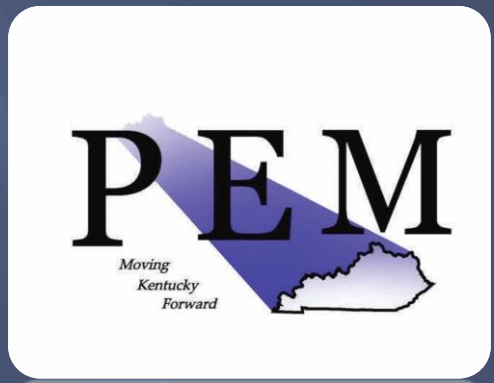
LONGWALL OPERATIONS IN ILLINOIS AND SUBSIDENCE MITIGATION

29th Annual Kentucky Professional Engineers In Mining Seminar

Dan Barkley
Illinois DNR
Office of Mines and Minerals



Illinois Mining History

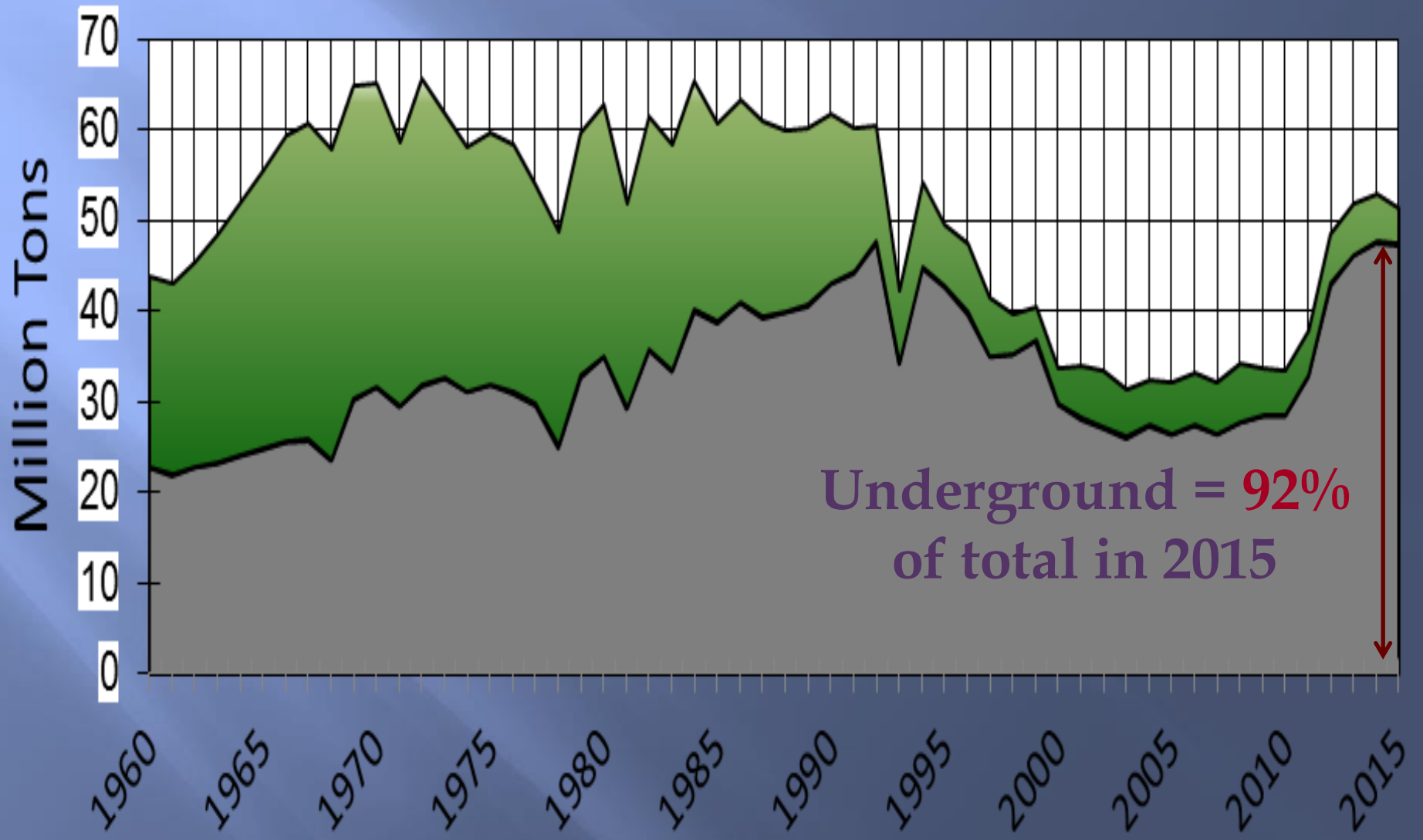
1915: Undercutting 14-foot Herrin Coal in southern Illinois.

- 1st recorded mining in 1810 (Underground near Murphysboro)
- Mining on an industrial scale began in the 1890's
- Surface mining became significant in the 1920's

Historical Underground Mining

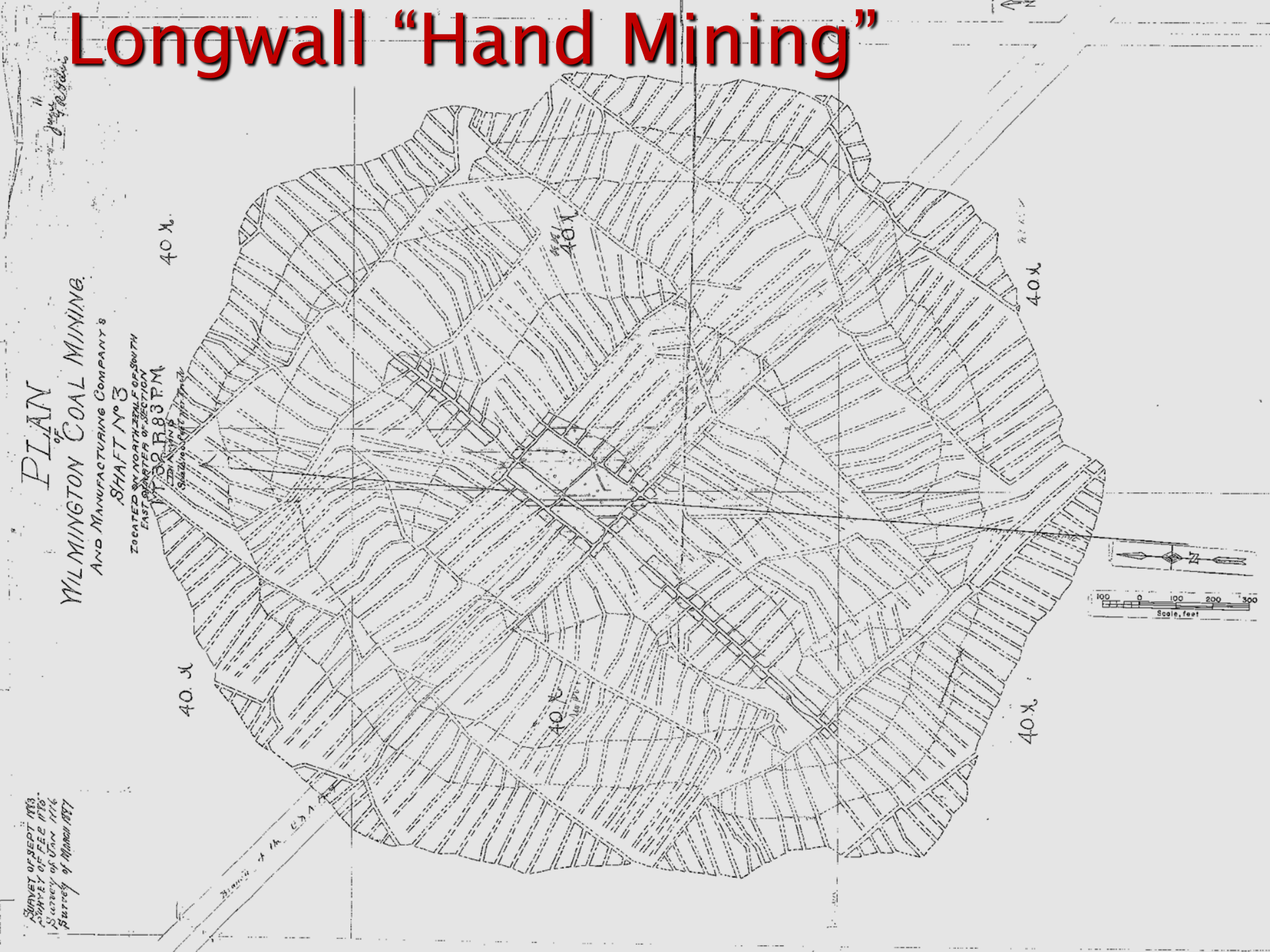
- 1.1 million acres have been undermined in Illinois by:
  - Room and pillar mining
  - Longwall mining

