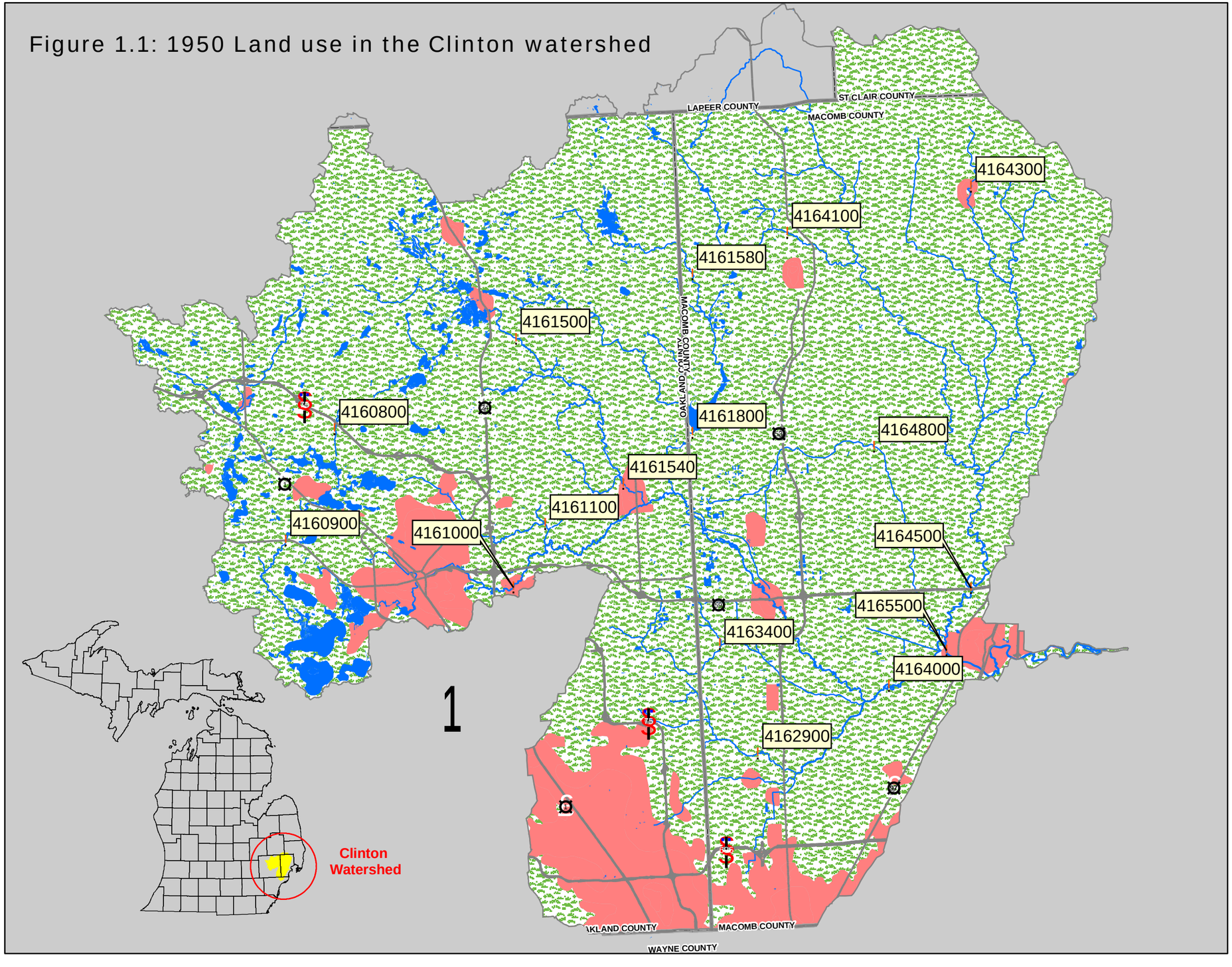
# APPENDIX A

# Document Figures

Figure 1.1: 1950 Land use in the Clinton watershed




## LEGEND

Urbanized Land as of 1950

! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for 1950 Urbanized land is part of a shapefile created by SEMCOG were obtained from SEMCOG from a 1980s SEMCOG paper map entitled 'Generalized Urbanization of Land from 1890-1980'
Lapeer County is not included in SEMCOG and therefore no data is shown

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

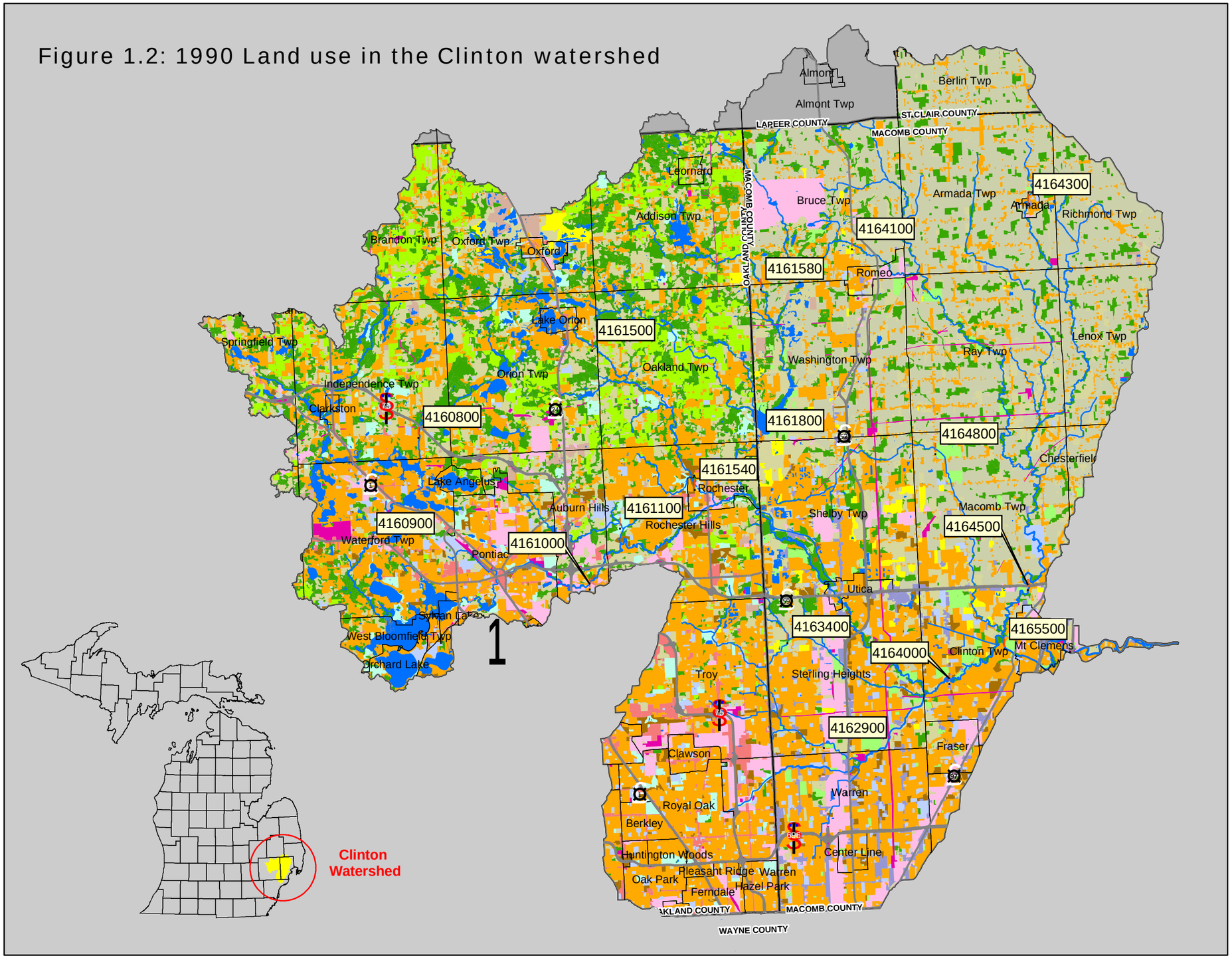
0 2 4 8 Miles

0 3 6 12 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT
Environmental Consulting & Technology, Inc.

# Figure 1.2: 1990 Land use in the Clinton watershed




## LEGEND

- Active Agriculture
- Commercial and Office
- Cultural, Outdoor Recreation, and Cemetery
- Extractive and Barren
- Grassland, and Shrub
- Industrial
- Institutional
- Multiple-family Residential
- Single-family Residential
- Transportation, Communication, and Utility
- Under Development
- Water
- Woodland and Wetland
- No Data
- ! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for land use/cover were obtained from SEMCOG*
*SEMCOG does not provide data for Lapeer County

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

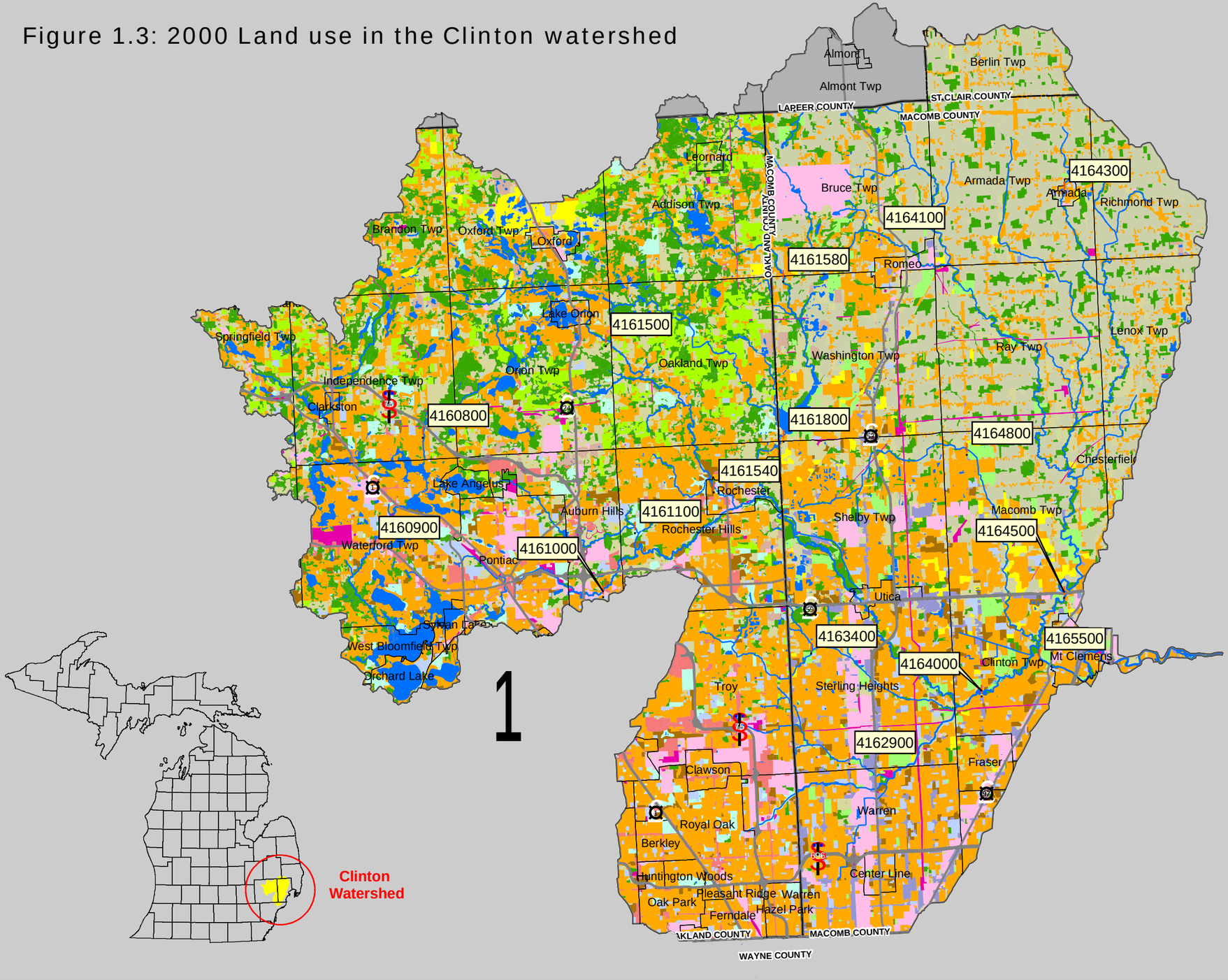
0 2 4 8 Miles

0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.

# Figure 1.3: 2000 Land use in the Clinton watershed




## LEGEND

- Active Agriculture
- Commercial and Office
- Cultural, Outdoor Recreation, and Cemetery
- Extractive and Barren
- Grassland, and Shrub
- Industrial
- Institutional
- Multiple-family Residential
- Single-family Residential
- Transportation, Communication, and Utility
- Under Development
- Water
- Woodland and Wetland
- No Data
- ! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for land use/cover were obtained from SEMCOG*
*SEMCOG does not provide data for Lapeer County

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

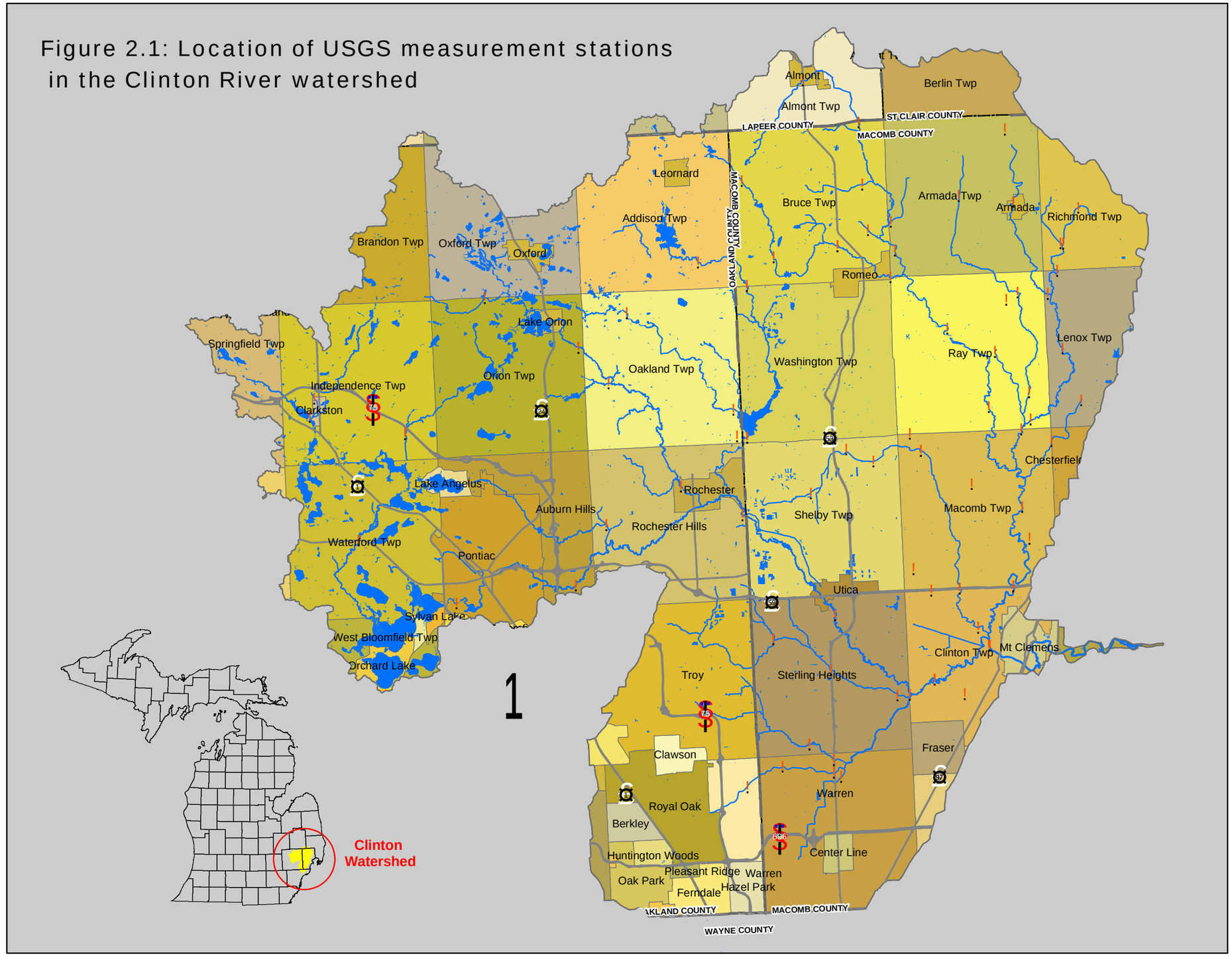
0 2 4 8 Miles

0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.

# Figure 2.1: Location of USGS measurement stations in the Clinton River watershed




## LEGEND

- ! USGS Stations
- Streams & Rivers
- State Roadways

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

0 2 4 8 Miles

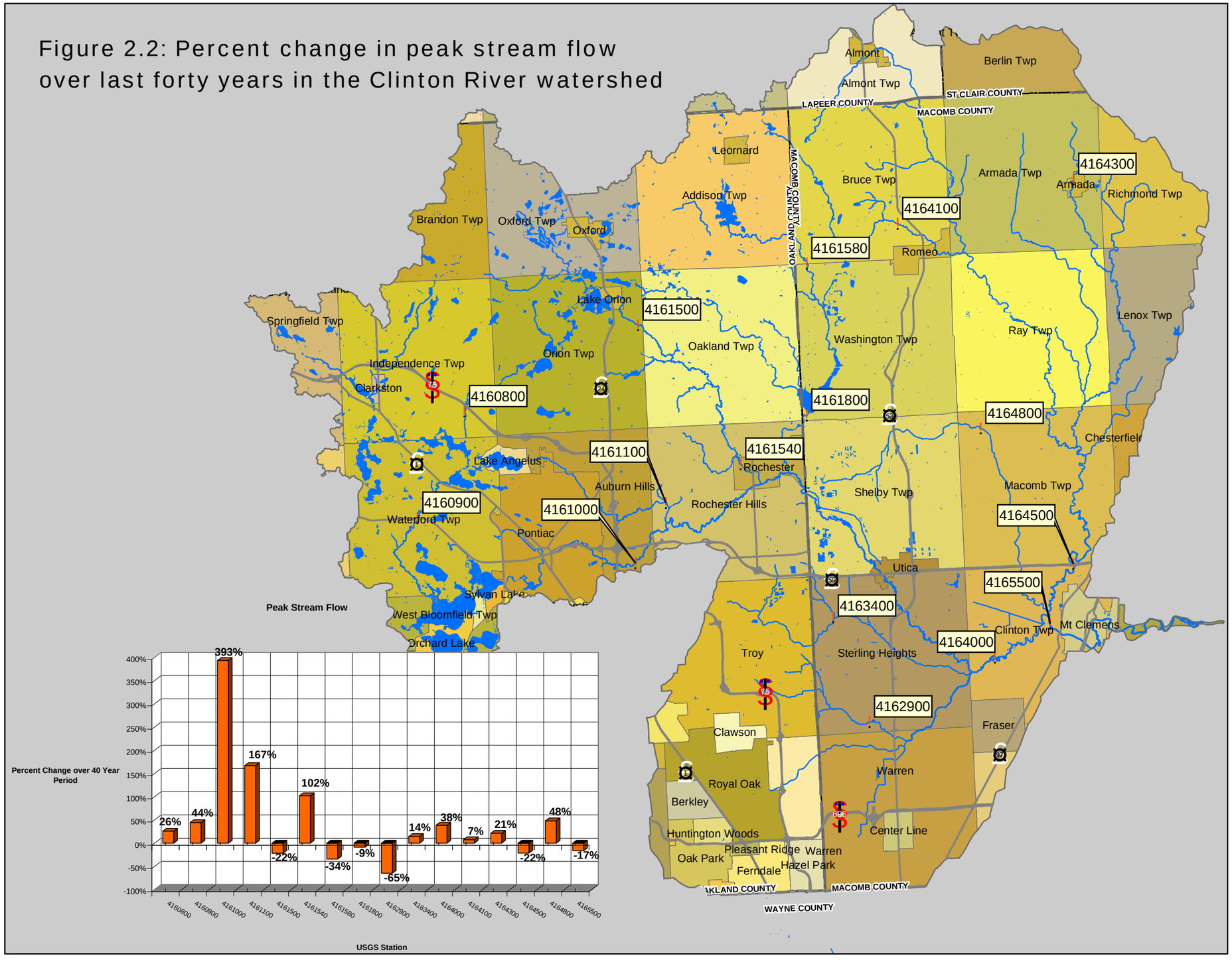
0 3 6 12 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

Environmental Consulting & Technology, Inc.

