175	0	NACT-8601	8	0.02		8-9	Cropland	0	Polygon	1024.06814	135.439655
176	0	NACT-8601	8	0.02		8-10	Cropland	0	Polygon	1068.73244	133.537148
177	0	NACT-9001	6	0.26	Inspected 4/5/2006	6-3	Cropland	0.5	Polygon	11464.393673	508.000722
178	0	NACT-9001	6	0.26	Inspected 4/5/2006	6-2	N. Grassland	0	Polygon	11138.908032	541.705082
179	0	NACT-9001	6	0.26	Inspected 4/5/2006	6-1	N. Grassland	0	Polygon	11464.353451	411.610723
180	0	NACT-9001	6	0.39		6-4	Cropland	0	Polygon	16843.243636	504.52089
181	0	NACT-9001	6	0.12		6-17	Cropland	0	Polygon	5212.646954	303.67714
182	0	NACT-9001	6	0.07		6-18	Cropland	0	Polygon	2968.689563	239.995559
183	0	NACT-9001	6	0.48		6-10	Cropland	0	Polygon	20850.586647	735.062194
184	0	NACT-9001	6	0.99		6-9	Cropland	0	Polygon	43210.803327	1087.504035
185	0	NACT-9001	6	0.28	Inspected 4/5/2006	6-8	Cropland	0	Polygon	12126.668665	795.260725
186	0	NACT-9001	6	0.28	Inspected 4/5/2006	6-7	Cropland	0	Polygon	12250.688194	481.691686
187	0	NACT-9001	6	0.41	Inspected 4/5/2006	6-6	Cropland	0	Polygon	17676.489358	515.102098
188	0	NACT-9001	6	0.26	Inspected 4/5/2006	6-5	Cropland	0	Polygon	11200.406996	409.300302
189	0	NACT-9001	6	0.2	Prime	6-11	Cropland	0	Polygon	8522.386324	413.248435
190	0	NACT-9001	6	0.41	Prime	6-12	Cropland	0	Polygon	17858.643564	619.774937
191	0	NACT-9001	6	0.79	Prime	6-13	Cropland	0	Polygon	34376.339065	1258.857915
192	0	NACT-9001	6	0.28	Prime	6-14	Cropland	0	Polygon	12212.273401	514.371211
193	0	NACT-9001	6	0.05	Prime	6-15	Cropland	0	Polygon	2305.967118	203.453463
194	0	NACT-8203	7	0.11	Repaired 2005	7-1	Cropland	0	Polygon	4653.048008	256.56433
195	0	NACT-8601	7	0.07		7-14	Cropland	0	Polygon	3118.481632	344.859856
196	0	NACT-8601	7	0.04		7-13	Cropland	0	Polygon	1718.481741	169.159944
197	0	NACT-8601	7	0.15		7-12	Cropland	0	Polygon	6747.866089	398.384761
198	0	NACT-8203	7	0.06	Repaired 2005	7-2	Repaired	0	Polygon	2647.609823	194.961501
199	0	NACT-8203	7	0.07	Repaired 2005	7-3	Repaired	0	Polygon	2838.944515	226.141322
200	0	NACT-8203	7	0.03	Repaired 2005	7-4	Repaired	0	Polygon	1329.783107	149.147148
201	0	NACT-8601	7	0.25	Repaired 2005	7-5	Repaired	0	Polygon	10695.729015	498.714392
202	0	NACT-8601	7	0.06	Repaired 2005	7-6	Repaired	0	Polygon	2790.046389	212.216725
203	0	NACT-8601	7	0.23	Repaired 2005	7-7	Repaired	0	Polygon	10091.938466	419.683325