Trend of Surface to Underground Through Time in Illinois



Brief Illinois Longwall History

Longwall "Hand Mining"



Longwall "Hand Mining"

- First practiced in ***1857*** in LaSalle County
- 1885 Illinois Coal Report used term "Long-wall"
- Waste rock packed into mined voids which limited, but did not prevent subsidence
- 1857-1951- over 100 mines in 15 counties


Packed rock limited but did not prevent subsidence

Modern Mechanized Longwall Use in Illinois

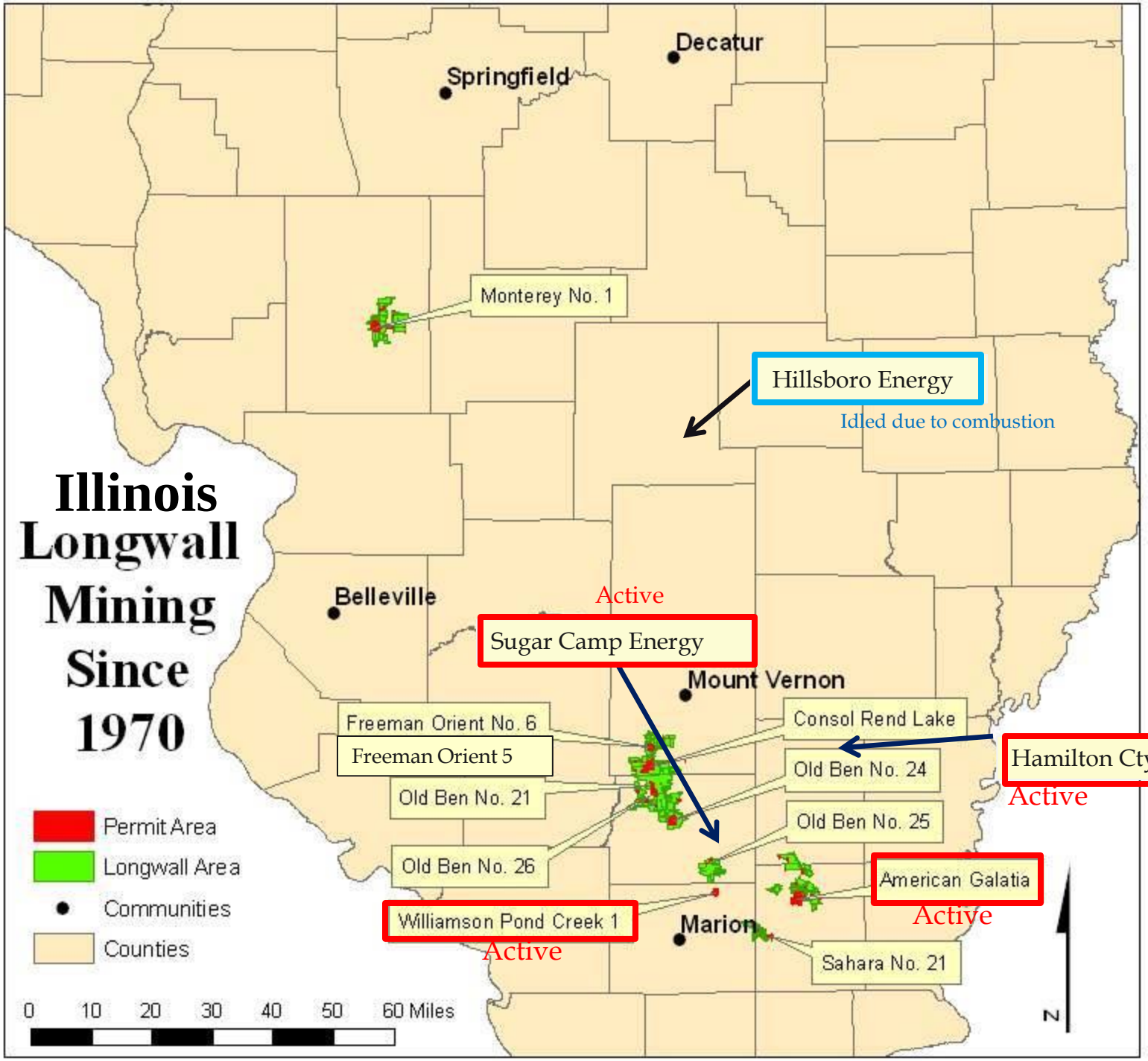
Illinois mechanized Longwall STATS

- 48,000 acres have been longwalled since mechanized longwall began in the 1970's
- 14 individual longwall mines in 7 counties
- 290 + individual longwall panels extracted
- **4** longwall mines currently active with 6 longwall units (2 mines run 2 longwall faces)
- (Recently reduced by 1 due to spontaneous combustion problems (Hillsboro))