# Figure 2.2: Percent change in peak stream flow over last forty years in the Clinton River watershed




## LEGEND

- ! USGS Stations
- Streams & Rivers
- State Roadways

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

0 2 4 8 Miles

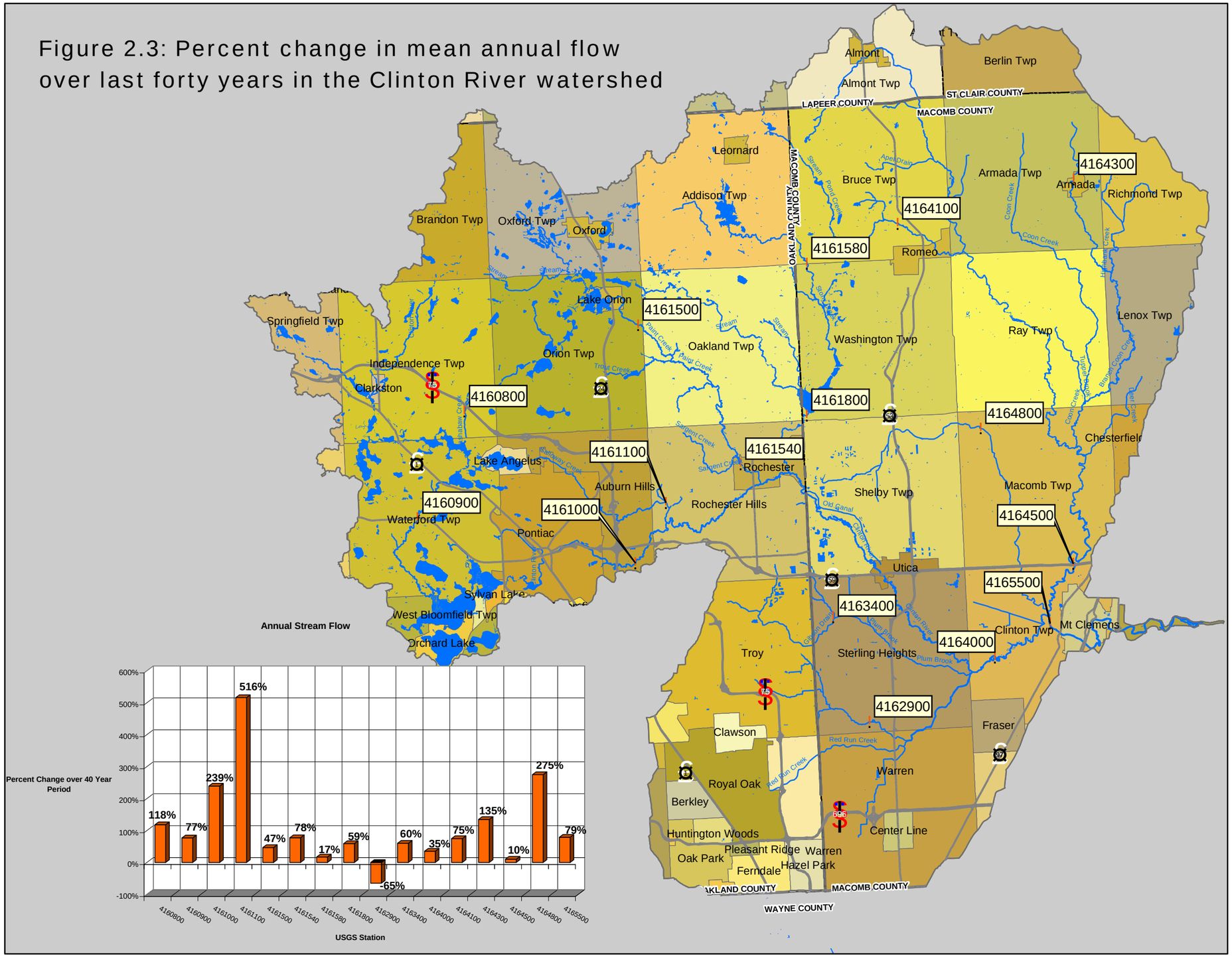
0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

# Figure 2.3: Percent change in mean annual flow over last forty years in the Clinton River watershed




## LEGEND

- ! USGS Stations
- Streams & Rivers
- State Roadways

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

0 2 4 8 Miles

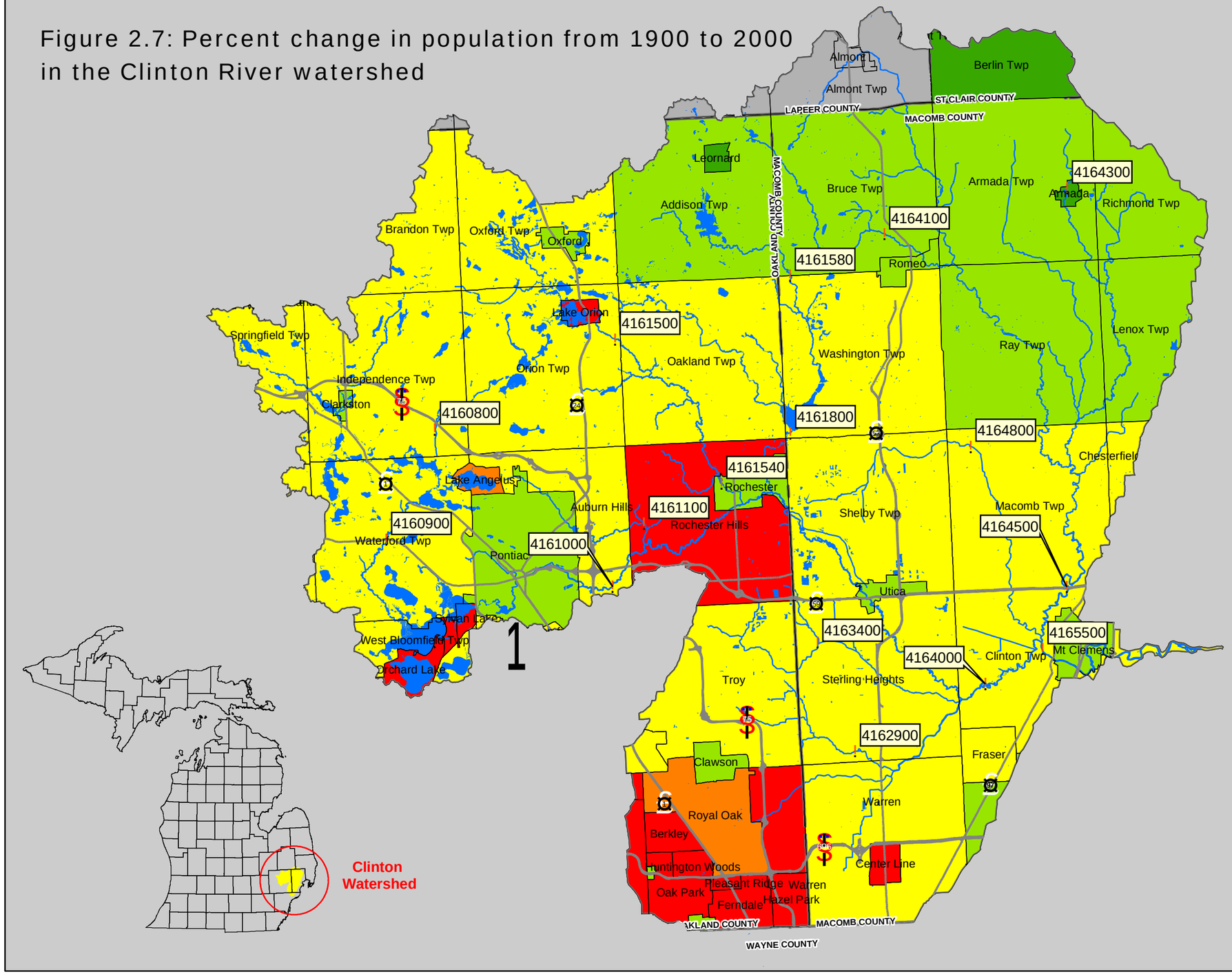
0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

# Figure 2.7: Percent change in population from 1900 to 2000 in the Clinton River watershed




## LEGEND

- Change of less than 100%
- Change of 100 to 1000%
- Change of 1000 to 10000%
- Change of 10000 to 100000%
- Change of greater than 100000%
- No Data
- ! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, Data for Population Increase derived from Population Numbers in SEMCOG Document- 'SEMCOG Historical Population 1900-2000' *Data includes only communities of Oakland and Macomb County

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

0 1.5 3 6 Miles

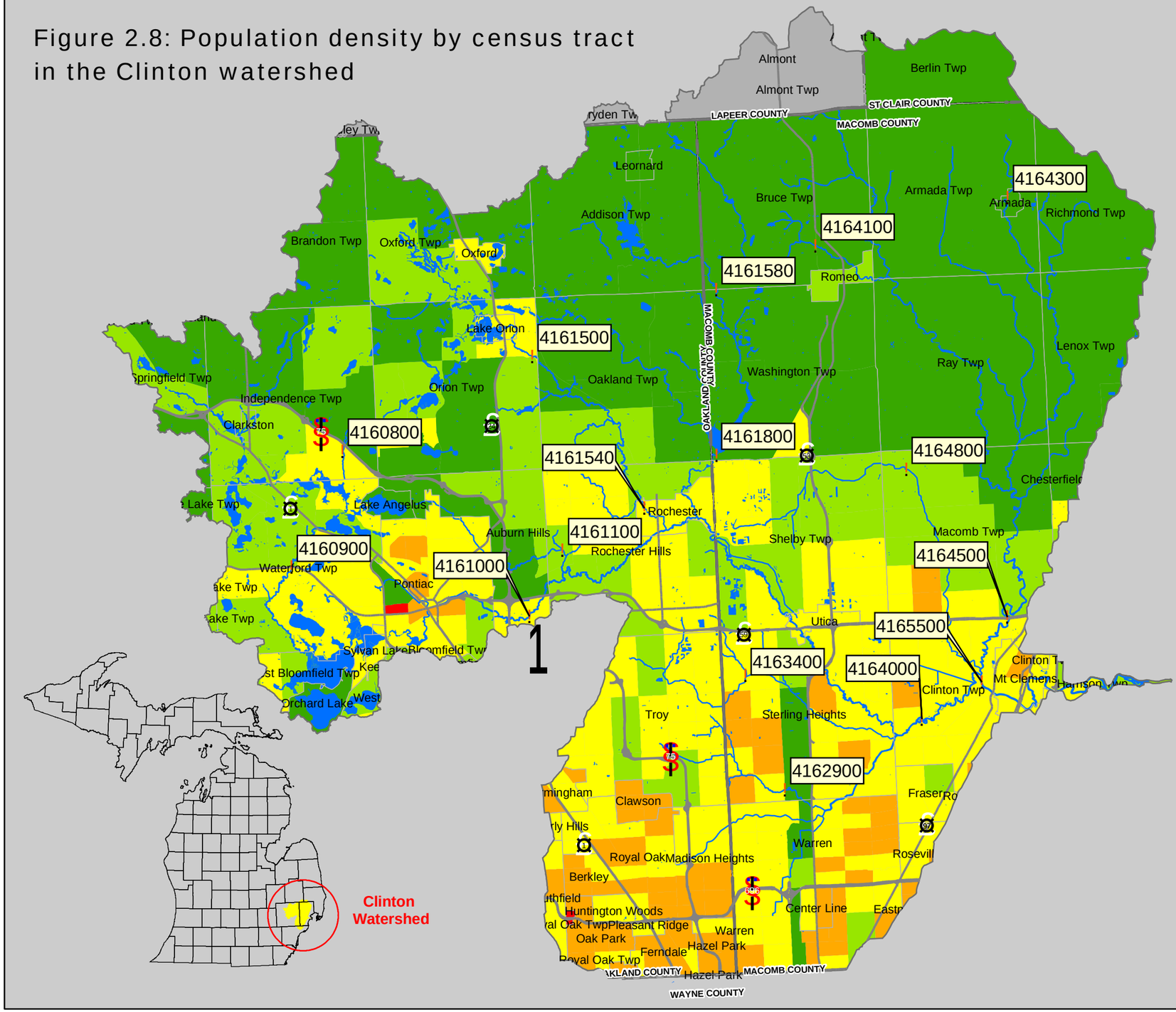
0 3 6 12 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

Environmental Consulting & Technology, Inc.

Figure 2.8: Population density by census tract in the Clinton watershed




## LEGEND

**Persons Per Acre**

- 0 - 1
- 1 - 3
- 3 - 8
- 8 - 14
- Greater than 14
- No Data
- ! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for Population Density was obtained from SEMCOG
Lapeer County is not included in SEMCOG

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

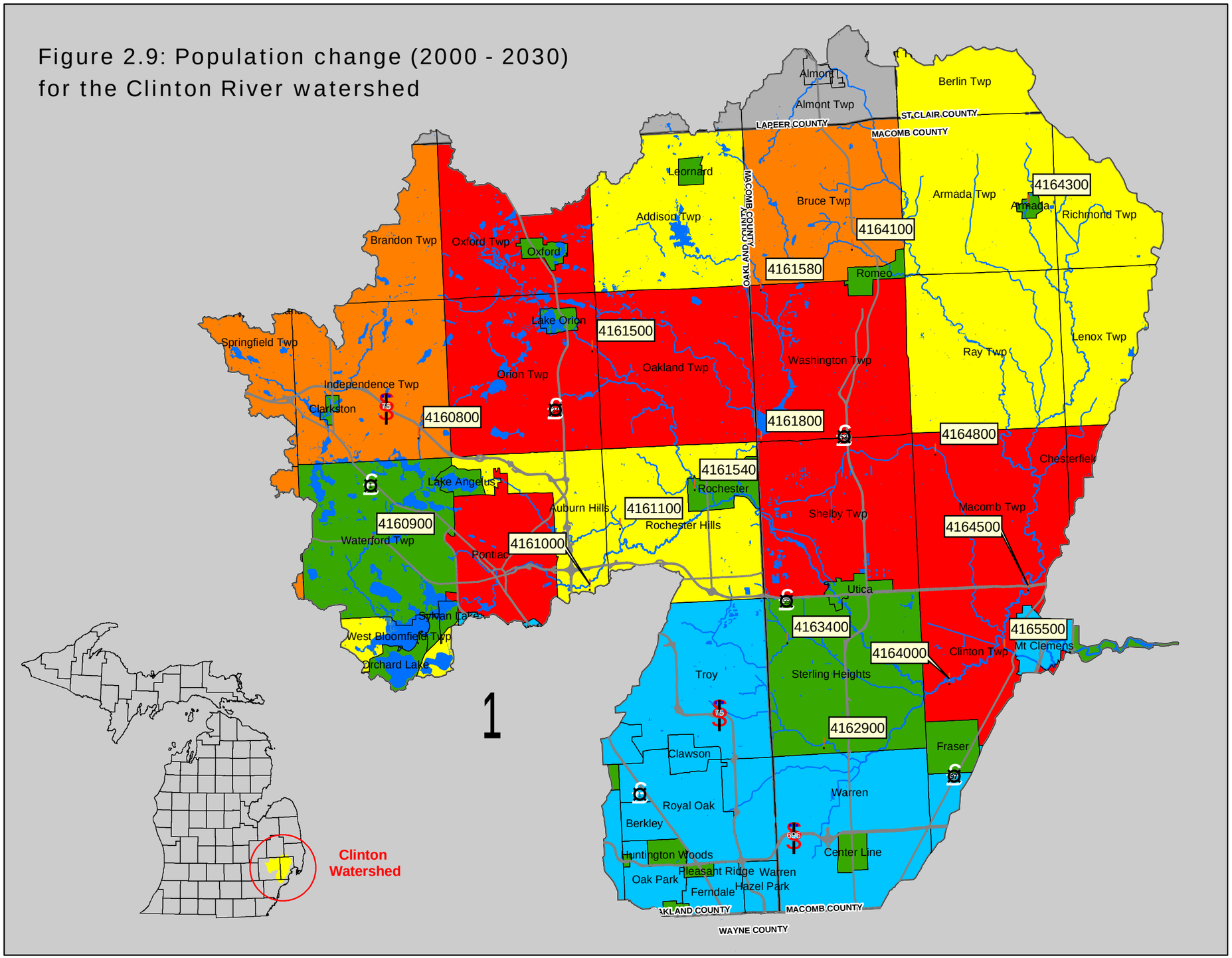
0 2 4 8 Miles

0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.