204	0	NACT-8601	7	0.56	Repaired 2005	7-8	Repaired	0	Polygon	24533.165059	845.341448
205	0	NACT-8601	7	0.09	Repaired 2005	7-9	Repaired	0	Polygon	3768.71948	273.005087
206	0	NACT-8601	7	0.08	Repaired 2005	7-10	Repaired	0	Polygon	3430.329491	233.02792
207	0	NACT-8601	7	0.15	Repaired 2005	7-11	Repaired	0	Polygon	6499.04927	325.607456
208	0	NACT-8601	7	0.03	Repaired 2005	7-15	Repaired	0	Polygon	1098.103545	158.684965
209	0	NACT-8601	7	0.11	Repaired 2005	7-16	Repaired	0	Polygon	4803.78913	262.586269
210	0	NACT-8601	7	0.06	Repaired 2005	7-17	Repaired	0	Polygon	2554.499544	250.497232
211	0	NACT-8601	7	0.03	Repaired 2005	7-18	Repaired	0	Polygon	1506.160596	149.973103
212	0	NACT-8601	7	0.4	Repaired 2005	7-19	Repaired	0	Polygon	17284.352243	535.029712
213	0	NACT-8601	7	0.14	Repaired 2005	7-20	Repaired	0	Polygon	6027.960278	327.203176
214	0	NACT-8601	7	0.03	Repaired 2005	7-21	Repaired	0	Polygon	1461.082184	173.781063
215	0	NACT-8601	7	0.06	Inspected 4/5/2006	7-22	Cropland	0	Polygon	2423.351698	197.65241
216	0	NACT-8601	12	0.73	Inspected 4/5/2006	12-1	N. Grassland	2	Polygon	31617.694399	796.213171
217	0	NACT-8601	12	0.11	Inspected 4/5/2006	12-2	N. Grassland	0.5	Polygon	4985.07438	270.460985
218	0	NACT-9001	2	0.12		2-1	N. Grassland	0	Polygon	5050.625404	499.835162
219	0	NACT-9001	1	0.32	Inspected 4/5/2006	1-11	Cropland	1	Polygon	13969.445591	500.335457
220	0	NACT-9001	1	0.25	Prime	1-10	Cropland	0	Polygon	11063.345013	477.000535
221	0	NACT-9001	1	0.2		1-1	Cropland	0	Polygon	8582.998301	395.257067
222	0	NACT-9001	1	2.35		1-2	Cropland	0	Polygon	102285.606719	1844.368127
223	0	NACT-9001	1	0.43		1-3	Cropland	0	Polygon	18754.026257	590.991497
224	0	NACT-9001	1	0.69		1-4	Cropland	0	Polygon	29959.905177	1196.373124
225	0	NACT-9001	1	0.08		1-5	Cropland	0	Polygon	3620.627782	251.699486
226	0	NACT-9001	1	0.03		1-6	Cropland	0	Polygon	1134.287127	131.900578
227	0	NACT-9001	1	0.24		1-7	Cropland	0	Polygon	10564.676105	556.728855
228	0	NACT-9001	1	0.31		1-8	Cropland	0	Polygon	13571.922124	644.130438
229	0	NACT-9001	1	0.42		1-9	Cropland	0	Polygon	18408.689216	670.157571
230	0	NACT-9001	1	0.04	Inspected 4/5/2006	1-12	Cropland	0	Polygon	1915.485565	170.397099
231	0	NACT-9001	1	0.03		1-13	Cropland	0	Polygon	1441.544303	185.457845
232	0	NACT-9001	1	0.05		1-14	Cropland	0	Polygon	2391.043965	199.903963