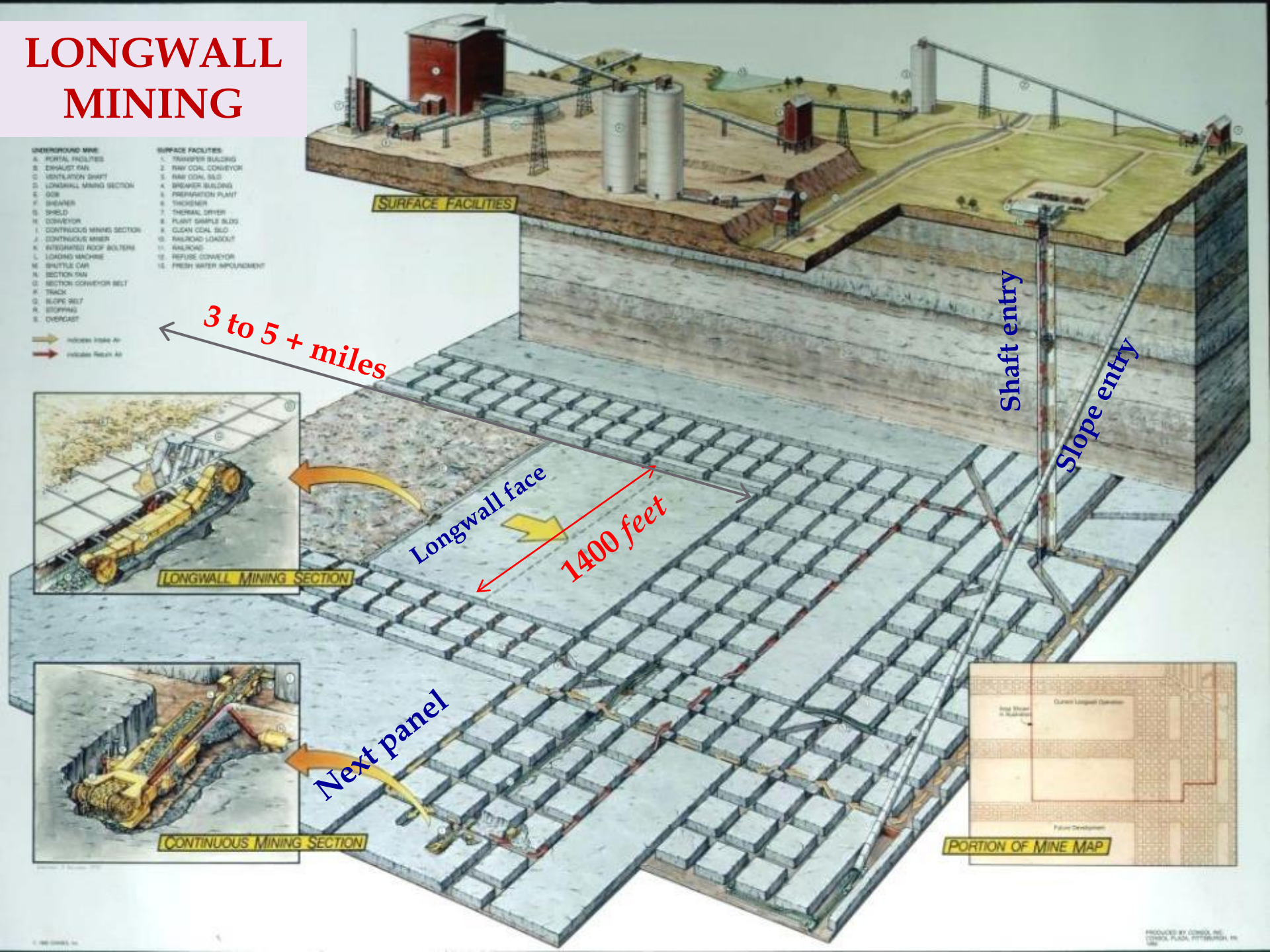
Surge in Longwall Production

METHOD	TONS	PERCENT
Surface	4,096.353	8
Room & Pillar	15,385,322	30
Longwall	*31,856,822*	*62* *
TOTAL	51,338,497	100

2015


Illinois Longwall Mining Since 1970
Decatur
Springfield
Monterey No. 1
Hillsboro Energy
Idled due to combustion
Belleville
Active
Sugar Camp Energy
Mount Vernon
Freeman Orient No. 6
Freeman Orient 5
Old Ben No. 21
Old Ben No. 26
Consol Rend Lake
Old Ben No. 24
Old Ben No. 25
Hamilton Cty Coal
Active
American Galatia
Active
Williamson Pond Creek 1
Active
Marion
Sahara No. 21
Permit Area
Longwall Area
Communities
Counties
0 10 20 30 40 50 60 Miles
N

LONGWALL MINING



Advances in Longwall Mining Over Time (80's to present)

- Panel widths increase from 600 feet to over 1400 feet
- Panel Lengths increase from 1 mile to 5 to 6 miles
- Panel advance rates per day increase from 35 feet to 0ver 100 feet despite wider widths.

Pros

- Faster subsidence creates more uniform subsidence
- Less strain results in less damage to surface structures

Cons

- To Achieve greater advance - Longwall equipment is oversized for the seam
- Roof and floor taken creates tremendous increase in percent reject (+ or - 50 percent)
- Refuse Disposal **space** has become the greatest obstacle

SUBSIDENCE IMPACTS

Illinois Longwall Experience

- Cropland
- Perennial streams
- Homes and buildings
- Public highways
- Railroads
- Major Pipelines
- Methane gas plant
- Capped slurry impoundment

Farmland subsidence issue

- Subsidence creates drainage problems that cause standing water
- Standing water created by subsidence kills crops
- Proper drainage must be eliminated to restore farming capabilities

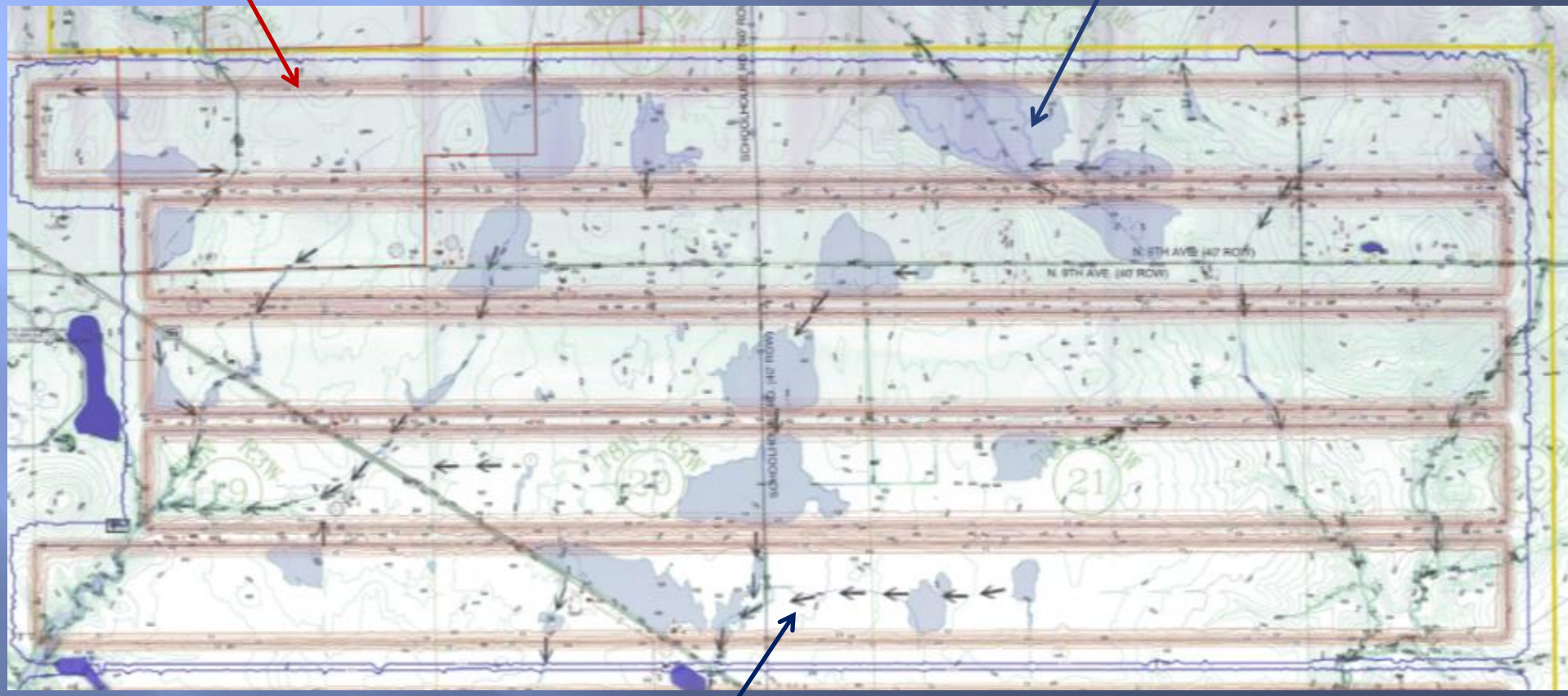
SUBSIDENCE CONTROL PLAN Land

- Existing and projected contours required to define potential drainage problems (This requirement is unique to Illinois)
- Drainage interruptions must be corrected
- Addition of drainage tile may be needed to supplement surface drainage
- Temporary crop damage compensation $$ is required until repair is complete (Not a SMCRA or state regulation…we work it into each individual longwall permit)