Figure 2.9: Population change (2000 - 2030) for the Clinton River watershed




## LEGEND

- Decrease; more than 1,000 loss
- Little change; 1,000 loss to 1,000 gain
- Moderate increase; 1,000 to 4000 gain
- Large increase; 4000 to 8000 gain
- Very large increase; more than 8,000 gain
- No Data
- ! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for Population changes was obtained from SEMCOG*
*Lapeer County is not included in SEMCOG

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

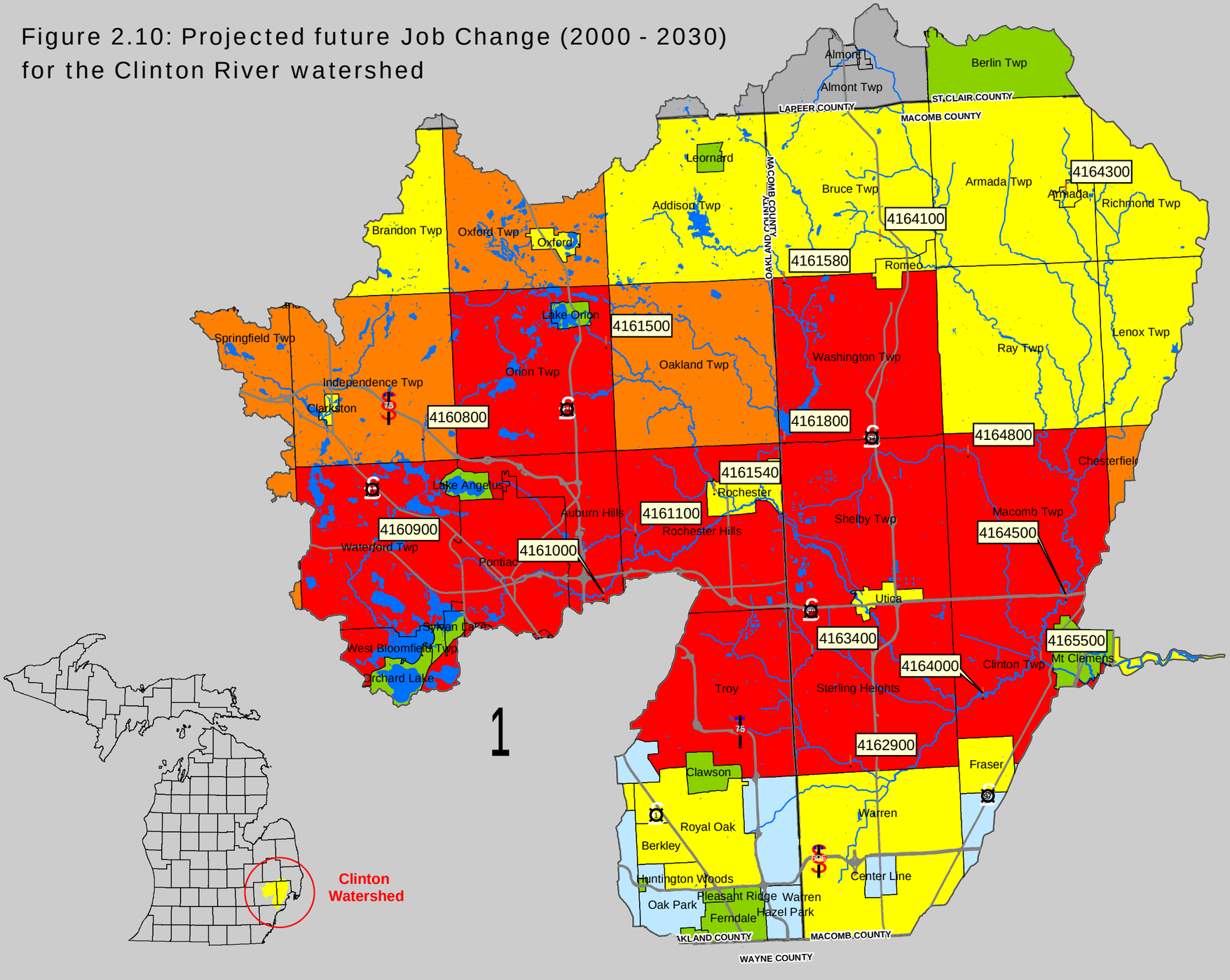
0 2 4 8 Miles

0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.

# Figure 2.10: Projected future Job Change (2000 - 2030) for the Clinton River watershed




## LEGEND

- Decrease; more than 500 loss
- Little change; 500 loss to 500 gain
- Moderate increase; 501 to 2500 gain
- Large increase; 2,501 to 5,000 gain
- Very large increase; more than 5,000 gain
- No Data
- ! USGS Stations

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for Job changes was obtained from SEMCOG*
*Lapeer County is not included in SEMCOG

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

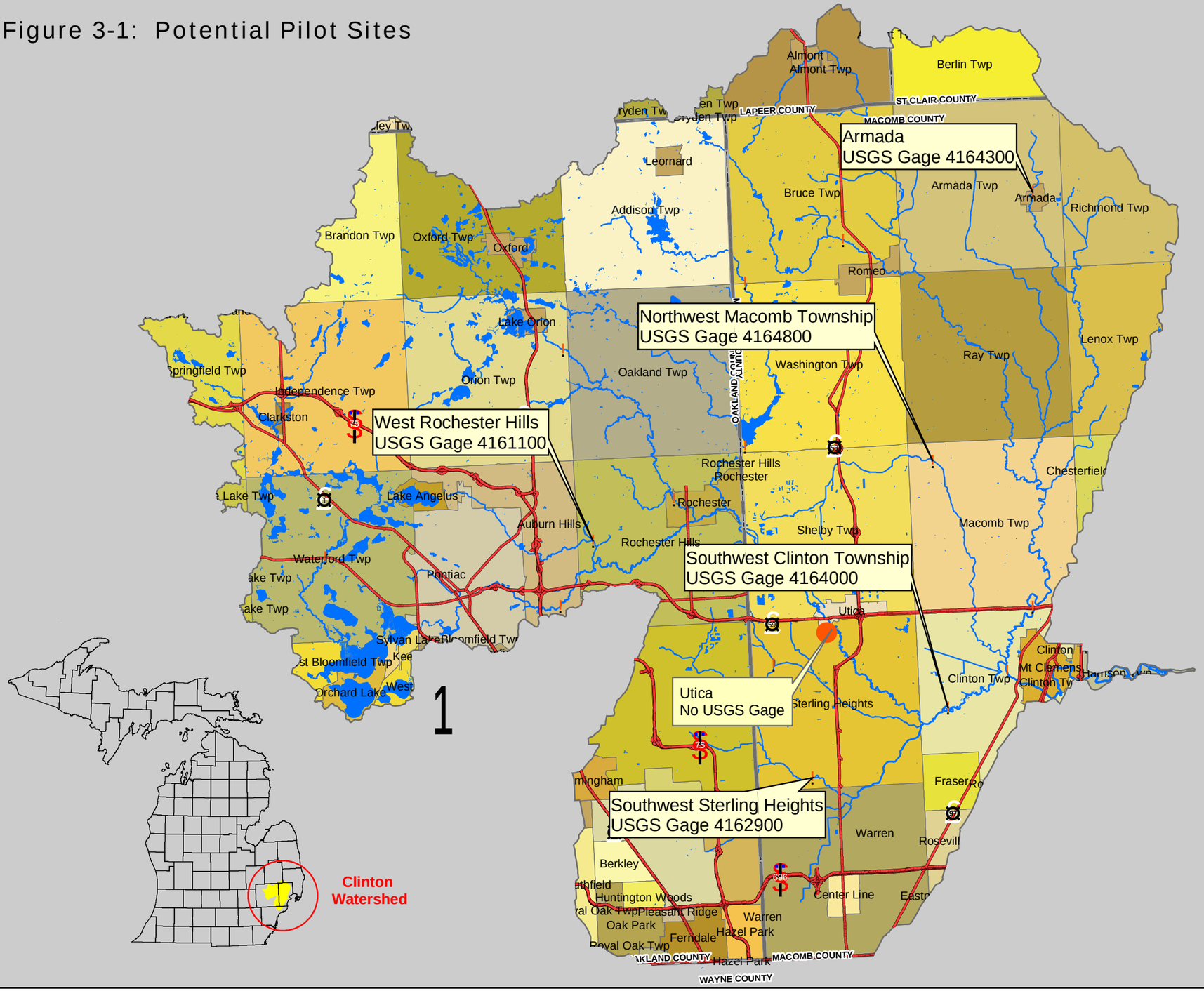
0 2 4 8 Miles

0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.

# Figure 3-1: Potential Pilot Sites




## Legend

- ! USGS Stations
- Major Roads
- Rivers
- Lakes

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for Population Density was obtained from SEMCOG

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

August 2003

0 2 4 8 Miles

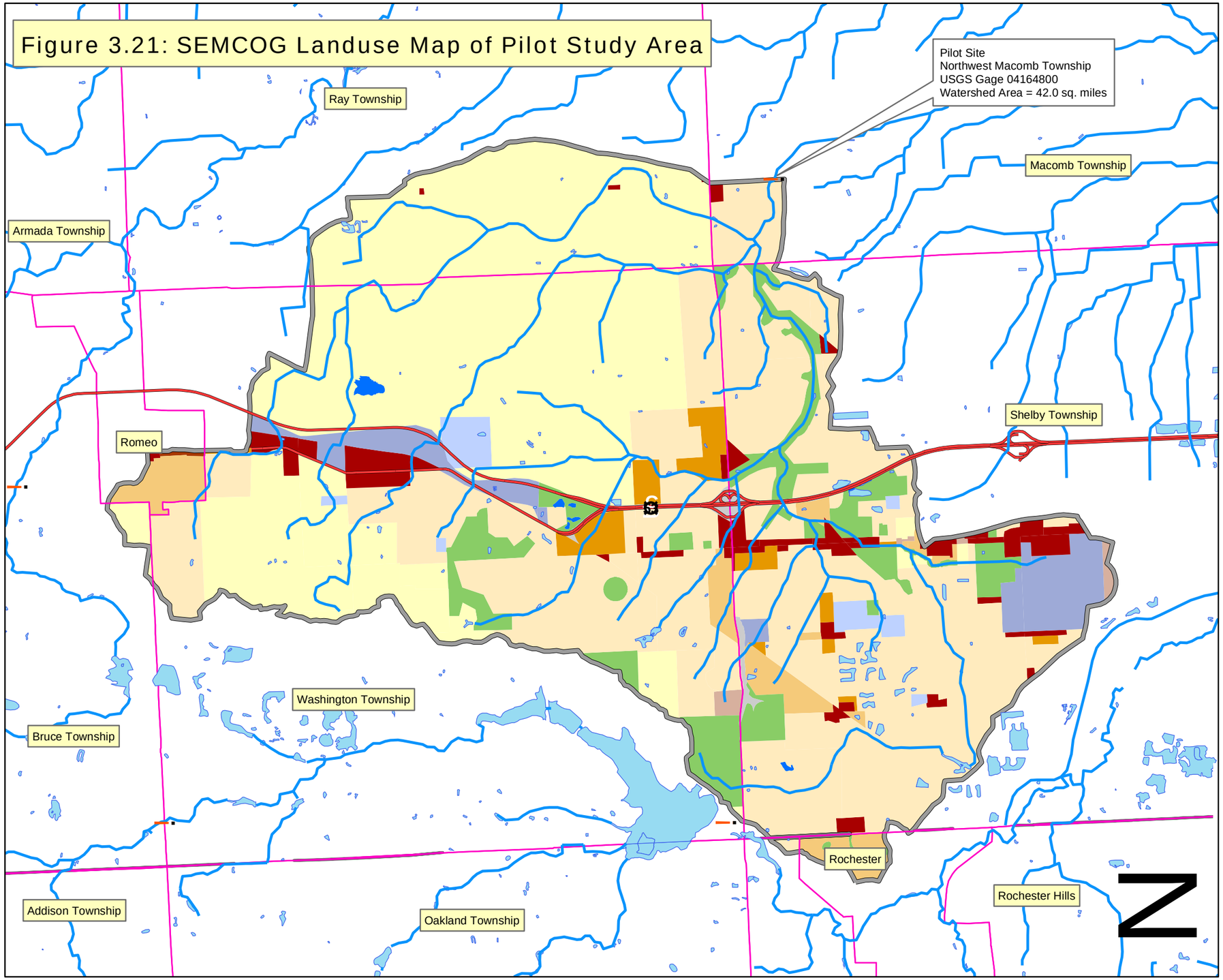
0 3 6 12 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

# Figure 3.21: SEMCOG Landuse Map of Pilot Study Area




## Legend

- USGS Gages
- Rivers
- Major Roads
- Lakes
- Macomb Sub Watershed Boundary
- <all other values>

**NAME**

- Agricultural/Rural Residential
- Commercial
- Commercial/Mixed Use
- High Density Residential
- Industrial
- Institutional/Public/Quasi Public
- Low Density Residential
- Medium Density Residential
- Office
- Open Space/Conservation
- Transportation/Communication/Utility
- Water

Source: Basemap files obtained from the Michigan Geographical Framework Website,

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

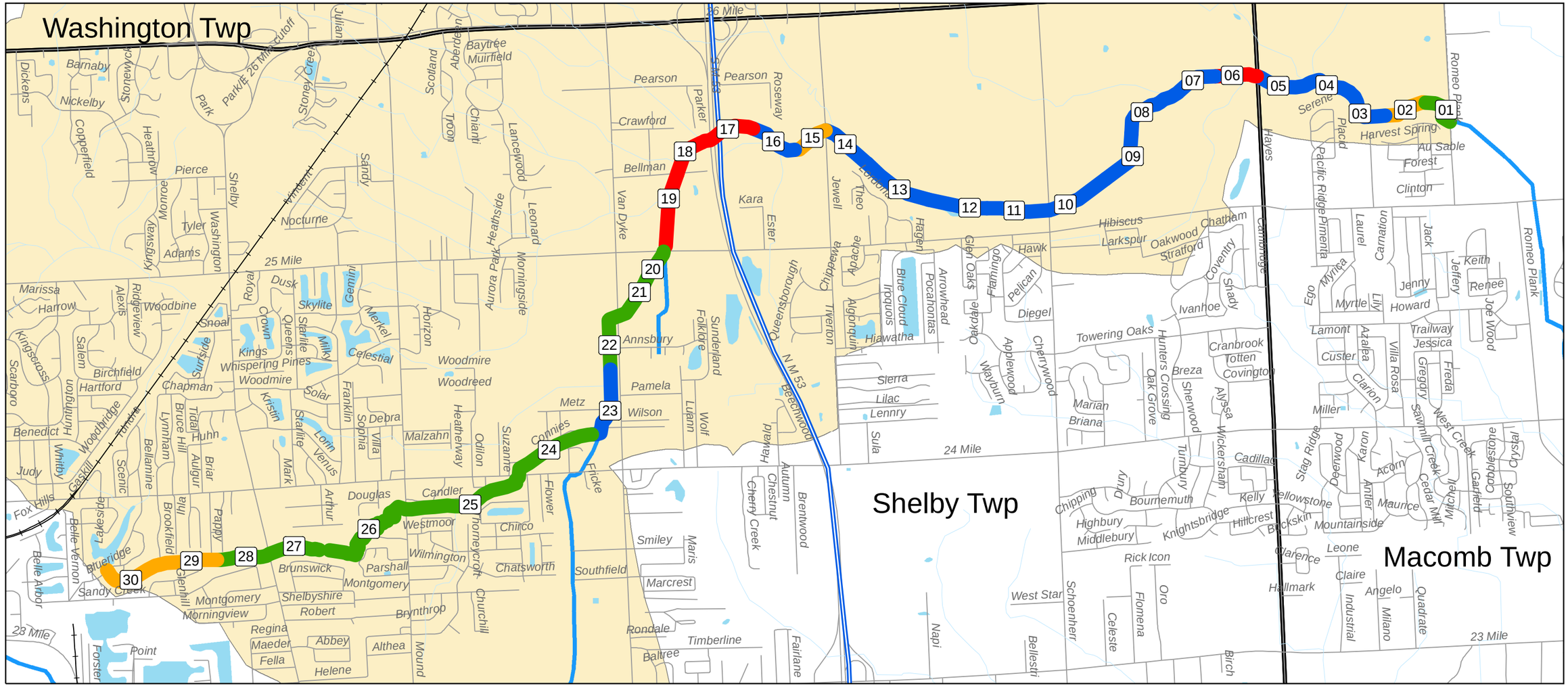
0 0.5 1 2 Miles

0 1 2 4 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*




## Legend

**Rosgen Level I**

- C
- E
- F
- G

- Roads
- Railroads
- Rivers
- Lakes
- Townships

0 0.4 0.8 1.6 Miles

Source: Data Obtained from field data collection.
May - July, 2004

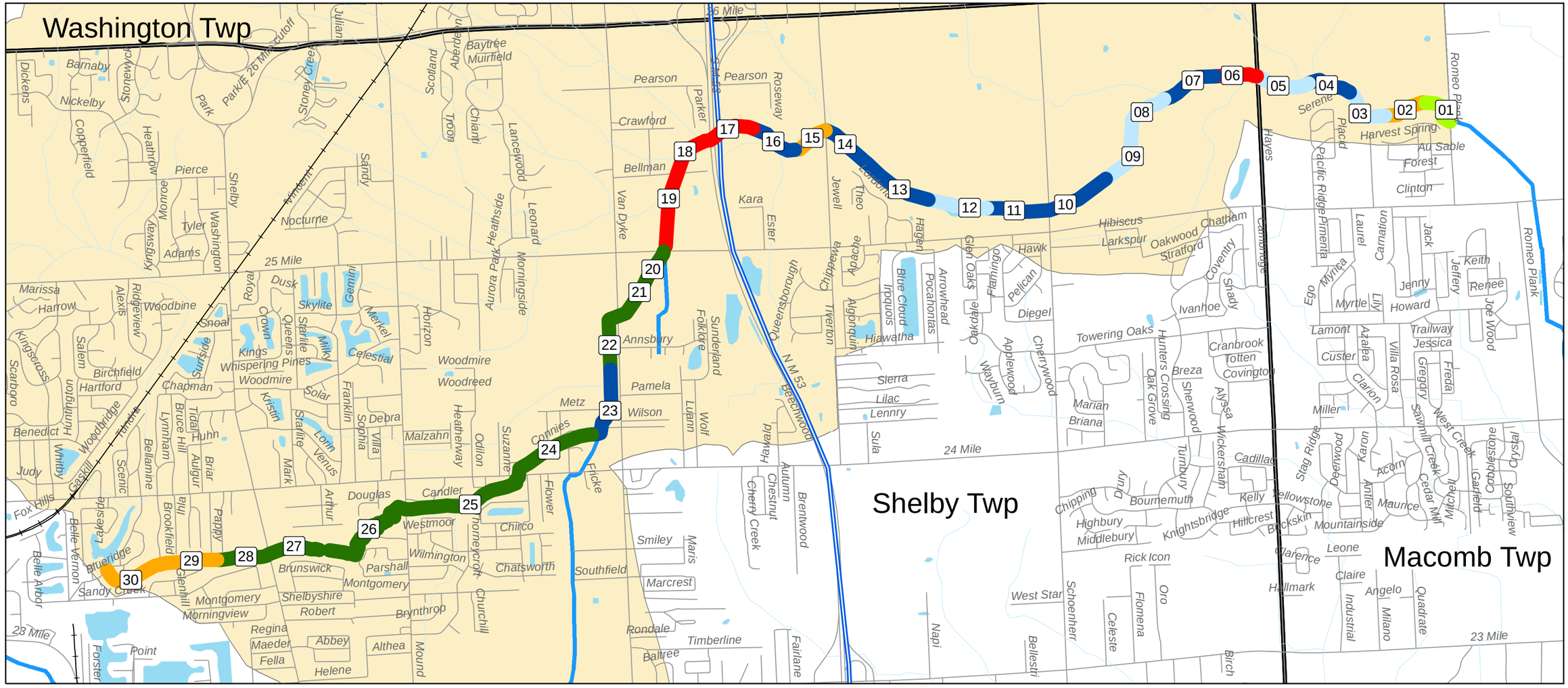
Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

# Figure 4.4
# Middle Branch of Clinton River
# Rosgen Level I Classification

MACOMB COUNTY MICHIGAN

ECT
Environmental Consulting & Technology, Inc.