The size of each feature calculated in ArcMap



Summary reports created using ArcMap

Preview

NACT-8401
NACT-8102
NACT-8601
NACT-8203
NACT-8503
NACT-9001
NACT-9101
NACT-9501

1/18/2008

Permit_No	Acres
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NACT-8401

NACT-8401	0.09
NACT-8401	0.15

NACT-8401

0.24

NACT-8102

NACT-8102	0.62
NACT-8102	0.18
NACT-8102	0.11
NACT-8102	0.06
NACT-8102	0.27
NACT-8102	0.20
NACT-8102	0.08
NACT-8102	0.19
NACT-8102	0.05
NACT-8102	0.16
NACT-8102	0.39
NACT-8102	0.04

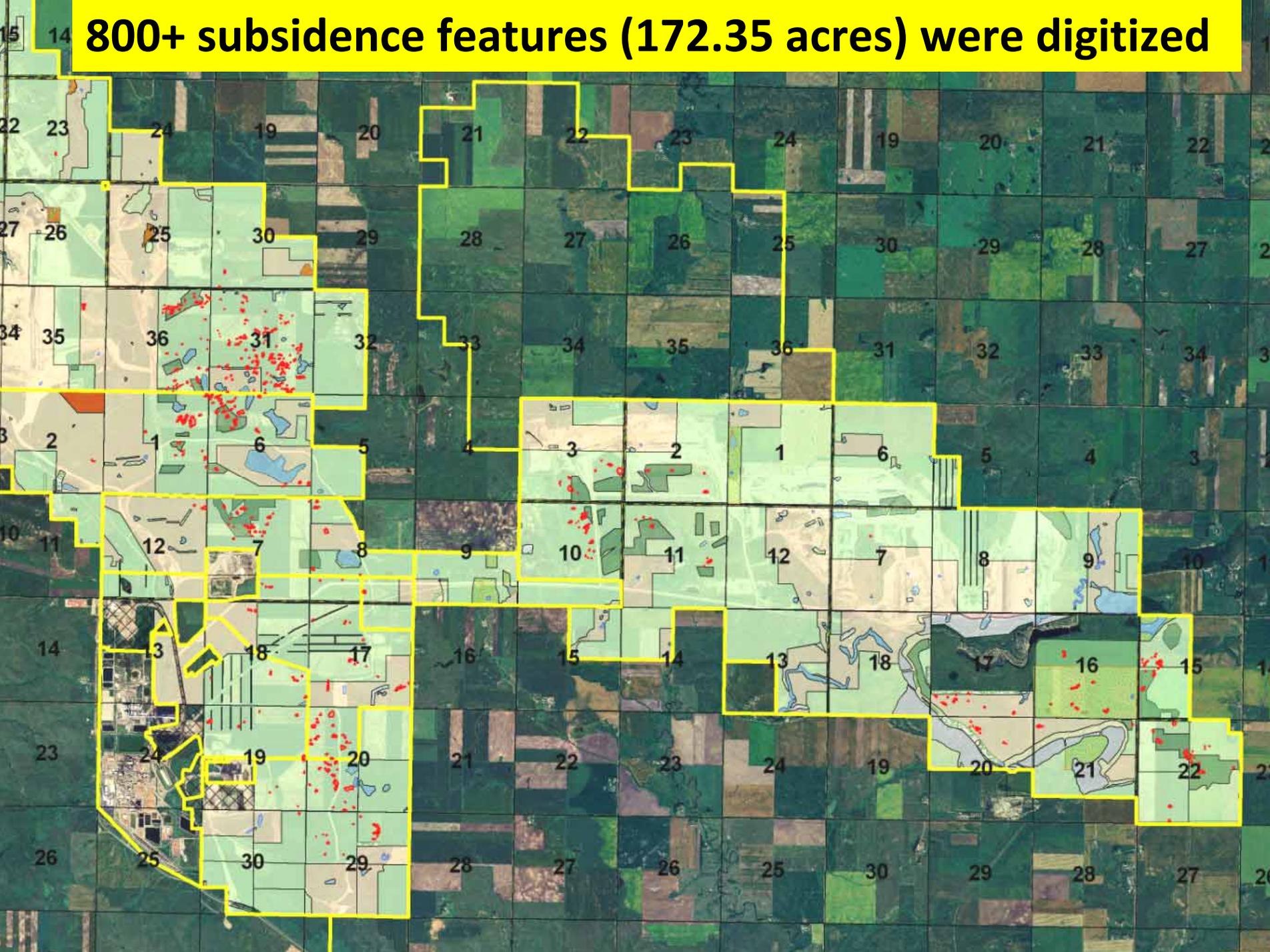
NACT-8102

2.35

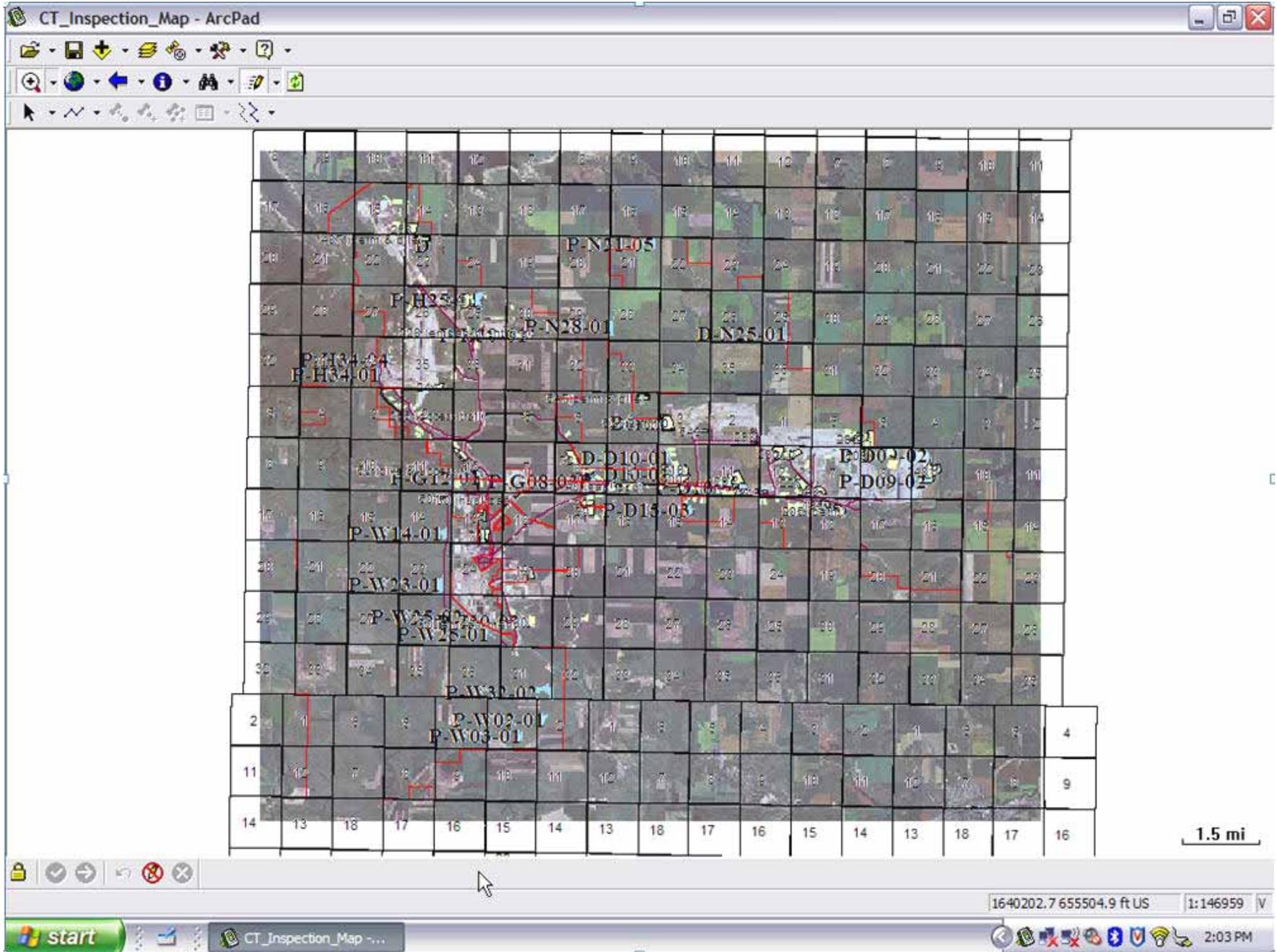
NACT-8601

NACT-8601	0.56
NACT-8601	0.73
NACT-8601	0.09
NACT-8601	0.08
NACT-8601	0.15
NACT-8601	0.03
NACT-8601	0.11
NACT-8601	0.06
NACT-8601	0.40
NACT-8601	0.14
NACT-8601	0.03
NACT-8601	0.23
NACT-8601	0.03
NACT-8601	0.06
NACT-8601	0.25
NACT-8601	0.15
NACT-8601	0.04
NACT-8601	0.07
NACT-8601	0.02
NACT-8601	0.02
NACT-8601	0.10
NACT-8601	0.42
NACT-8601	0.06
NACT-8601	0.05
NACT-8601	0.36
NACT-8601	0.11