Post Subsidence Contour Map
2 Foot Contour Interval

Isopleth lines for subsidence trough

Projected Ponding



Arrows show path of mitigation

Cut and fill work

Waterway Construction

Initial poor mitigation effort

Improved mitigation effort

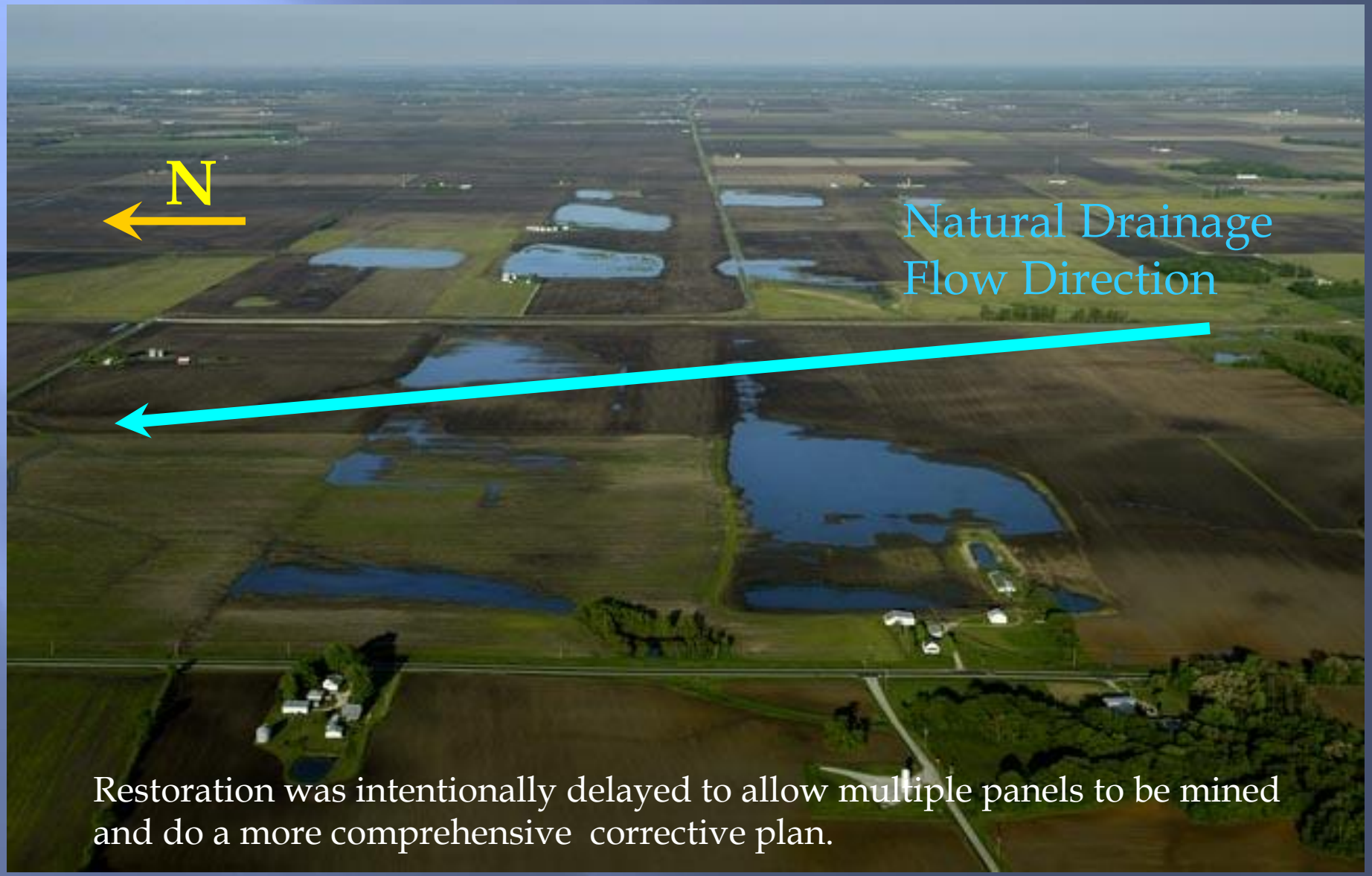
Road raised – waterway improved

Placement of subsurface drainage tile

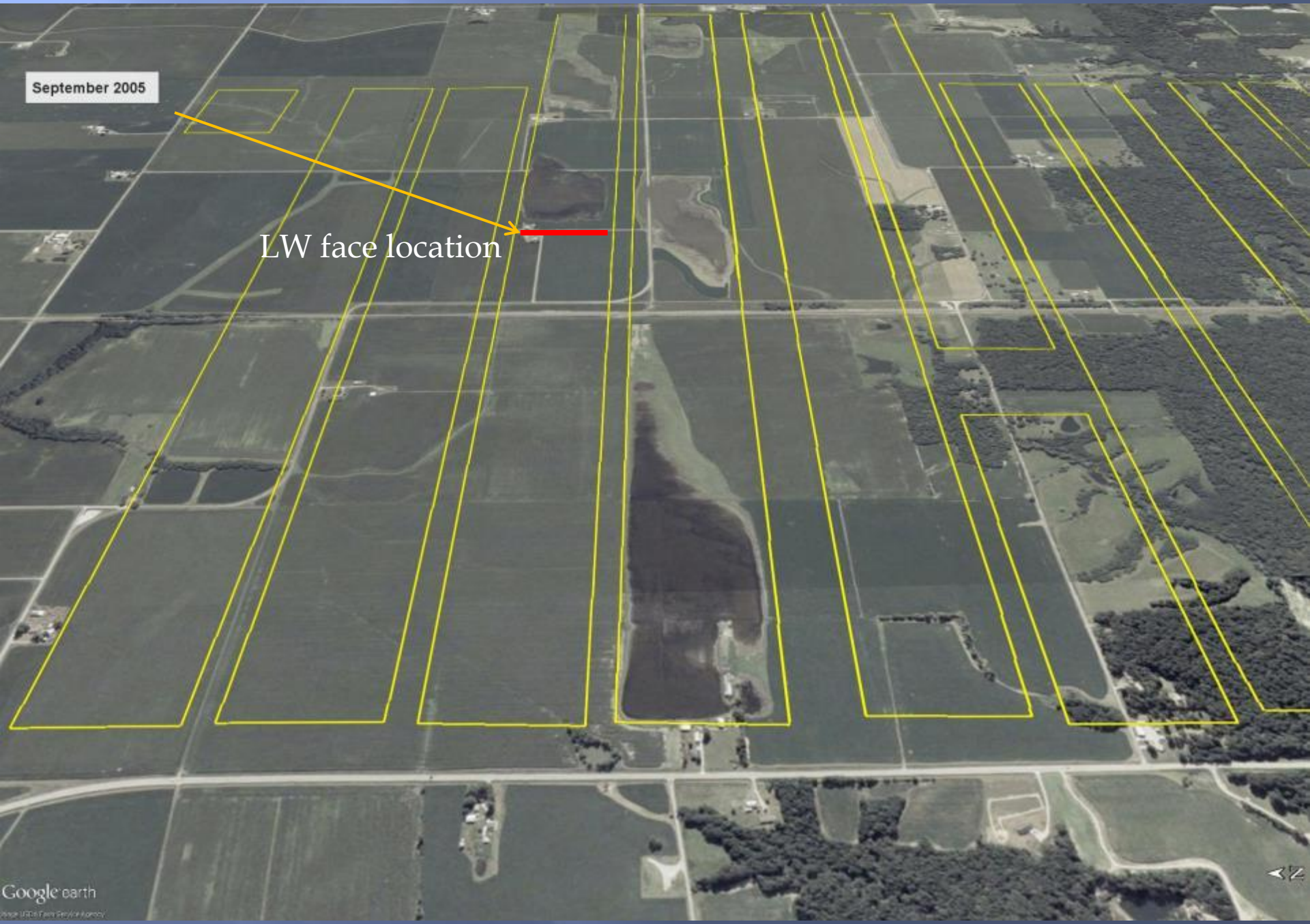
Replacing Drainage Tile

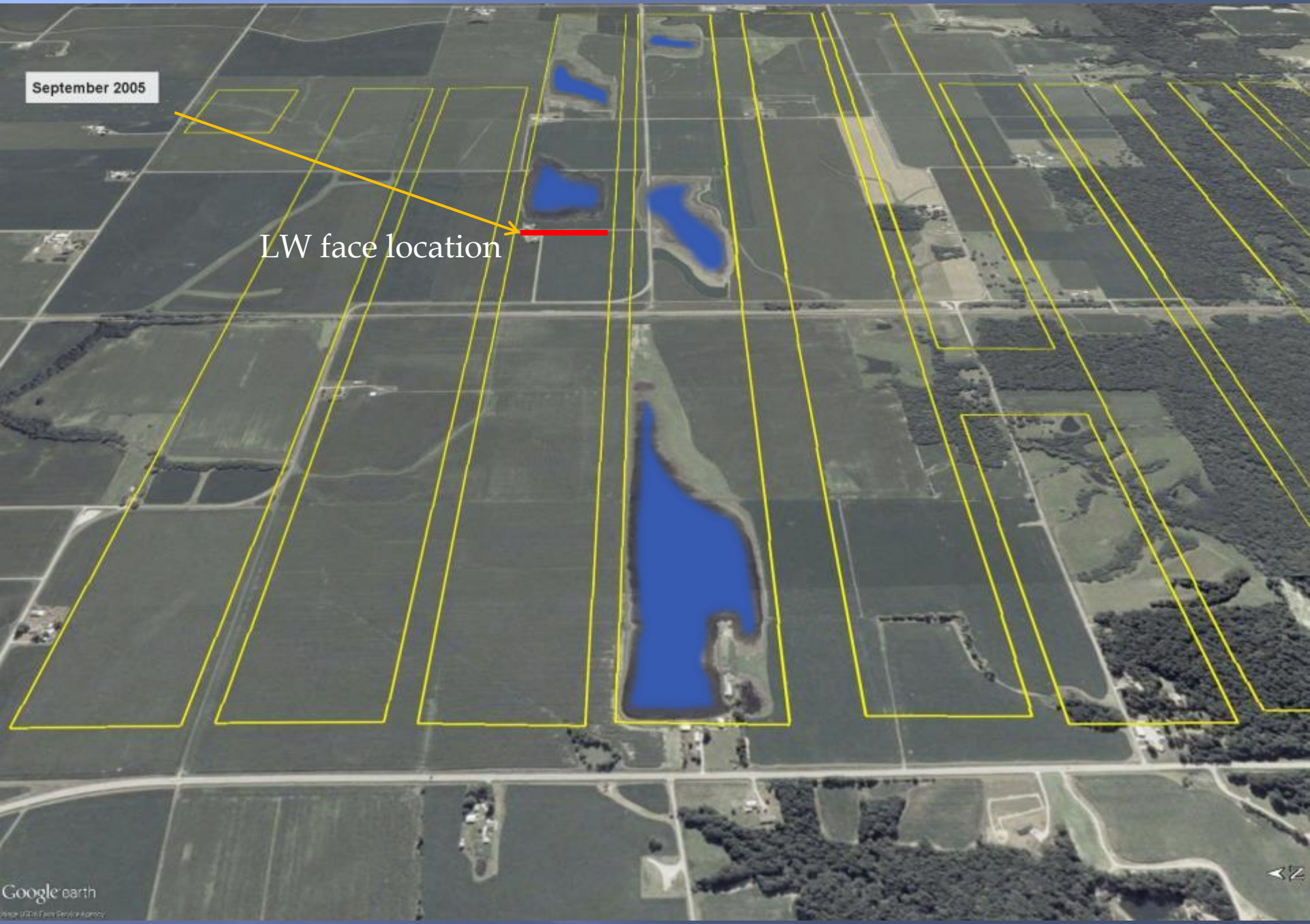
Broad waterway with subsurface tile inlet

Flat Topography=drainage problems from chain pillars between subsidence troughs



Restoration was intentionally delayed to allow multiple panels to be mined and do a more comprehensive corrective plan.