## Legend

### Rosgen Level II

- C4
- E4
- E5
- F4
- F5
- G5c
- Roads
- Railroads
- Rivers
- Lakes
- Townships

0 0.5 1 2 Miles

Source: Data Obtained from field data collection.
May - July, 2004

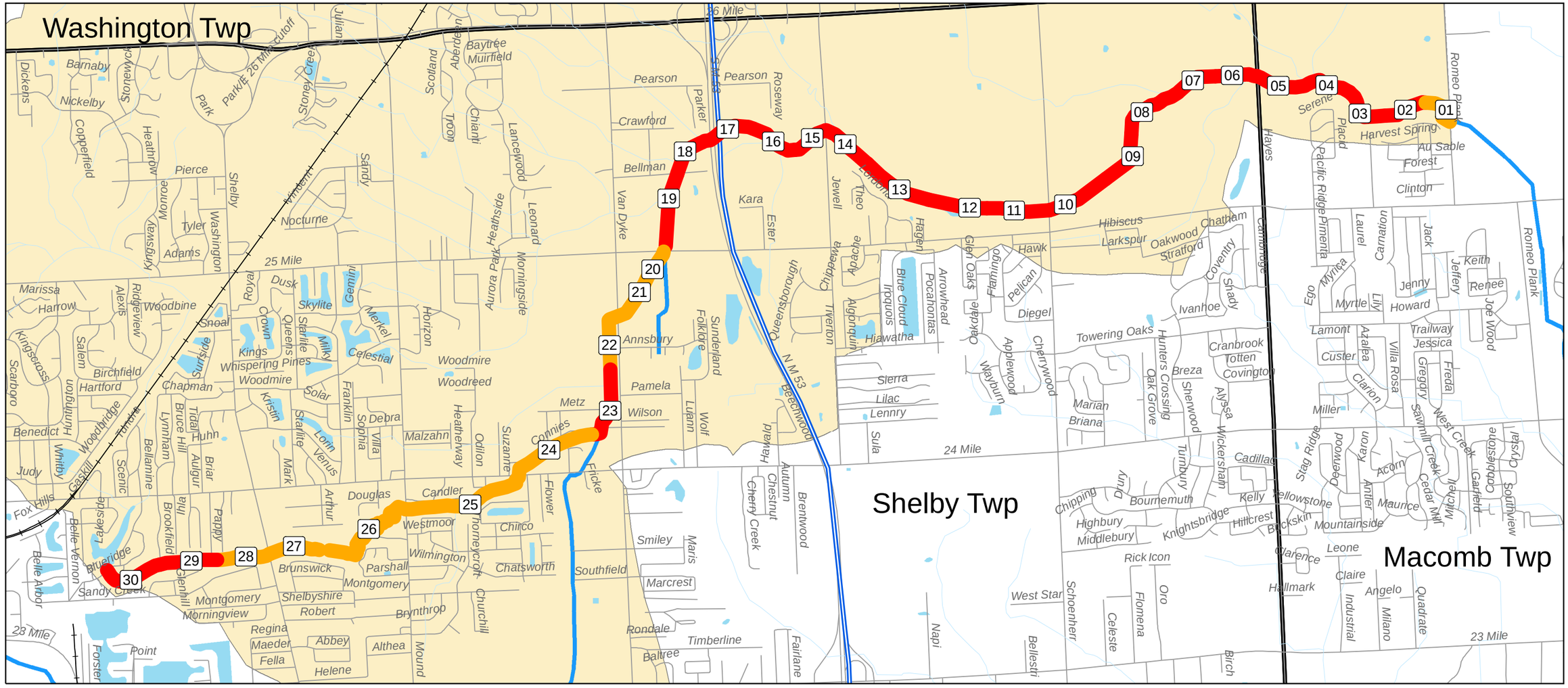
Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

# Figure 4.5
# Middle Branch of Clinton River
# Rosgen Level II Classification

MACOMB COUNTY MICHIGAN 1818

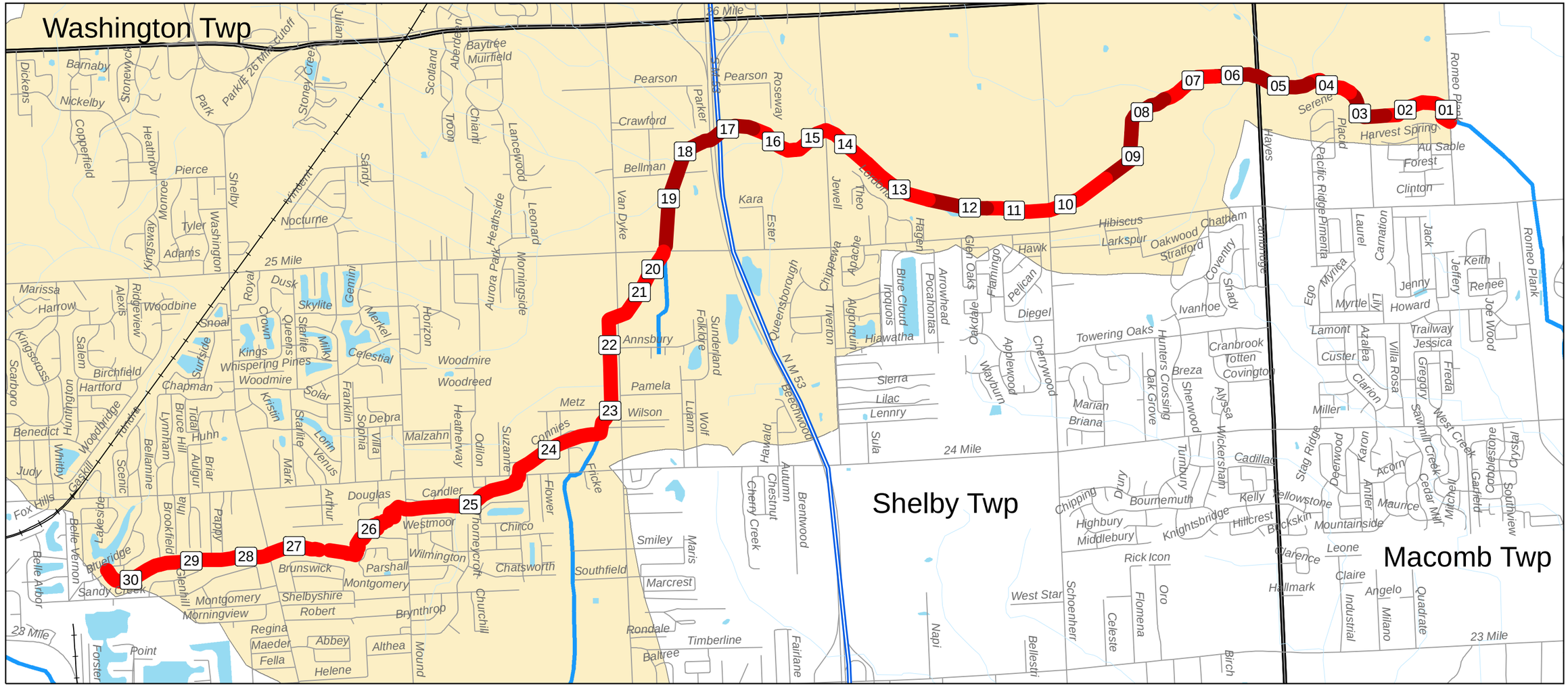
ECT
Environmental Consulting & Technology, Inc.




# Figure 4.6
# Middle Branch of Clinton River
# Streambank Erosion Potential

MACOMB COUNTY 1818 MICHIGAN

ECT
Environmental Consulting & Technology, Inc.




# Legend

## Sensitivity to Disturbance

- Extreme
- Very High
- High
- Moderate
- Low
- Very Low

- Roads
- Railroads
- Rivers
- Townships
- Lakes

μ

Source: Data Obtained from field data collection.
July - November, 2004

Software: ArcGIS 9.0

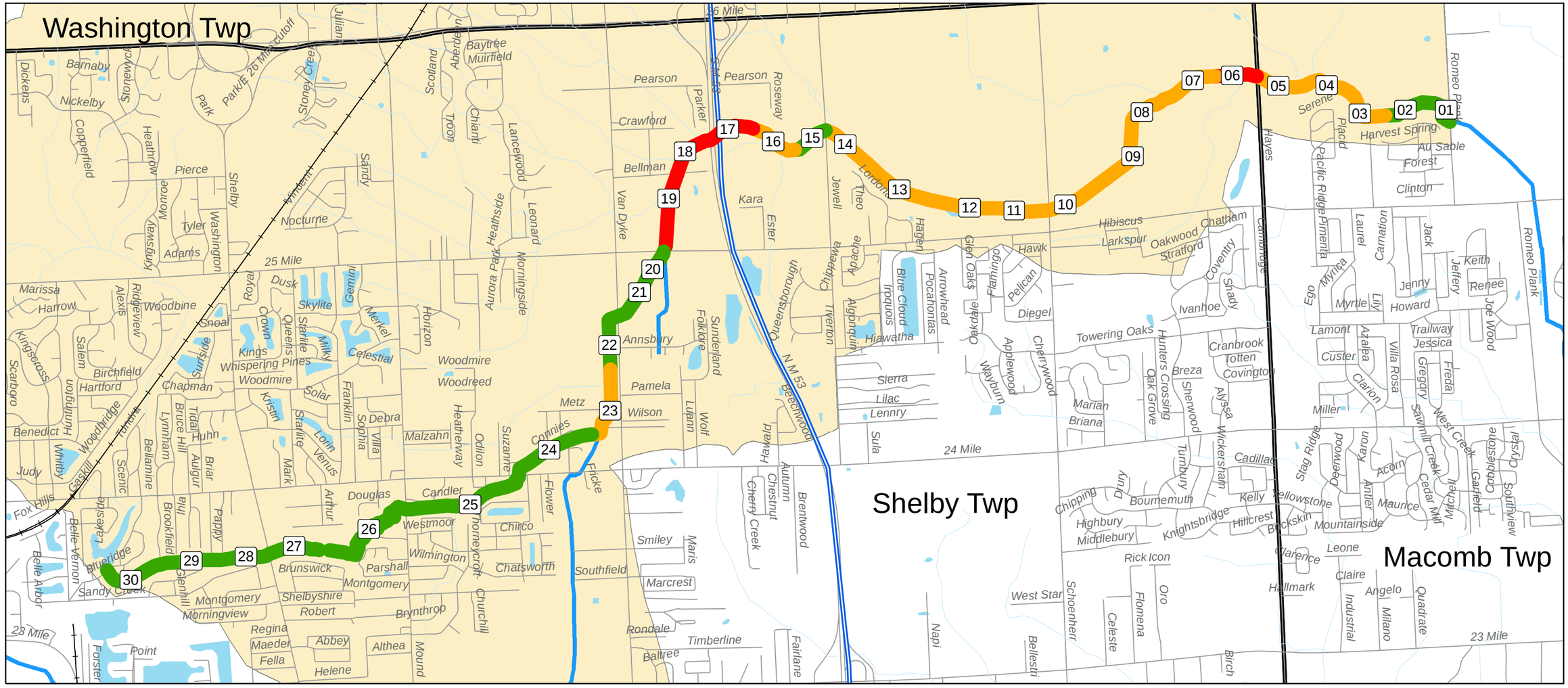
State Plane NAD 83 Michigan South

0 0.5 1 2 Miles

# Figure 4.7
# Middle Branch of Clinton River
# Sensitivity to Disturbance

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.




## Legend

**Natural Recovery Potential**

- Very Poor
- Poor
- Fair
- Good
- Excellent

- Roads
- Railroads
- Rivers
- Townships
- Lakes

0 0.5 1 2 Miles

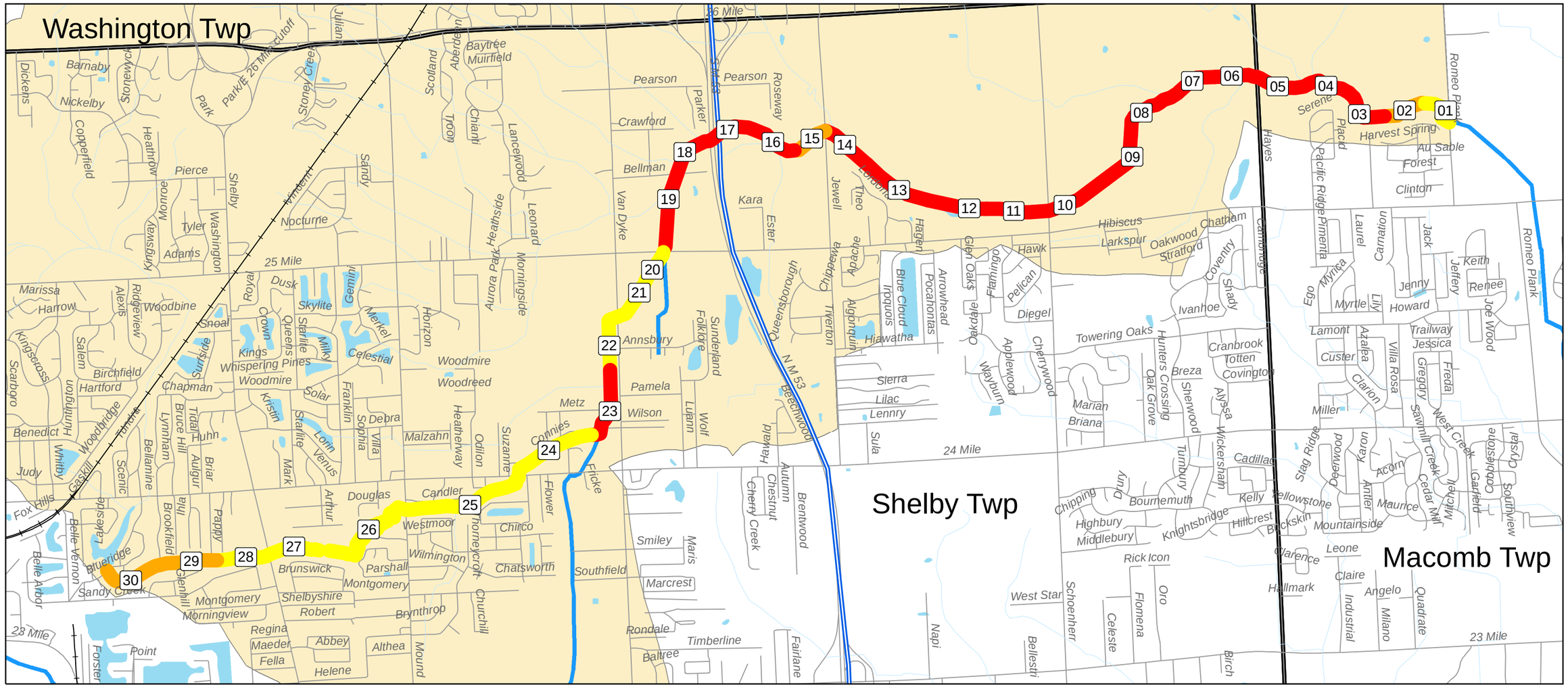
Source: Data Obtained from field data collection.
July - November, 2004

Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

# Figure 4.8
# Middle Branch of Clinton River
# Natural Recovery Potential

Environmental Consulting & Technology, Inc.




## Legend

**Sediment Supply**

- Very High
- High
- Moderate
- Low
- Very Low

- Roads
- Railroads
- Rivers
- Townships
- Lakes

μ

0 0.5 1 2 Miles

Source: Data Obtained from field data collection.
July - November, 2004

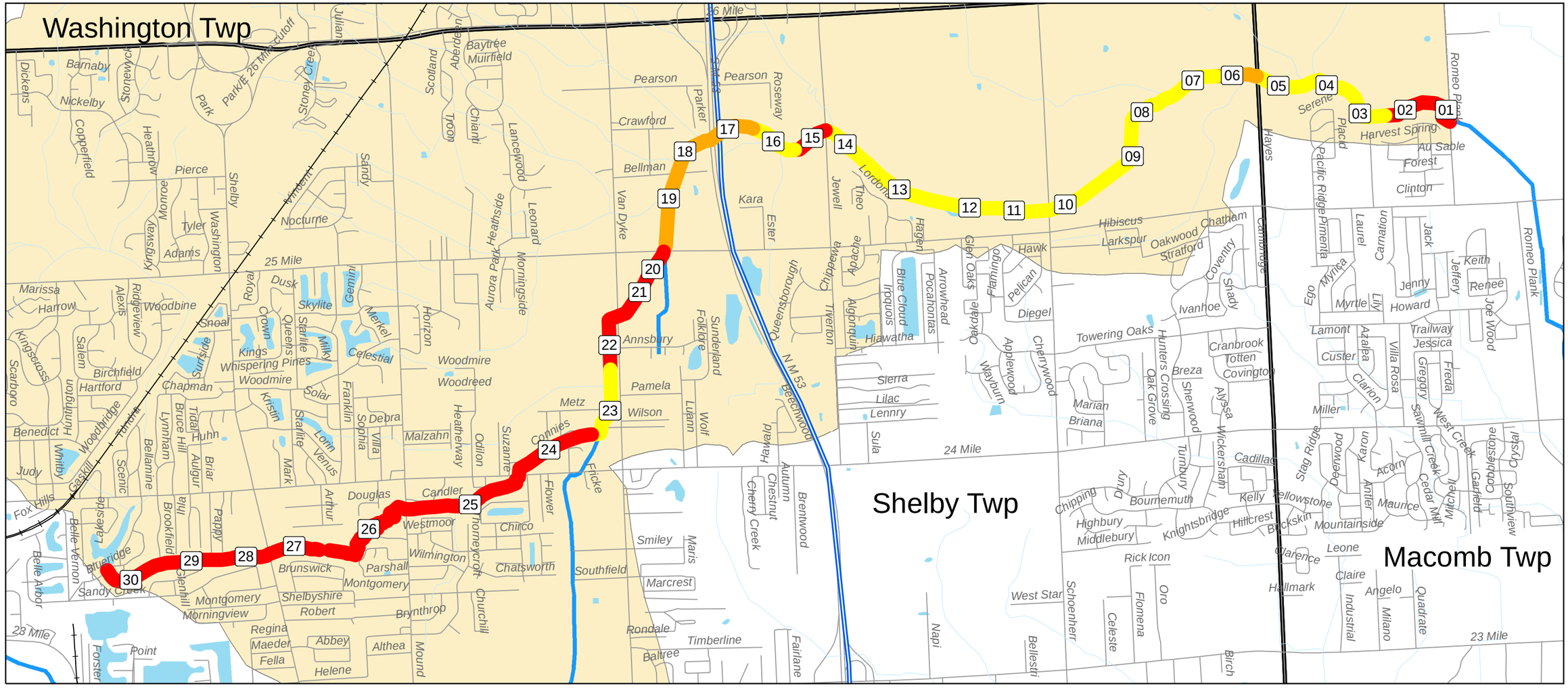
Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

# Figure 4.9
# Middle Branch of Clinton River
# Sediment Supply

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.