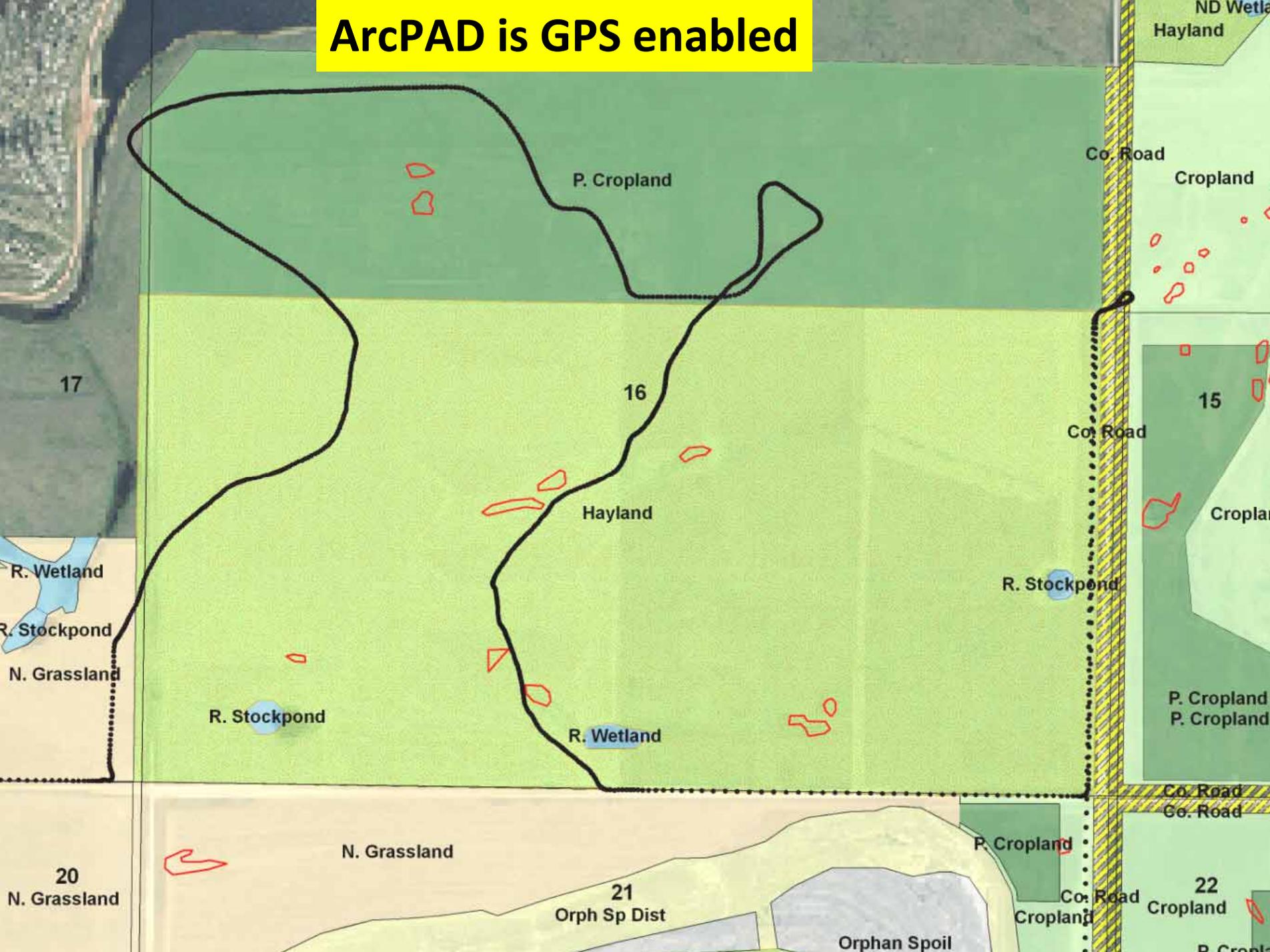
800+ subsidence features (172.35 acres) were digitized