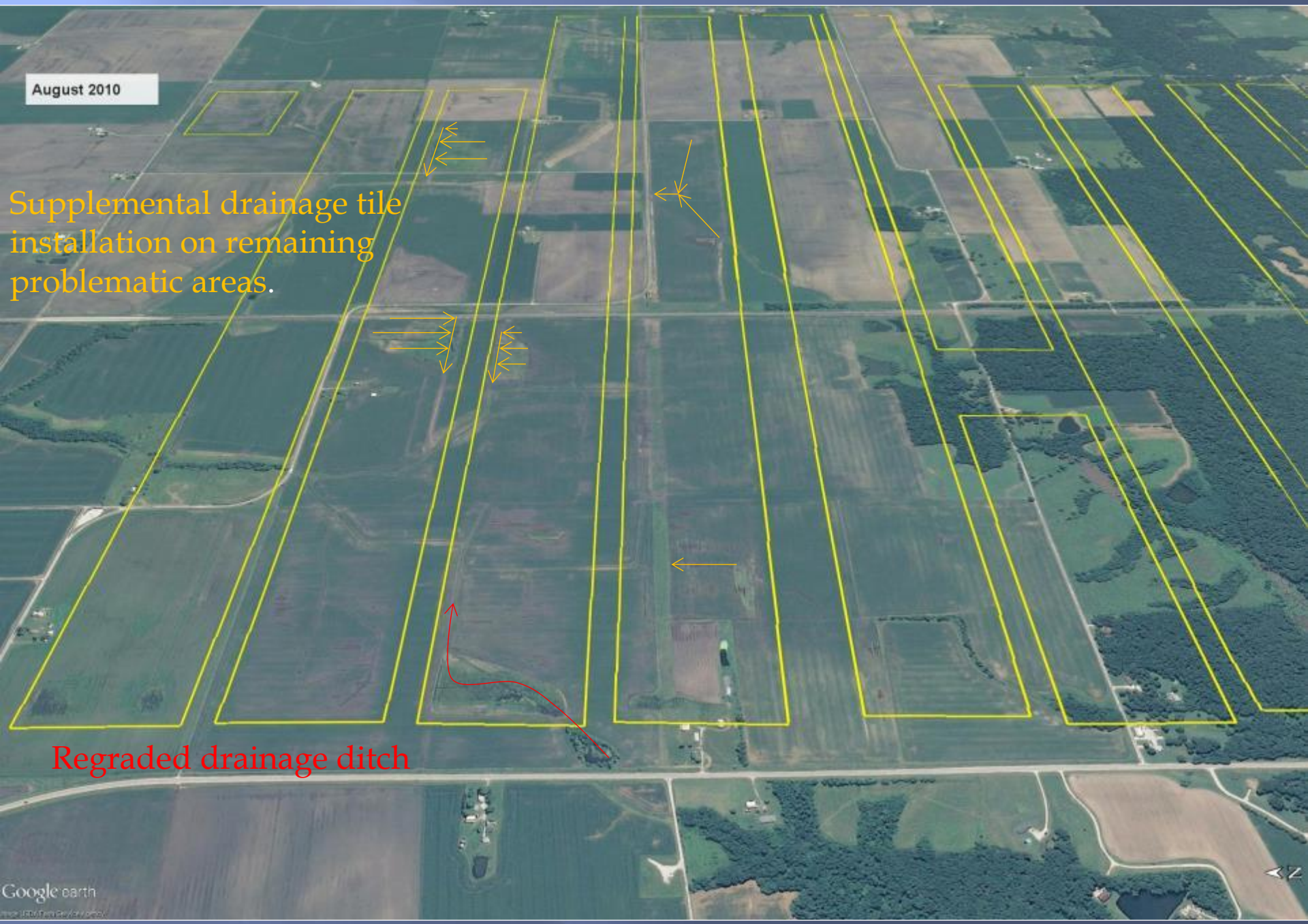

September 2005
LW face location
Google earth


September 2005
LW face location
Google earth


August 2006
LW face location
Google earth

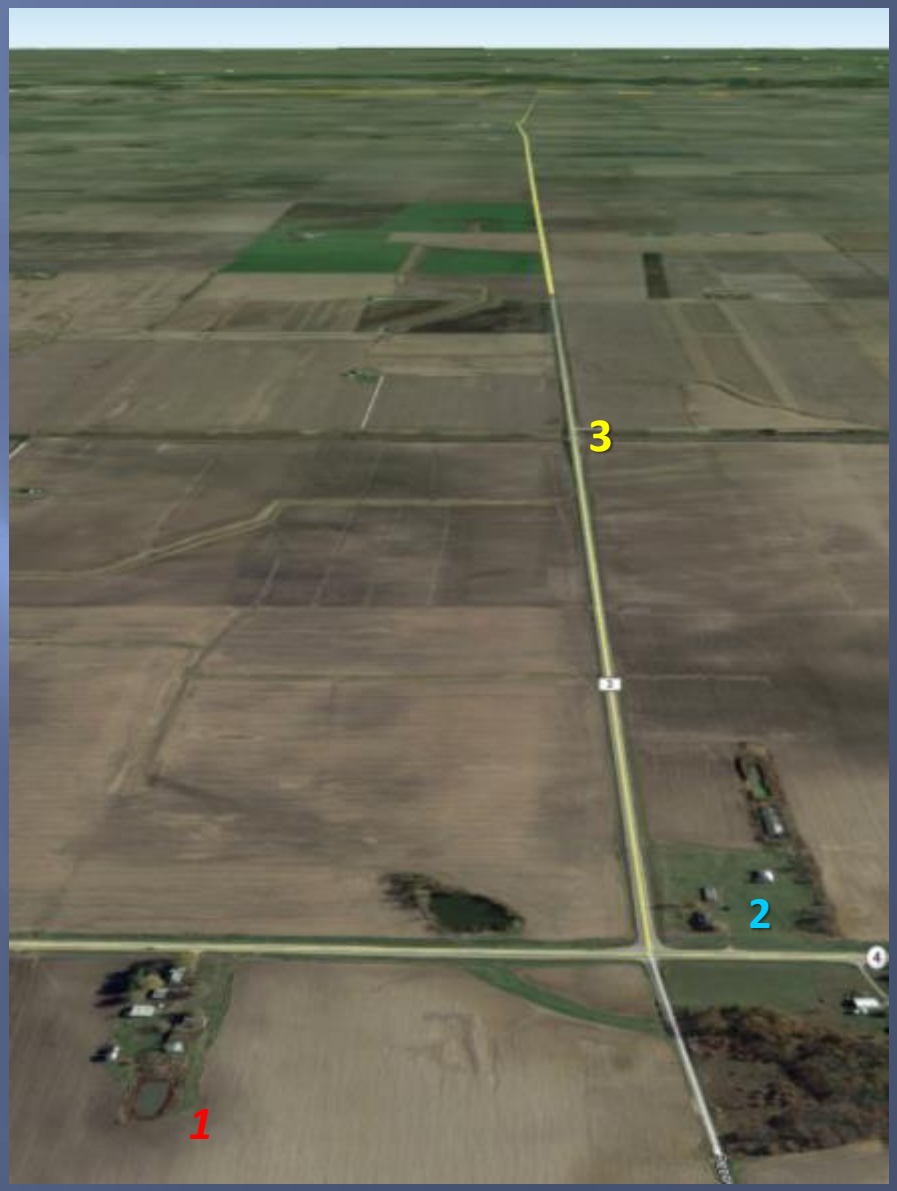

August 2006
LW face location
Google earth

Drainage mitigation 90 percent complete


August 2010
Supplemental drainage tile installation on remaining problematic areas.
Regraded drainage ditch
Google earth