## Legend

**Influence of Vegetation on Stability**

- Very High
- High
- Moderate
- Low
- Negligible

- Roads
- Railroads
- Rivers
- Townships
- Lakes

μ

0 0.5 1 2 Miles

Source: Data Obtained from field data collection.
July - November, 2004

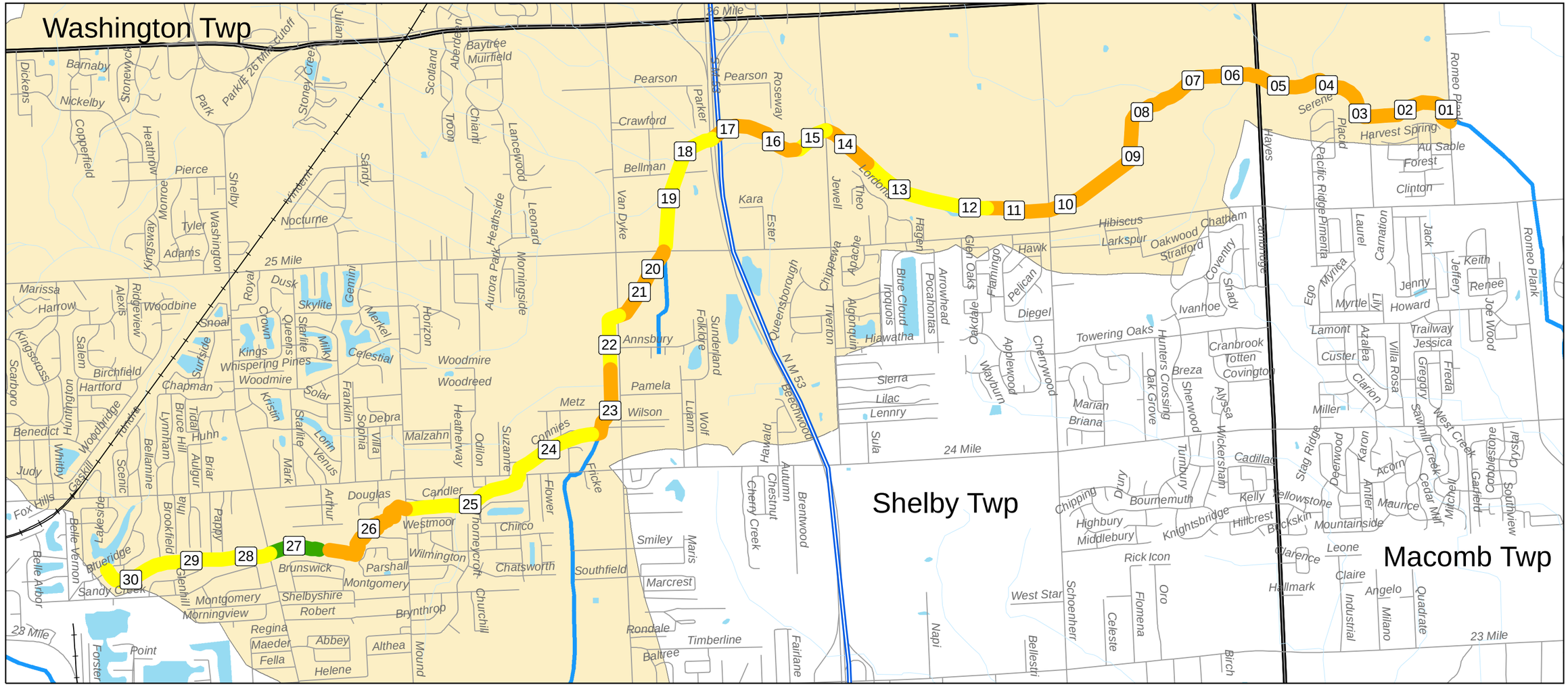
Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

# Figure 4.10
# Middle Branch of Clinton River
# Influence of Vegetation on Stability

MACOMB COUNTY MICHIGAN 1818

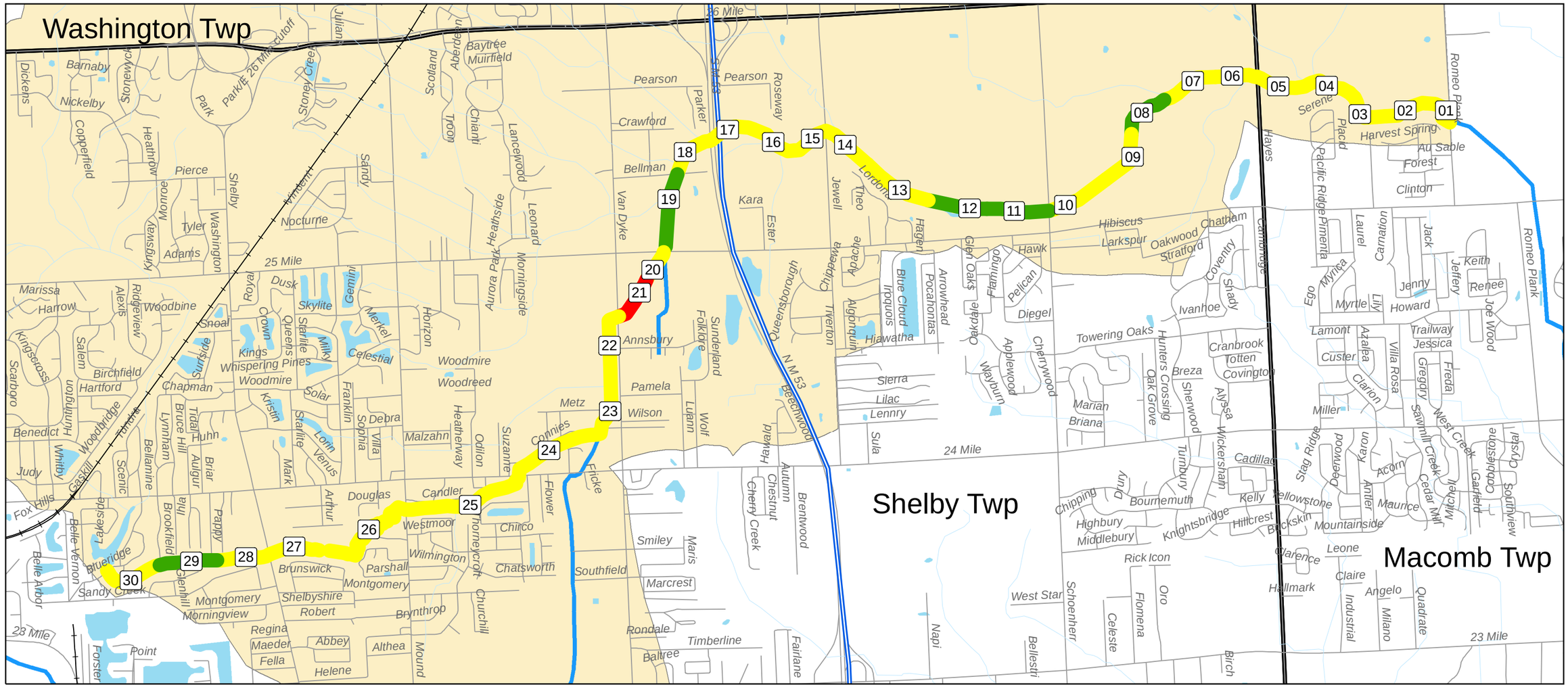
ECT
Environmental Consulting & Technology, Inc.




# Figure 4.11
# Middle Branch of Clinton River Bank Erosion Hazard Index (BEHI)

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.




## Legend

**Pfankuk Ratings**

- Poor
- Fair
- Good
- Excellent

- Roads
- Railroads
- Rivers
- Townships
- Lakes

μ

0 0.5 1 2 Miles

Source: Data Obtained from field data collection.
July - November, 2004

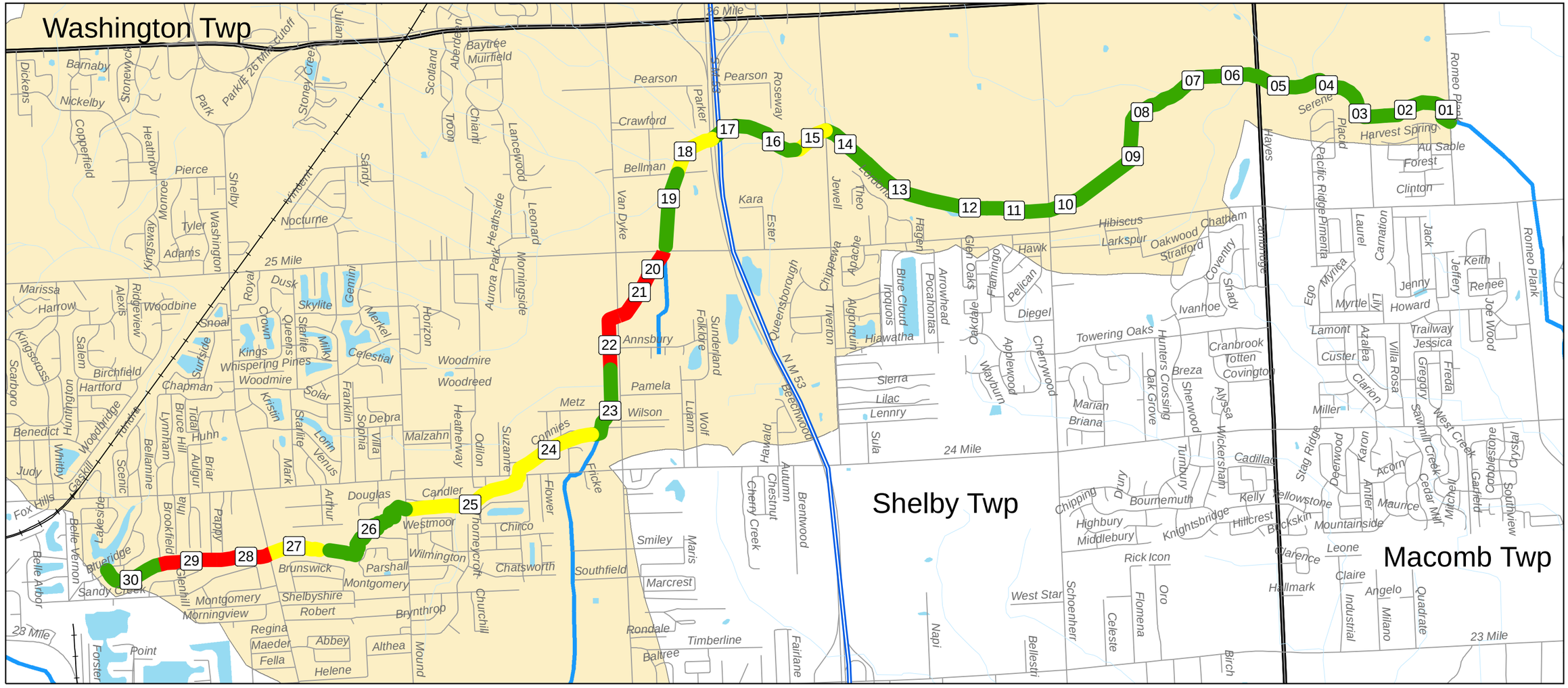
Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

# Figure 4.13
# Middle Branch of Clinton River
# Pfankuk Ratings

MACOMB COUNTY MICHIGAN 1818

ECT
Environmental Consulting & Technology, Inc.




## Legend

**Stability Rating**

- Aggraded
- Degraded
- Neither

- Roads
- Railroads
- Rivers
- Townships
- Lakes

μ

Source: Data Obtained from field data collection.
July - November, 2004

Software: ArcGIS 9.0

State Plane NAD 83 Michigan South

0 0.5 1 2 Miles

# Figure 4.16
# Middle Branch of Clinton River
# Regional Curve Stability Rating

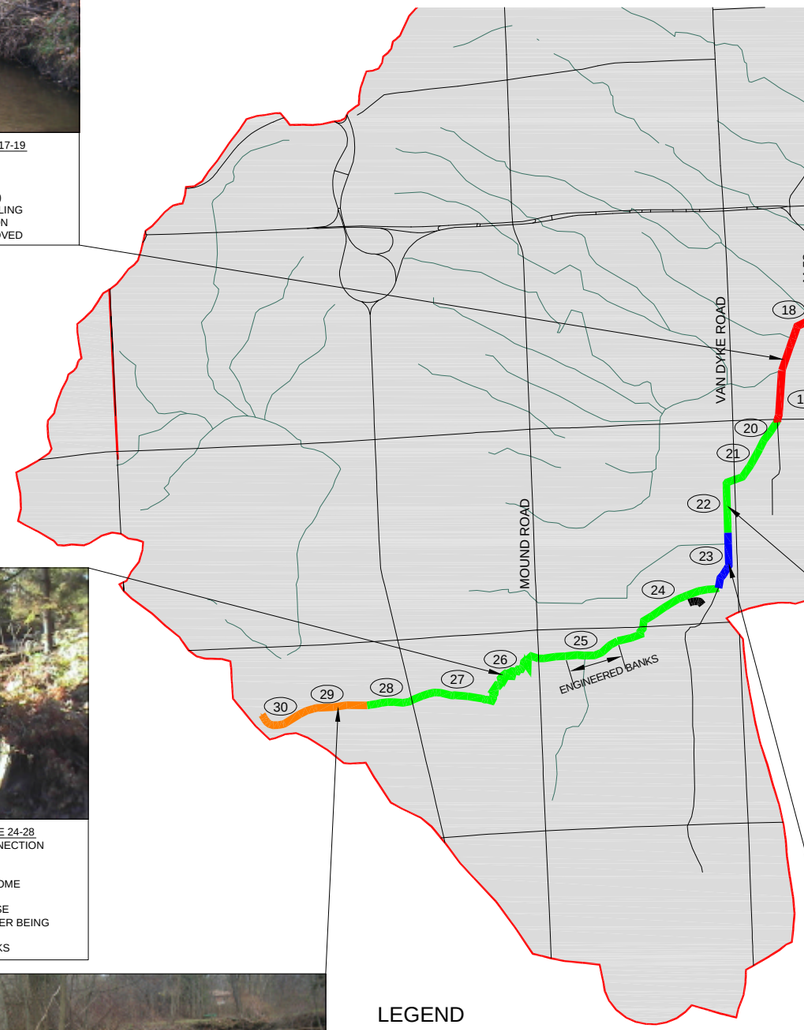
MACOMB COUNTY 1818 MICHIGAN

ECT
Environmental Consulting & Technology, Inc.

MIDDLE BRANCH OF CLINTON RIVER REACHE 17-19
DESCRIPTION: NARROW, DEEP RIVER,
DISCONNECTED FROM FLOODPLAIN
RIVER TYPE: "G"
STABILITY: SLIGHTLY UNSTABLE (DEGRADING)
OTHER NOTES: HEAVY BRUSH IS MOST ENABLING
SOME STABILITY, ALTHOUGH SEVERE EROSION
WOULD BE PREDICTED IF BRUSH WERE REMOVED

MIDDLE BRANCH OF CLINTON RIVER REACHE 24-28
DESCRIPTION: NARROW, DEEP RIVER, CONNECTION
TO FLOODPLAIN VARIES
RIVER TYPE: TYPICALLY "E"
STABILITY: UNSTABLE (DEGRADING WITH SOME
AGGRADING IN SPOTS)
OTHER NOTES: MEANDERS THROUGH DENSE
RESIDENTIAL, WITH MANY SECTIONS OF RIVER BEING
AFFECTED BY AD-HOC EROSION CONTROL
TECHNIQUES AND HARDENING OF THE BANKS

MIDDLE BRANCH OF CLINTON RIVER
REACHE 29-30
DESCRIPTION: MEANDERING RIVER
WITH MEDIUM WIDTH AND DEPTH.
STRONG CONNECTION TO FLOODPLAIN
RIVER TYPE: "C"
STABILITY: STABLE (VERY SLIGHT
DEPOSITION)
OTHER NOTES: HEALTHY RIVER
SYSTEM WITH WELL SPACE RIFFLES &
POOLS WITH A HIGH SINUOSITY AND
WELL CONNECTED TO THE
FLOODPLAIN




LEGEND

"C" STREAM TYPE

"E" STREAM TYPE

"F" STREAM TYPE

"G" STREAM TYPE

MIDDLE BRANCH OF CLINTON RIVER REACHES 1-15
DESCRIPTION: WIDE, SHALLOW RIVER,
DISCONNECTED FROM FLOODPLAIN
RIVER TYPE: TYPICALLY "F"
STABILITY: FAIRLY STABLE, ALTHOUGH AGGRADATION
OF UPSTREAM EROSION IS EVIDENT
OTHER NOTES: NUMEROUS LOG JAMS FROM
UPSTREAM FALLEN TREES THROUGHOUT THIS
SHALLOW SECTION OF RIVER

MIDDLE BRANCH OF CLINTON RIVER REACHE 15-16
DESCRIPTION: WIDE, SHALLOW RIVER,
DISCONNECTED FROM FLOODPLAIN
RIVER TYPE: "F" AND "C"
STABILITY: VERY UNSTABLE (DEGRADING)
OTHER NOTES: SIGNIFICANT EROSION AND FALLEN
TREES IS PRESENT IN THIS SECTION OF THE RIVER

MIDDLE BRANCH OF CLINTON RIVER REACH 23
DESCRIPTION: MEDIUM WIDTH AND DEPTH,
SOMEWHAT CONNECTED TO FLOODPLAIN
RIVER TYPE: "F", BUT ALSO RESEMBLES "E" TRAITS
STABILITY: STABLE

MIDDLE BRANCH OF CLINTON RIVER REACHE 20-22
DESCRIPTION: WIDE, SHALLOW RIVER, CONNECTED
TO FLOODPLAIN
RIVER TYPE: "E", BUT UNCHARACTERISTICALLY WIDE
STABILITY: SLIGHTLY UNSTABLE (AGGRADATION)
OTHER NOTES: SMALL CROSS SECTIONAL AREA
COMPARED TO THE REST OF THE RIVER, GIVEN THE
SIZE OF THE DRAINAGE AREA

MIDDLE BRANCH OF CLINTON RIVER SUMMARY

THE GEOMORPHOLOGY PILOT STUDY CONSISTED OF THE MIDDLE BRANCH OF THE CLINTON RIVER WITH AN UPSTREAM BOUNDARY OF CHESTNUT LAKE AND A DOWNSTREAM BOUNDARY OF ROMEO PLANK ROAD. THIS MAIN CHANNEL IS APPROXIMATELY 8 MILES IN LENGTH AND HAS BEEN DIVIDED INTO THIRTY REACHES. THE RIVER MEANDERS THROUGH LANDTYPES THAT ARE PRIMARILY RESIDENTIAL WITH VARYING DEGREES OF DENSITY. THE RIVER IN PORTIONS IS CONNECTED TO A FLOODPLAIN, HOWEVER, MUCH OF THE RIVER IS ALSO INCISED AND DISCONNECTED TO A FLOODPLAIN. THIS RIVER EVENTUALLY OUTLETS TO THE MAIN BRANCH OF THE CLINTON RIVER, WHICH IN TURN OUTLETS TO LAKE ST. CLAIR IN HARRISON TOWNSHIP, MACOMB COUNTY, MICHIGAN.