The subsidence shape files transferred to ArcPAD



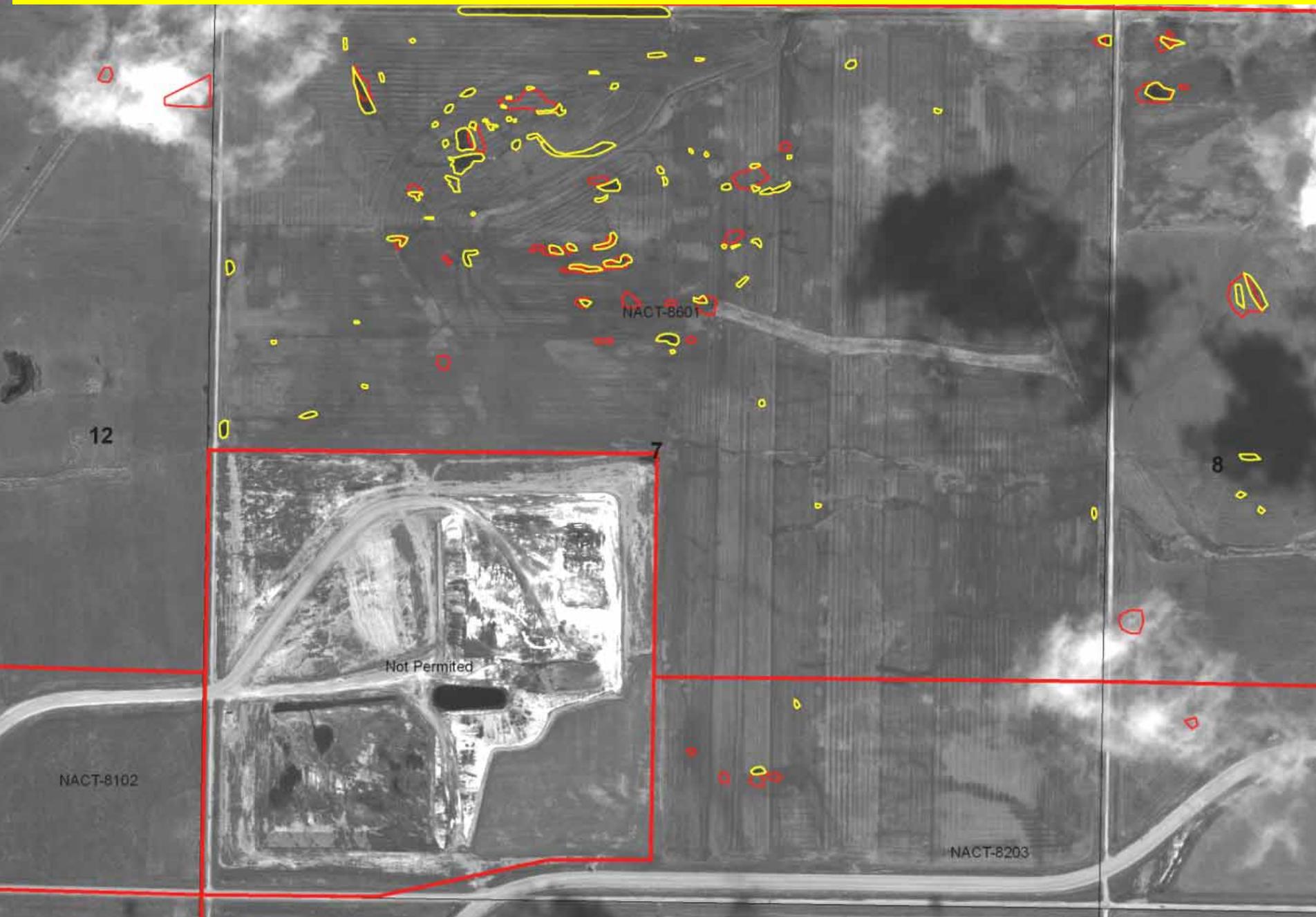
ArcPAD is GPS enabled



A new subsidence shape file created using 2007 imagery



The 2005 and 2007 subsidence shape files can be compared



2006 photograph showing 2005 repair areas



09.20.2006 10:40