Completed Restoration

BEFORE



AFTER

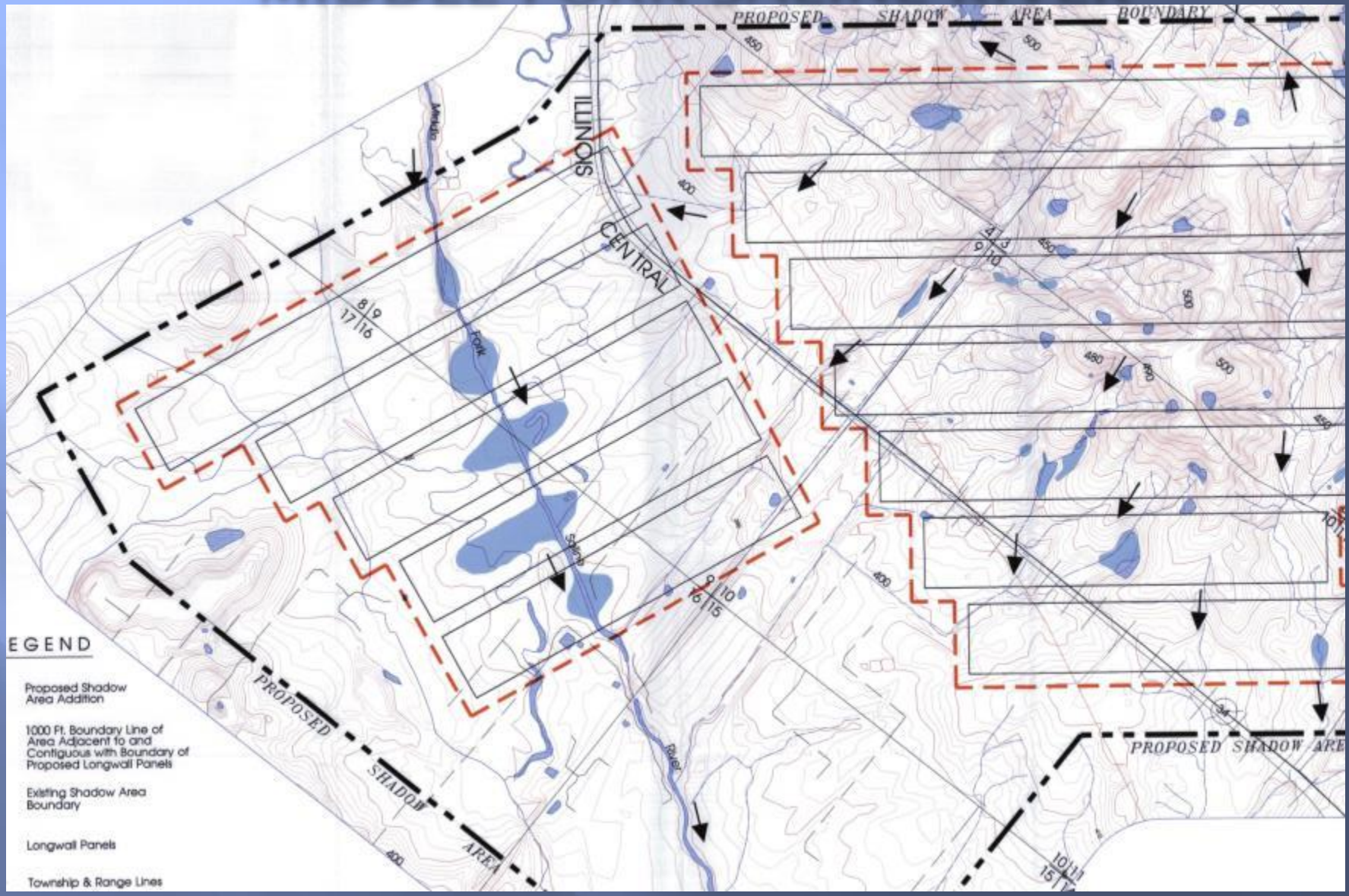
SUBSIDENCE CONTROL PLAN Streams

- Pre and Post Stream Profiles along larger streams typically required to define extent of mitigation
- Stream loss **does not** occur due to geologic setting. Unlike Appalachia, Illinois must address ponding and out of bank flooding
- Gate cuts and dredging downstream of the last panel to relieve ponding is often necessary
- Stream bank berms are sometimes necessary with one way flap gate culverts to control out of bank flooding
- CORPS 404 permitting (if necessary) occurs at the time of mitigation - not in the up-front permitting process.