DOWNSTREAM REACHES 1-16: THE DOWNSTREAM REACHES OF THE PILOT STUDY AREA CONSIST OF A WIDE, SHALLOW STREAMTYPE THAT IS PRIMARILY DISCONNECTED FROM THE FLOODPLAIN. THIS RIVER TYPE IS CLASSIFIED AS AN "F" STREAM IN THE ROSGEN CLASSIFICATION SYSTEM. ALTHOUGH THIS PORTION OF THE RIVER IS FAIRLY STABLE, THERE IS AGGRADATION OF SEDIMENT AS WELL AS NUMEROUS LOG JAMS AND PORTIONS OF SPOTTY (BUT SEVERE) EROSION.

MIDDLE REACHES 17-19: THE MIDDLE REACHES OF THE PILOT STUDY AREA CONSIST OF A NARROW AND DEEP RIVER TYPE THAT IS DISCONNECTED FROM AN ESTABLISHED FLOODPLAIN (ROSGEN "G" STREAM TYPE). THE CROSS SECTIONAL AREA OF THE RIVER IS LARGER THAN THE REGIONAL CURVE WOULD PREDICT AND ALTHOUGH THERE IS NOT SEVERE EROSION, THIS IS PRIMARILY DUE TO THE DENSE VEGETATION THROUGHOUT THIS SECTION OF RIVER.

UPSTREAM REACHES 20-30: THE UPSTREAM REACHES CONSIST OF A MEANDERING DEEP RIVER OF MEDIUM WIDTH THAT IS PRIMARY CONNECTED TO A FLOODPLAIN. THIS RIVER TYPE IS AN "E" STREAM IN ROSGEN'S CLASSIFICATION, HOWEVER, THESE REACHES HAVE WIDER CROSS SECTIONS THAN A TYPICAL "E" STREAM. ALTHOUGH "E" STREAMS ARE NATURALLY FORMED AND EXPECTED INTHE MIDDLE CLINTON'S VALLEY TYPE, THERE IS ALTERNATING EROSION AND DEPOSITION SECTIONS THROUGHOUT THESE STREAM REACHES, WHICH IS A SIGN OF INSTABILITY.

**FIGURE 5.8**
**PILOT STUDY AREA MORPHOLOGICAL CHARACTERISTICS**

GRAPHIC SCALE
0 1000 2000 4000
SCALE IN FEET

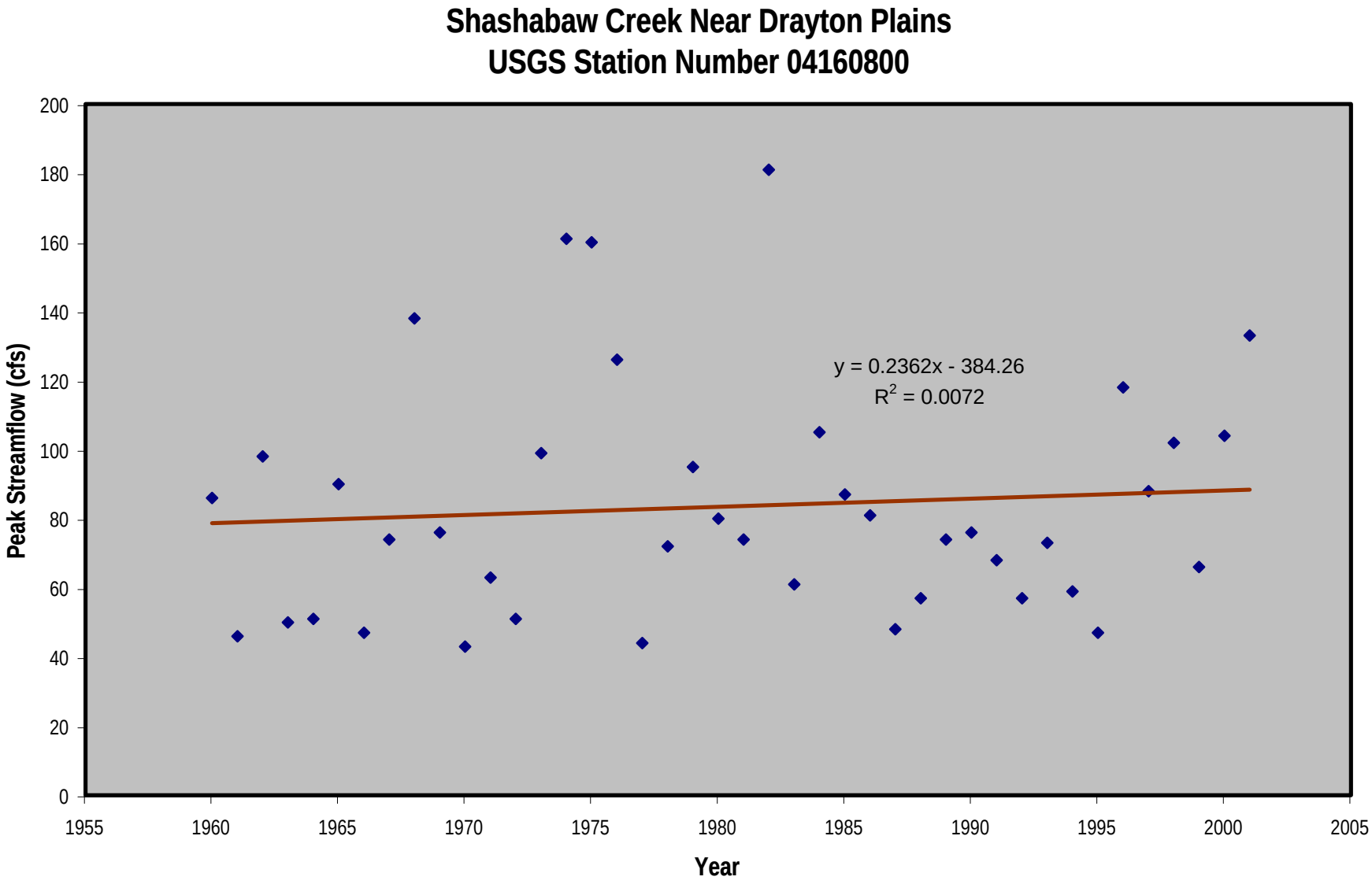
**Source: ECT, 2005**

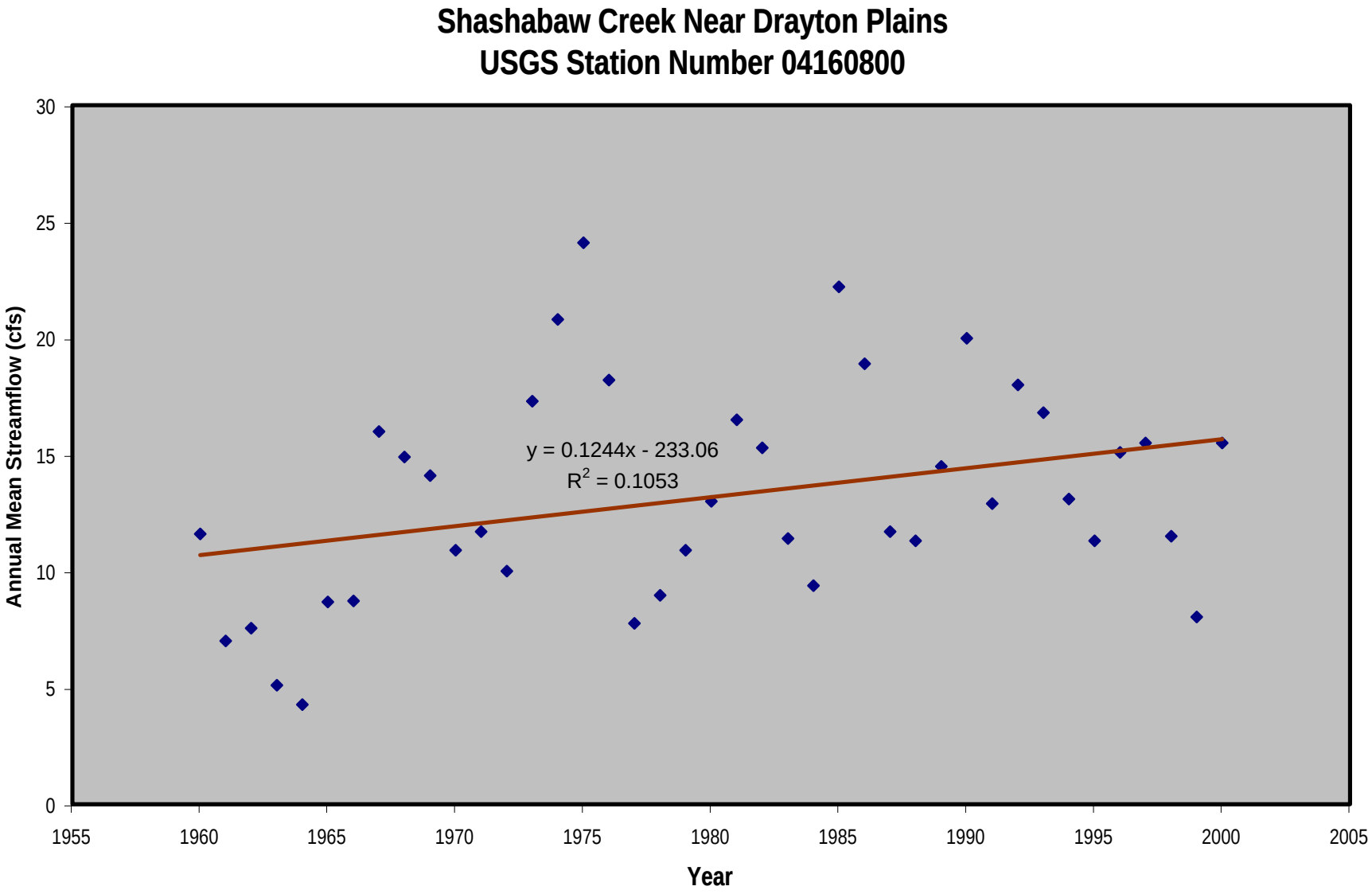
**MACOMB COUNTY PUBLIC WORKS**
**115 S. GROESBECK HIGHWAY**
**MOUNT CLEMENS, MICHIGAN 48043**

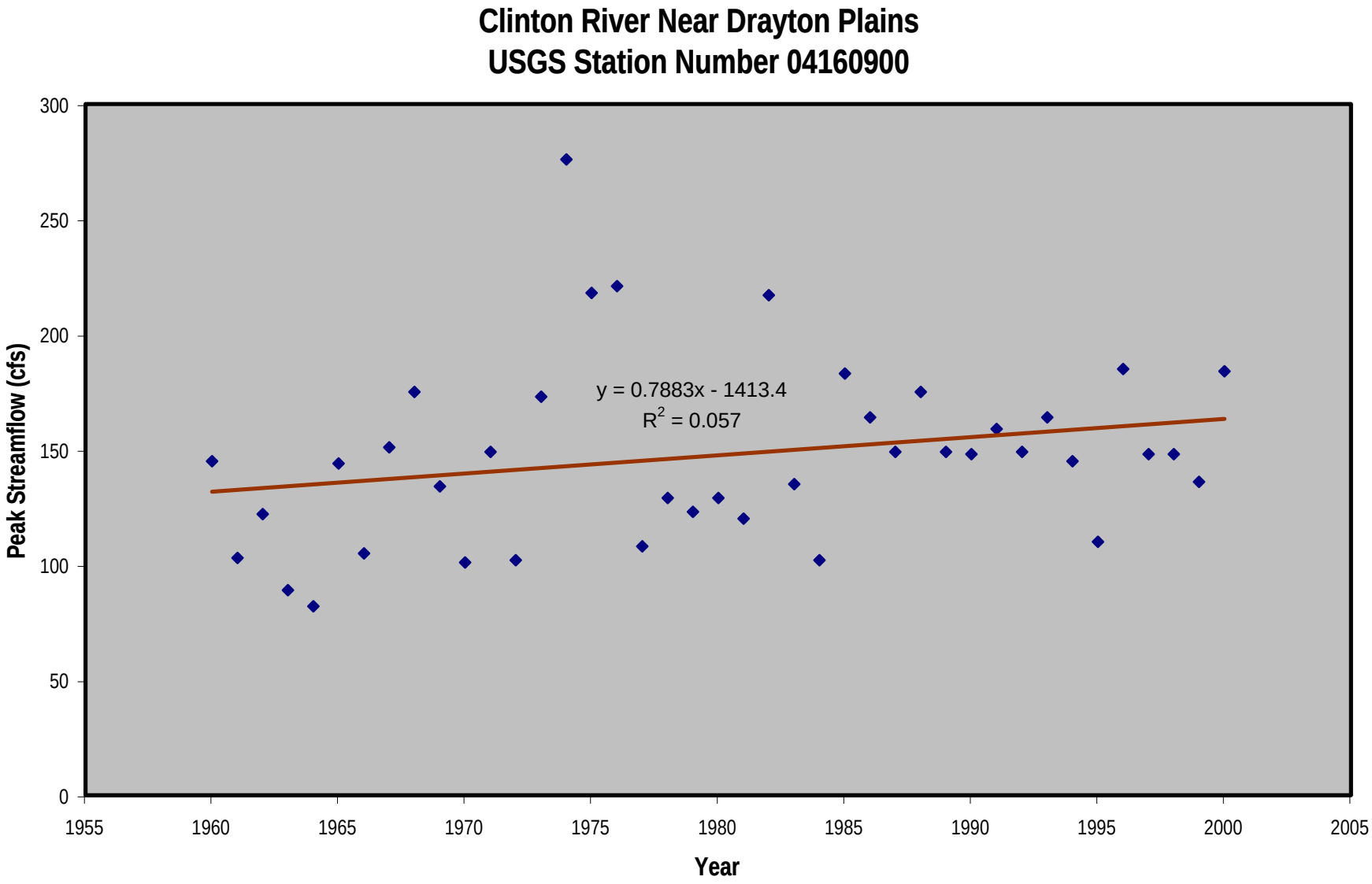

**ECT**
**Environmental Consulting & Technology, Inc.**
**The Dime Building**
**719 Griswold Street, Suite 520**
**Detroit, Michigan 48226**
**Phone: (313) 963-6600 Fax: (313) 963-1707**