Conclusions

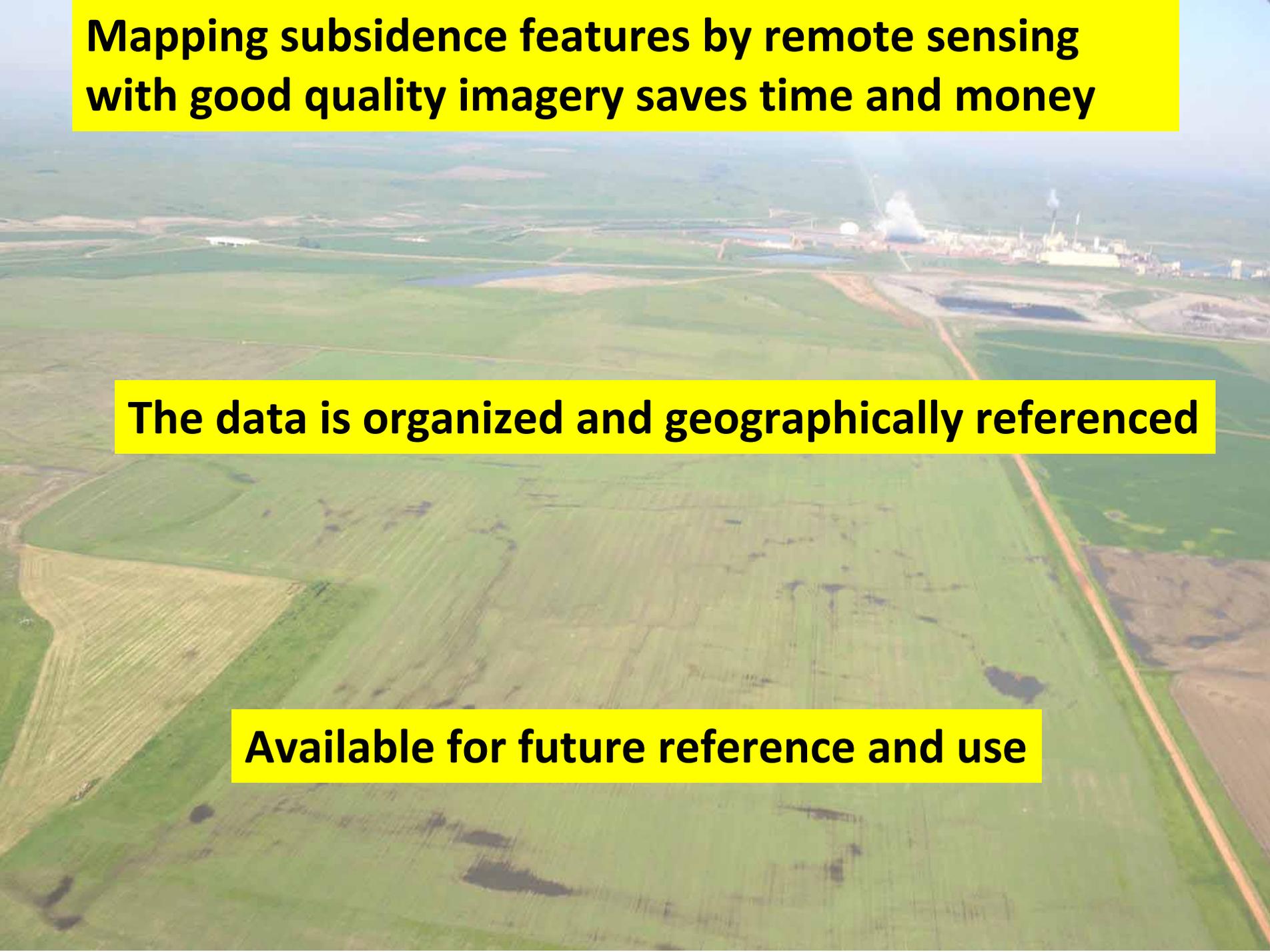


08.01.2006

Mapping subsidence features by remote sensing with good quality imagery saves time and money

The data is organized and geographically referenced

Available for future reference and use



The ND PSC thanks OSM –TIPS Division