Tension cracks adjacent and through a stream

Tension cracks through stream

POST SUBSIDENCE STREAM FLOODING MIDDLE FORK SALINE RIVER



Stream Bank Berms to reproduce pre subsidence elevations

Completed Flood Control Berm

Inlet crop field Side

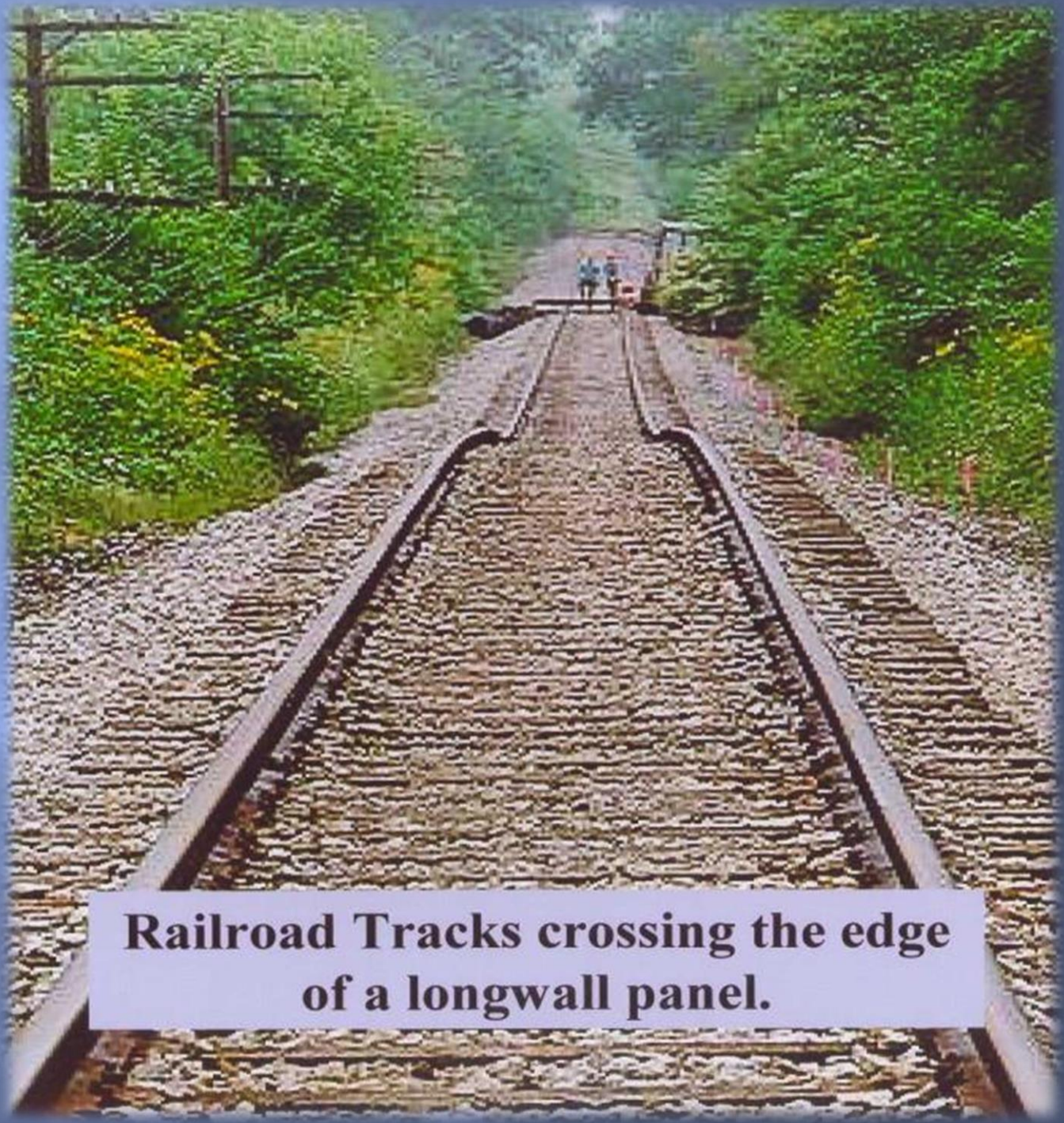
Flap Gate

Outlet stream Side

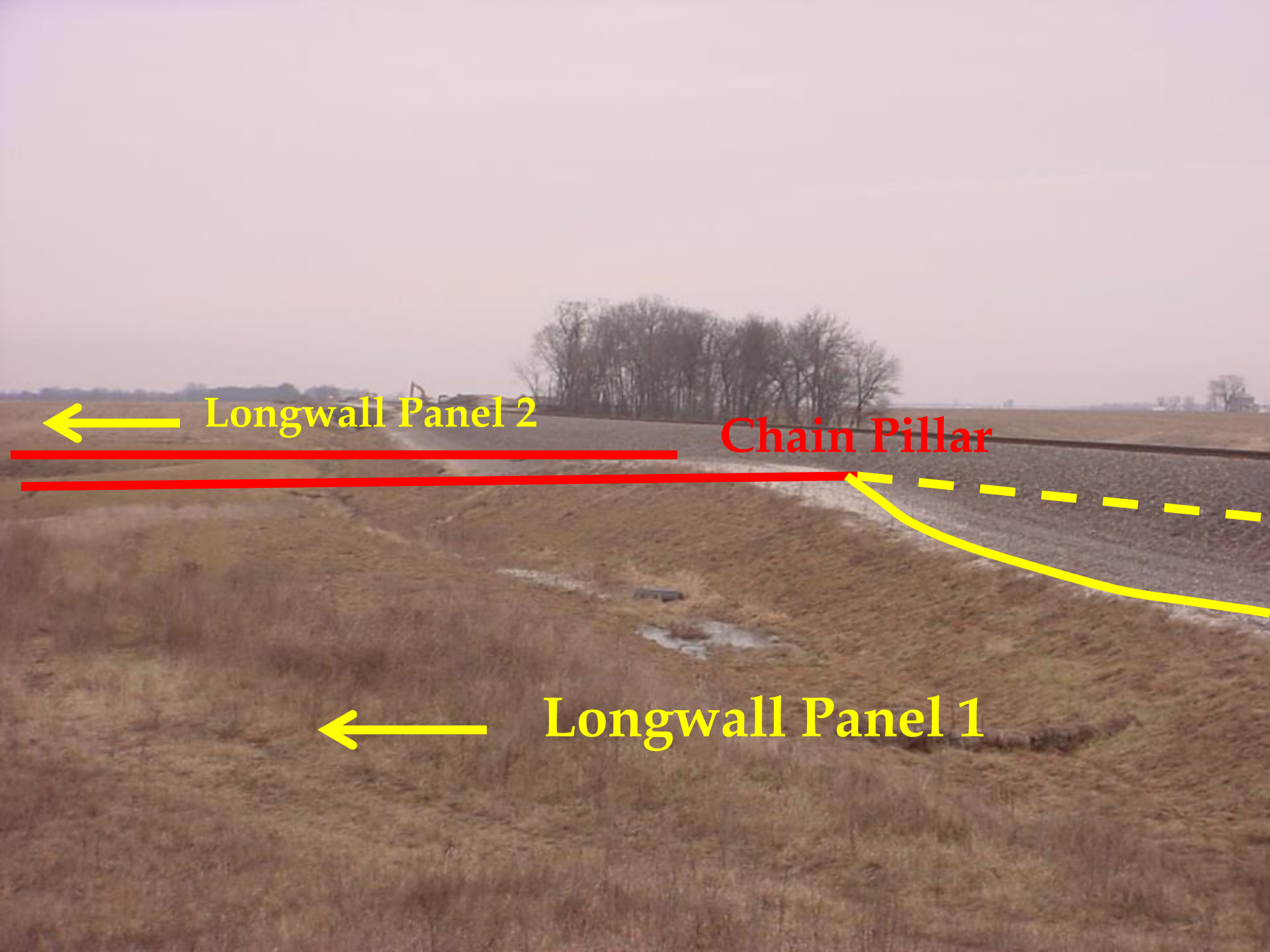
Roads & Longwall Subsidence

State Route IL 34 Subsided by Longwall Mining

State Route IL 34 Raised and Restored Post Subsidence


Railroad Tracks crossing the edge
of a longwall panel.

Two Longwall panels perpendicular to rail post subsidenceand restoration


Longwall Panel 2
Chain Pillar
Longwall Panel 1

Rail Raising & Leveling Equipment