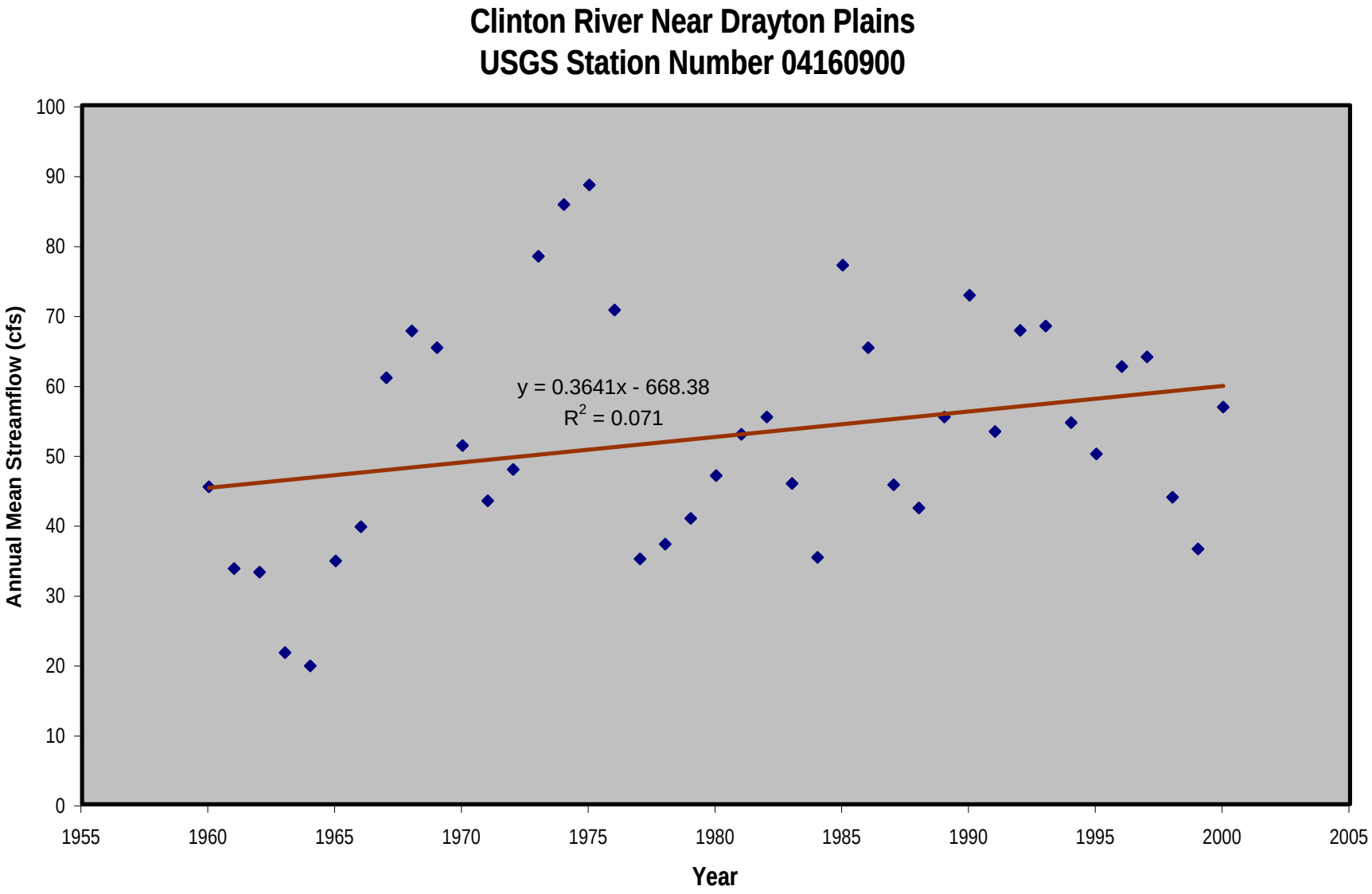
# APPENDIX B

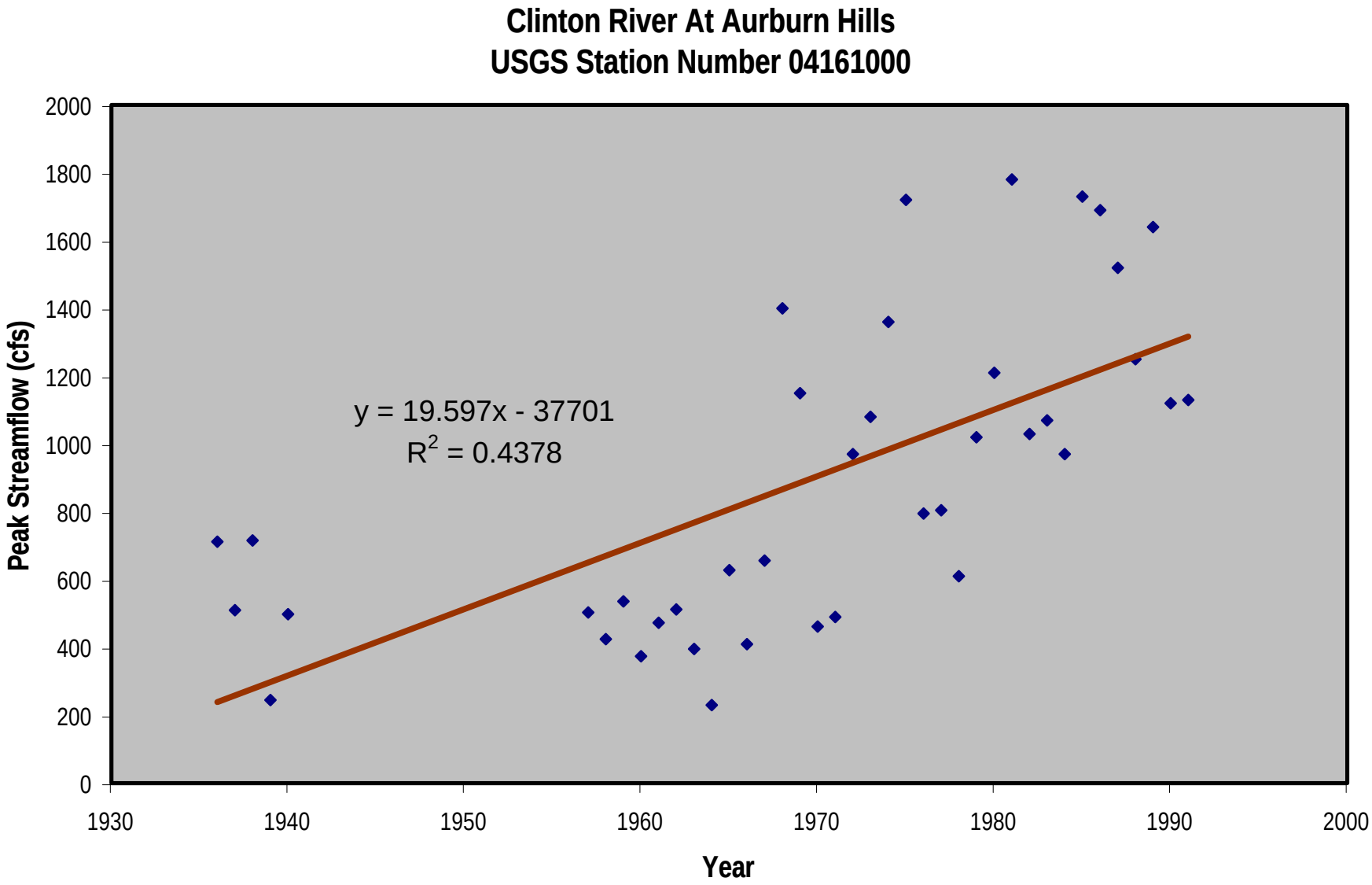
# Hydrologic Analysis of USGS Gages within the Clinton River Watershed

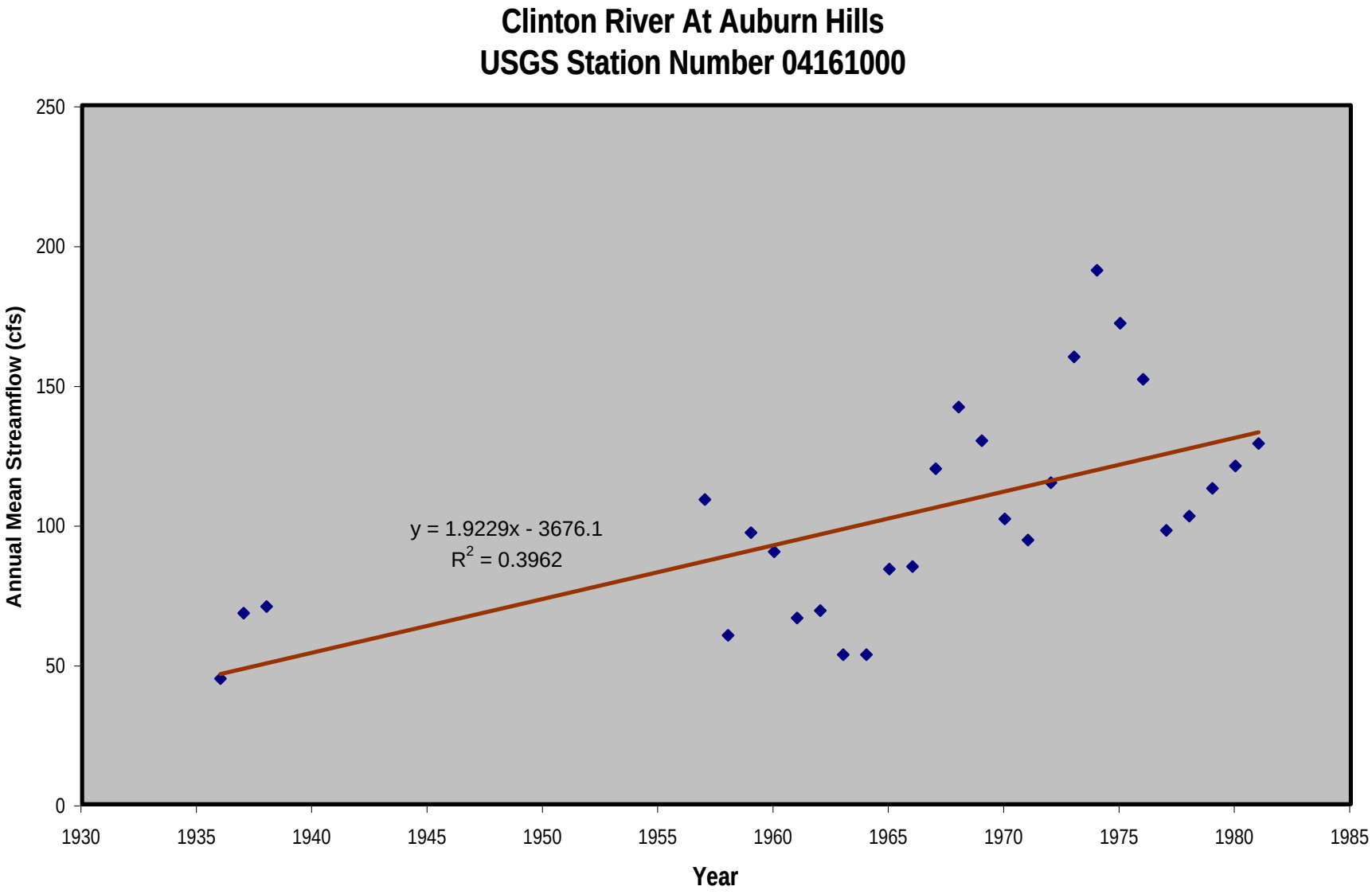

Shashabaw Creek Near Drayton Plains
USGS Station Number 04160800
Peak Streamflow (cfs)
Year
y = 0.2362x - 384.26
R2 = 0.0072
0
20
40
60
80
100
120
140
160
180
200
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

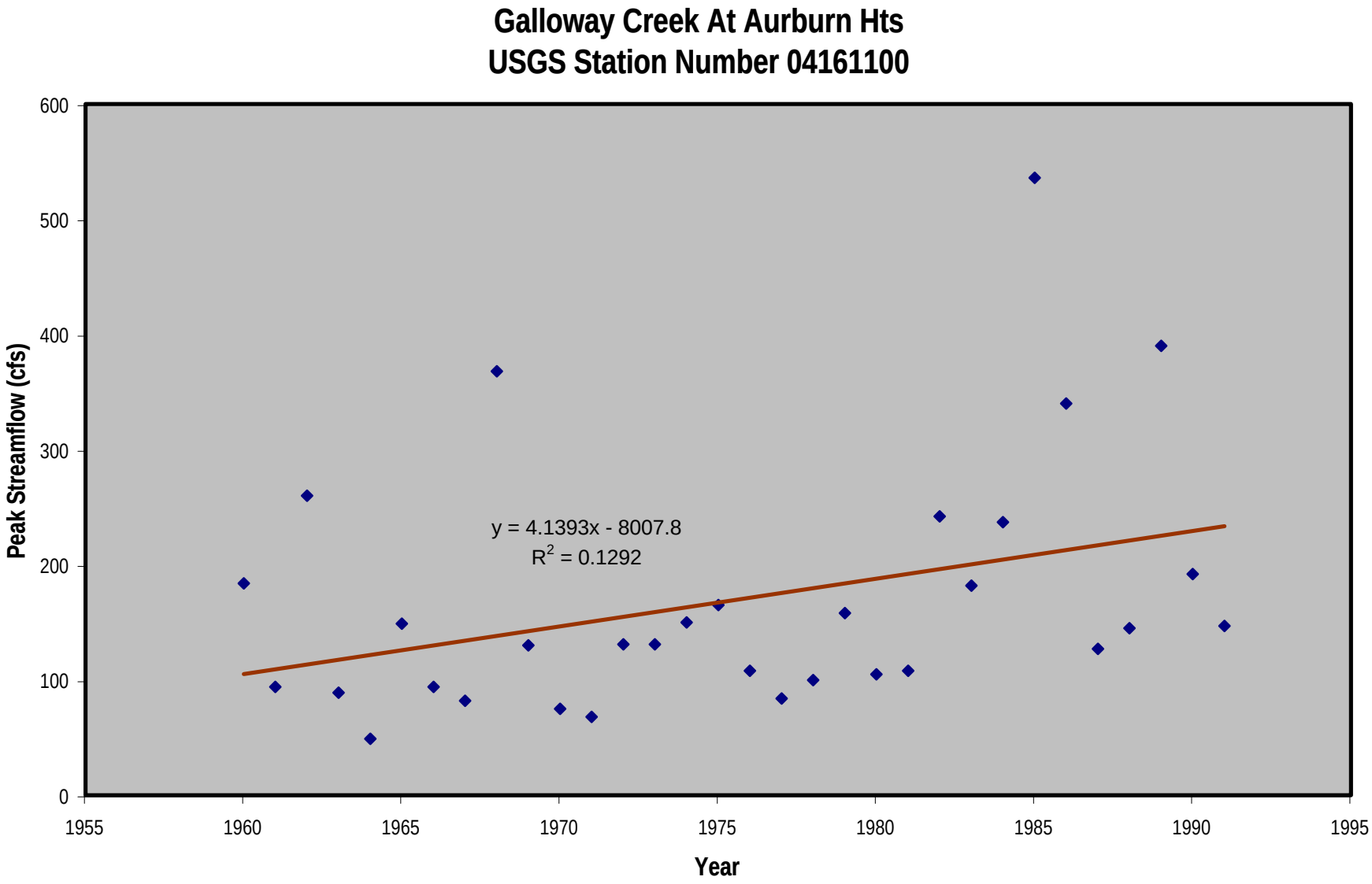

Shashabaw Creek Near Drayton Plains
USGS Station Number 04160800
Annual Mean Streamflow (cfs)
Year
y = 0.1244x - 233.06
R2 = 0.1053
0
5
10
15
20
25
30
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

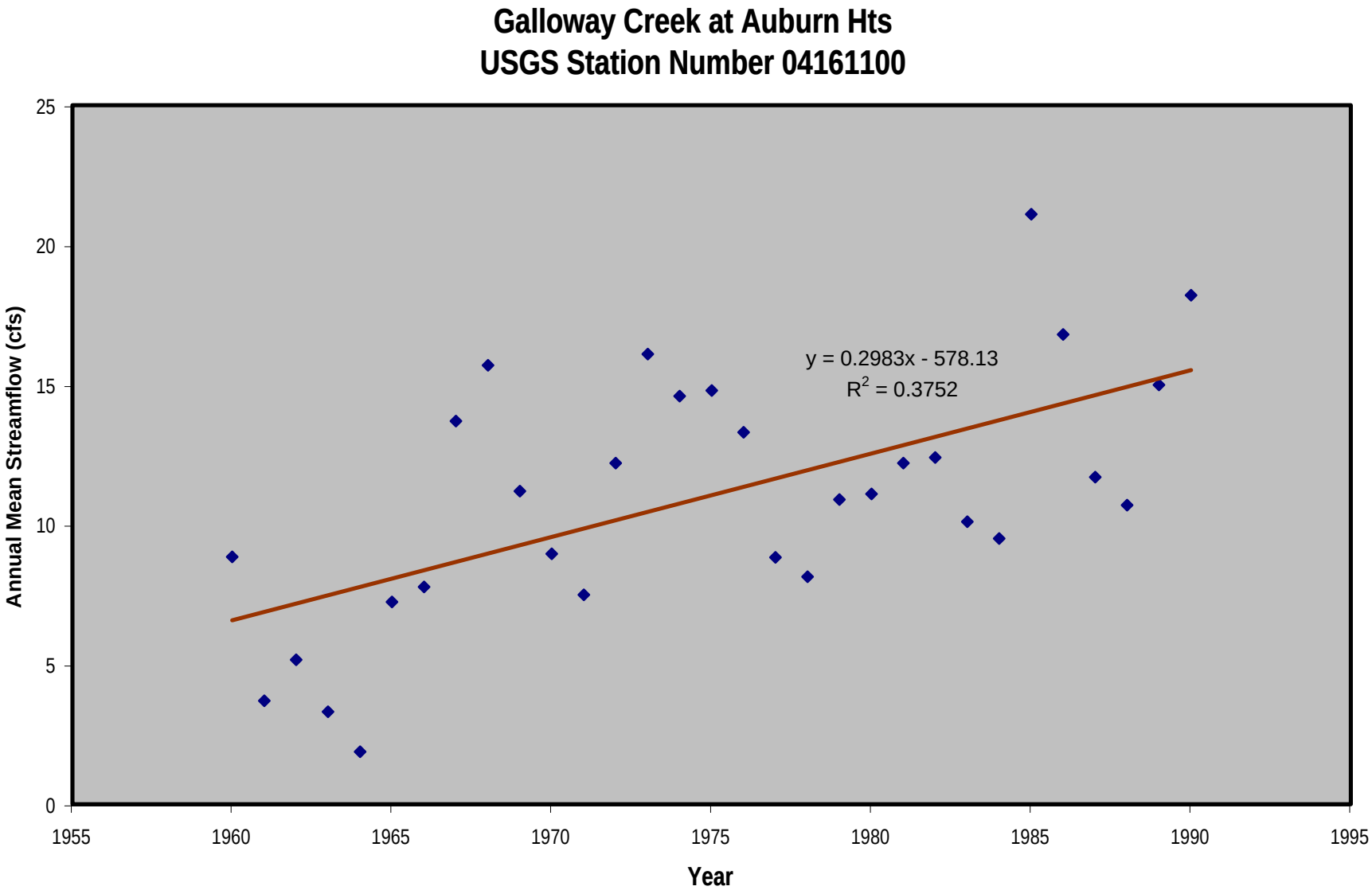

Clinton River Near Drayton Plains
USGS Station Number 04160900
Peak Streamflow (cfs)
300
250
200
150
100
50
0
y = 0.7883x - 1413.4
R2 = 0.057
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