Subsidence Trough

Preparation for Subsidence

Holes cut in foundation for beams

“I” Beams for Floating

Home floated above foundation

Hydraulic Jacks for leveling

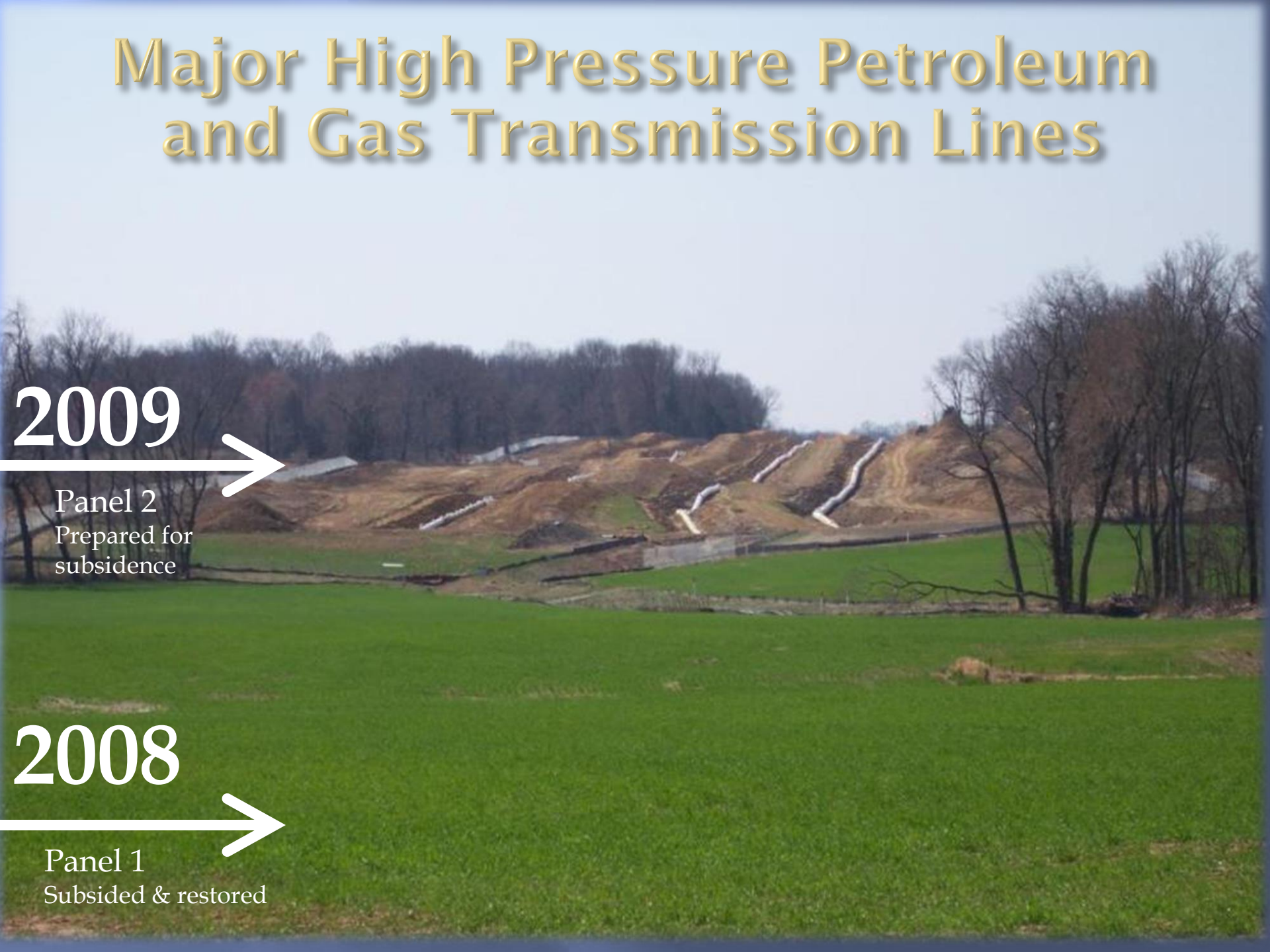
Utility precautions during subsidence

Home reset on new foundation after completion of subsidence movements

Home Relocation away from subsidence

Reset in new location

Major High Pressure Petroleum and Gas Transmission Lines



Strain Monitoring During Subsidence

So What is the problem with LONGWALL MINING ??

- It is intrusive & stressful for surface owners
- It does not always go smoothly
- Misinformation spreads easily and quickly
- Correcting and clarifying misinformation can be difficult

QUESTIONS??