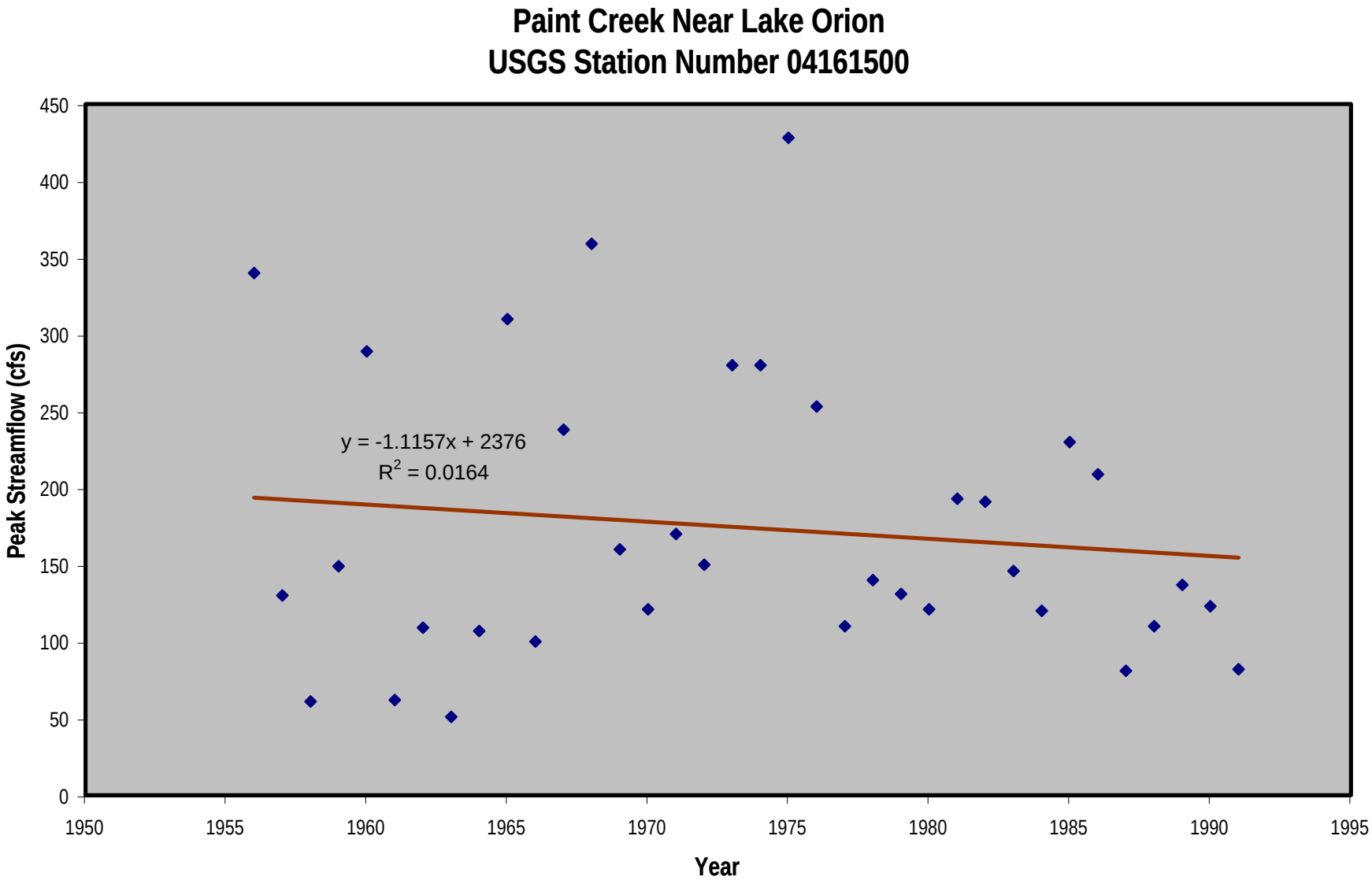

Clinton River Near Drayton Plains
USGS Station Number 04160900
Annual Mean Streamflow (cfs)
Year
y = 0.3641x - 668.38
R2 = 0.071
0
10
20
30
40
50
60
70
80
90
100
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

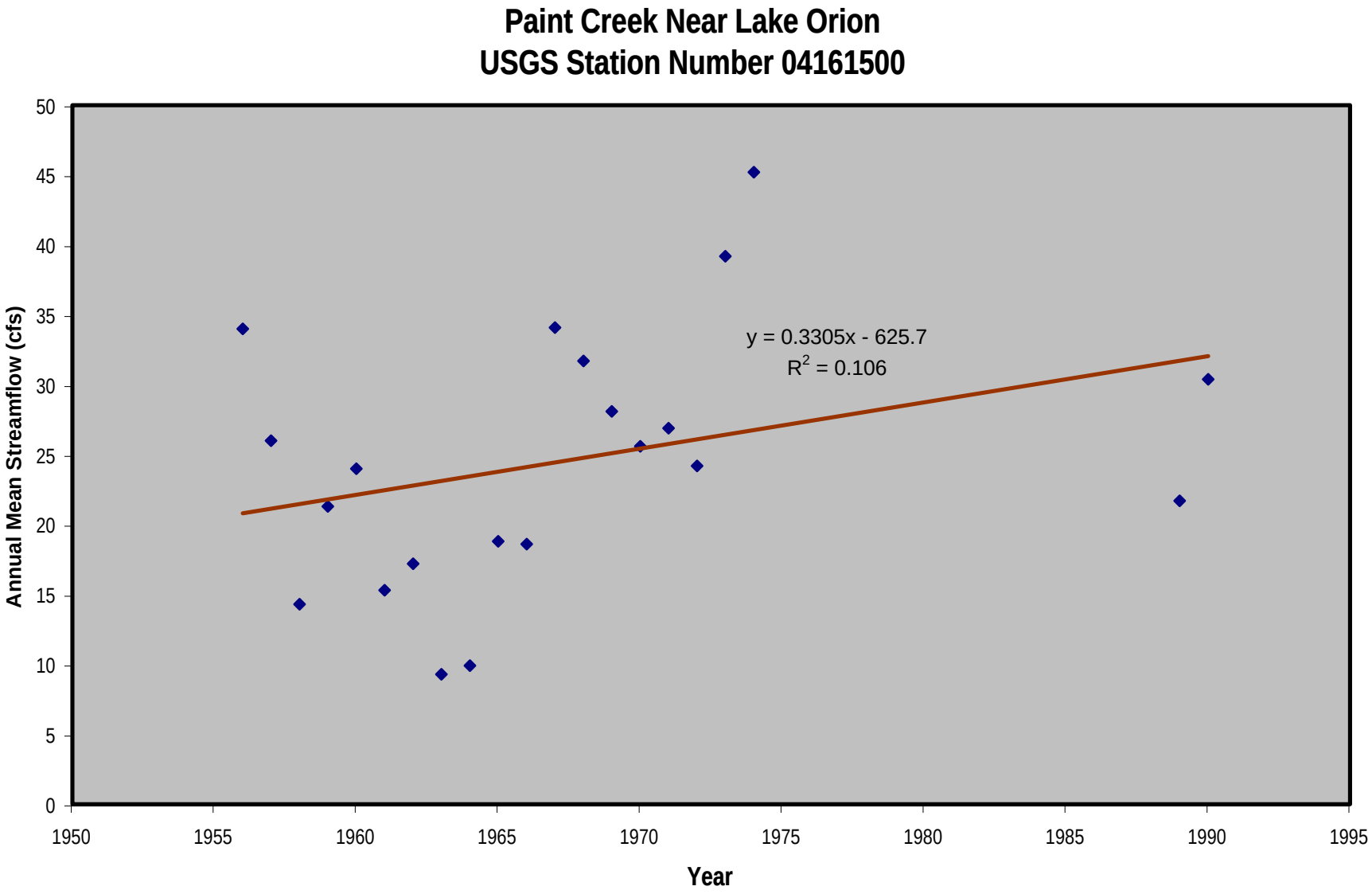

Clinton River At Aurburn Hills
USGS Station Number 04161000
Peak Streamflow (cfs)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
y = 19.597x - 37701
R2 = 0.4378
1930
1940
1950
1960
1970
1980
1990
2000
Year

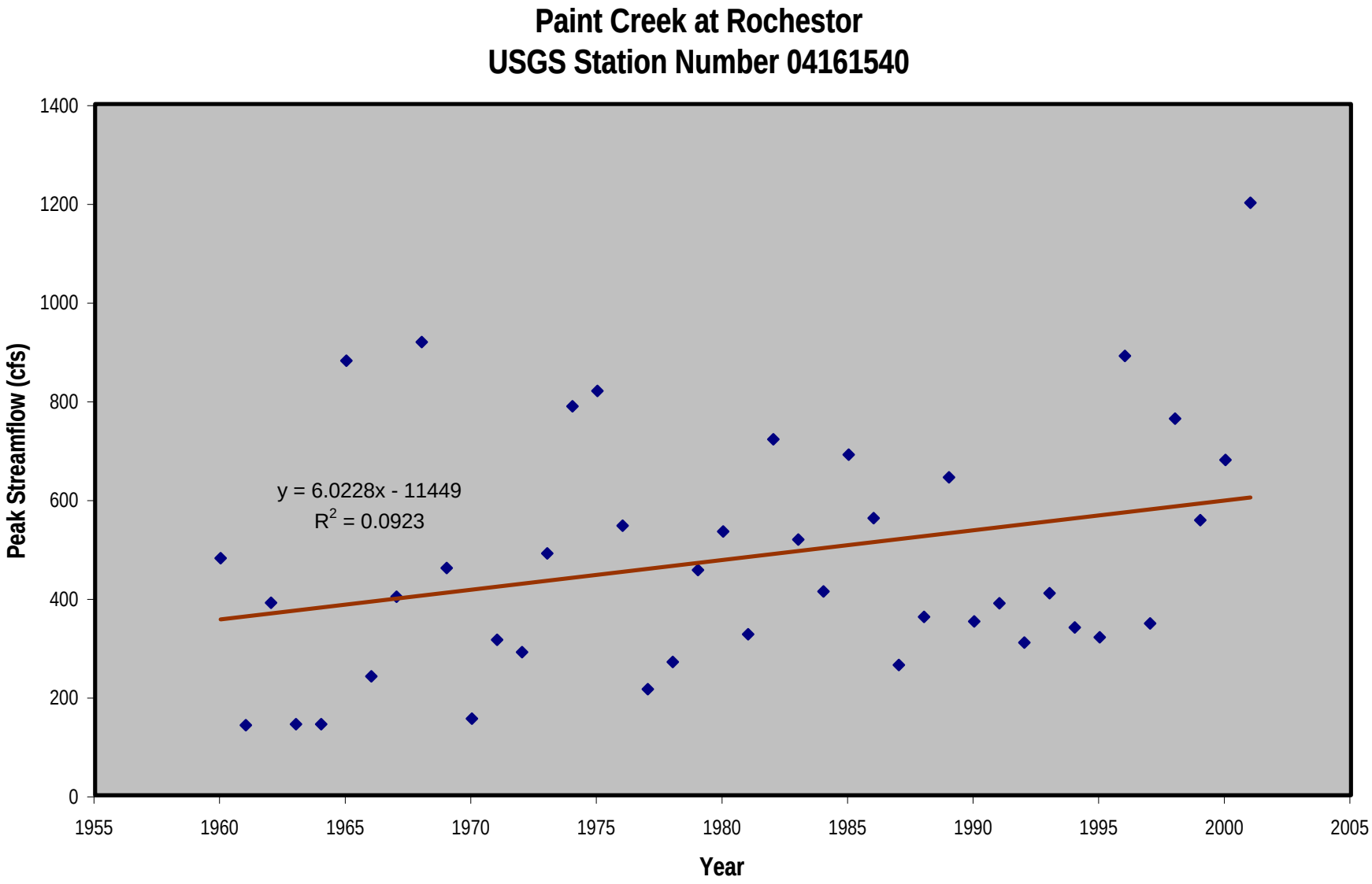

Clinton River At Auburn Hills
USGS Station Number 04161000
Annual Mean Streamflow (cfs)
250
200
150
100
50
0
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
Year
y = 1.9229x - 3676.1
R2 = 0.3962

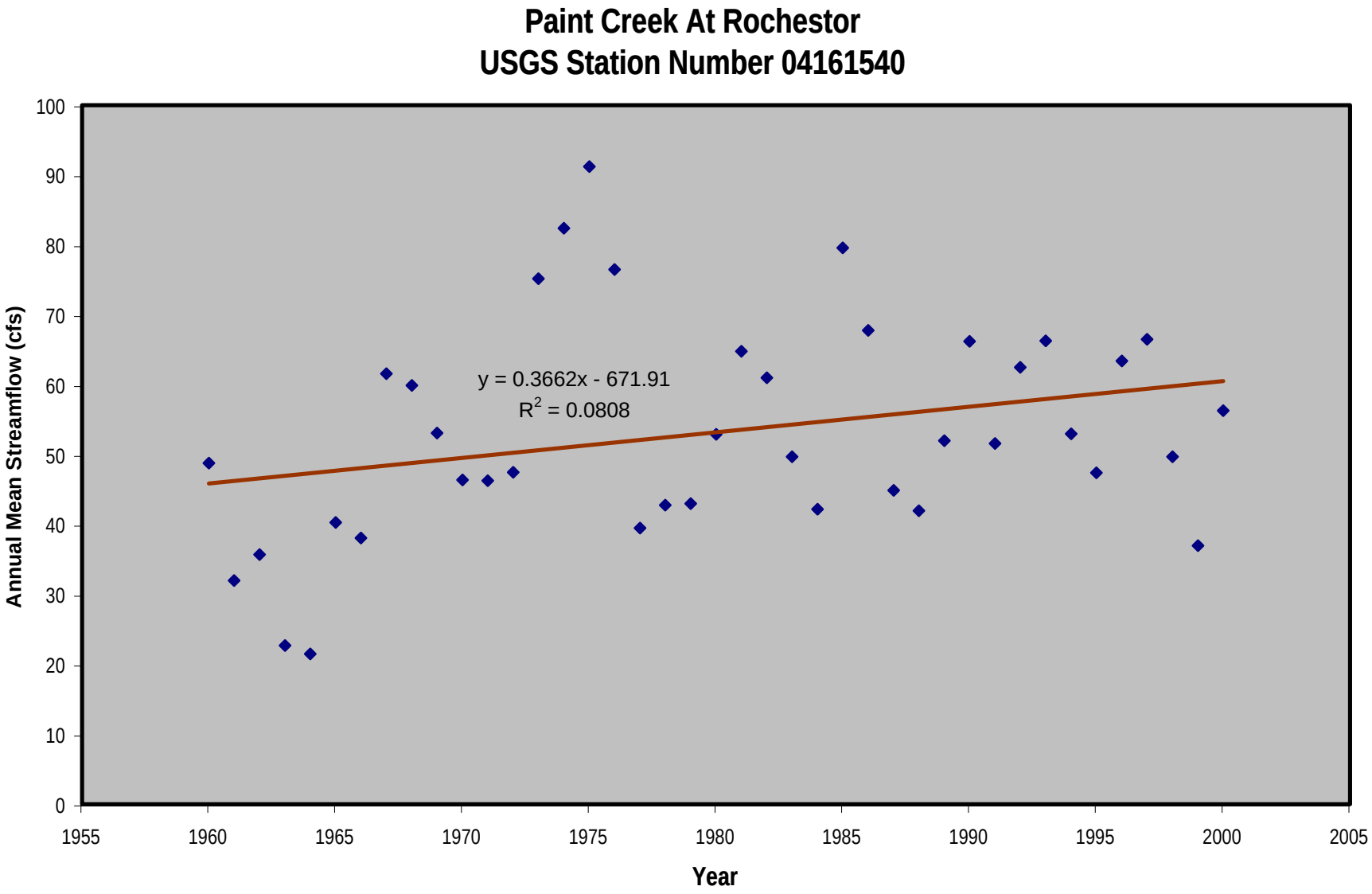

Galloway Creek At Aurburn Hts
USGS Station Number 04161100
Peak Streamflow (cfs)
600
500
400
300
200
100
0
y = 4.1393x - 8007.8
R2 = 0.1292
1955
1960
1965
1970
1975
1980
1985
1990
1995
Year

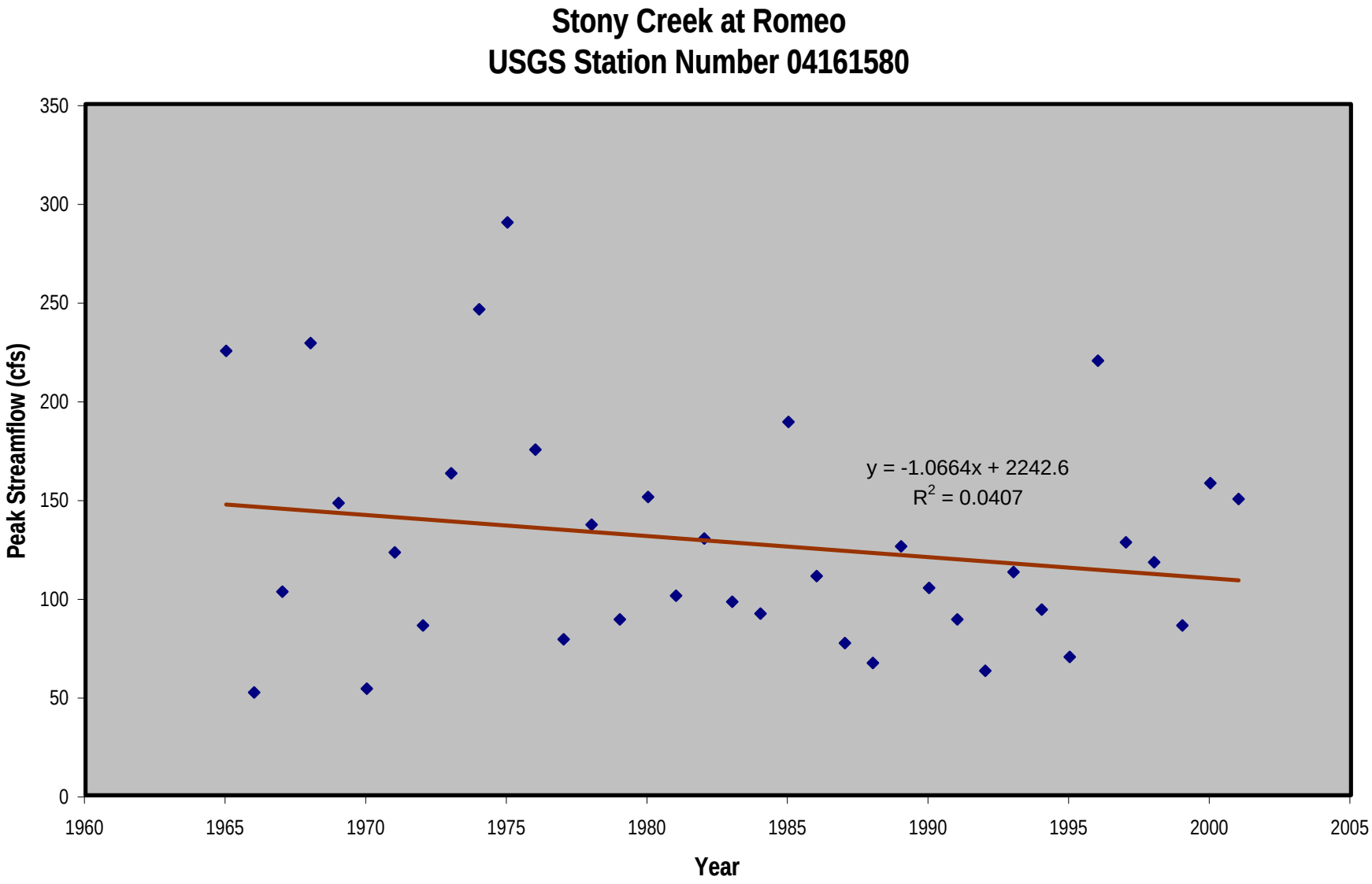

Galloway Creek at Auburn Hts
USGS Station Number 04161100
Annual Mean Streamflow (cfs)
Year
y = 0.2983x - 578.13
R2 = 0.3752
0
5
10
15
20
25
1955
1960
1965
1970
1975
1980
1985
1990
1995

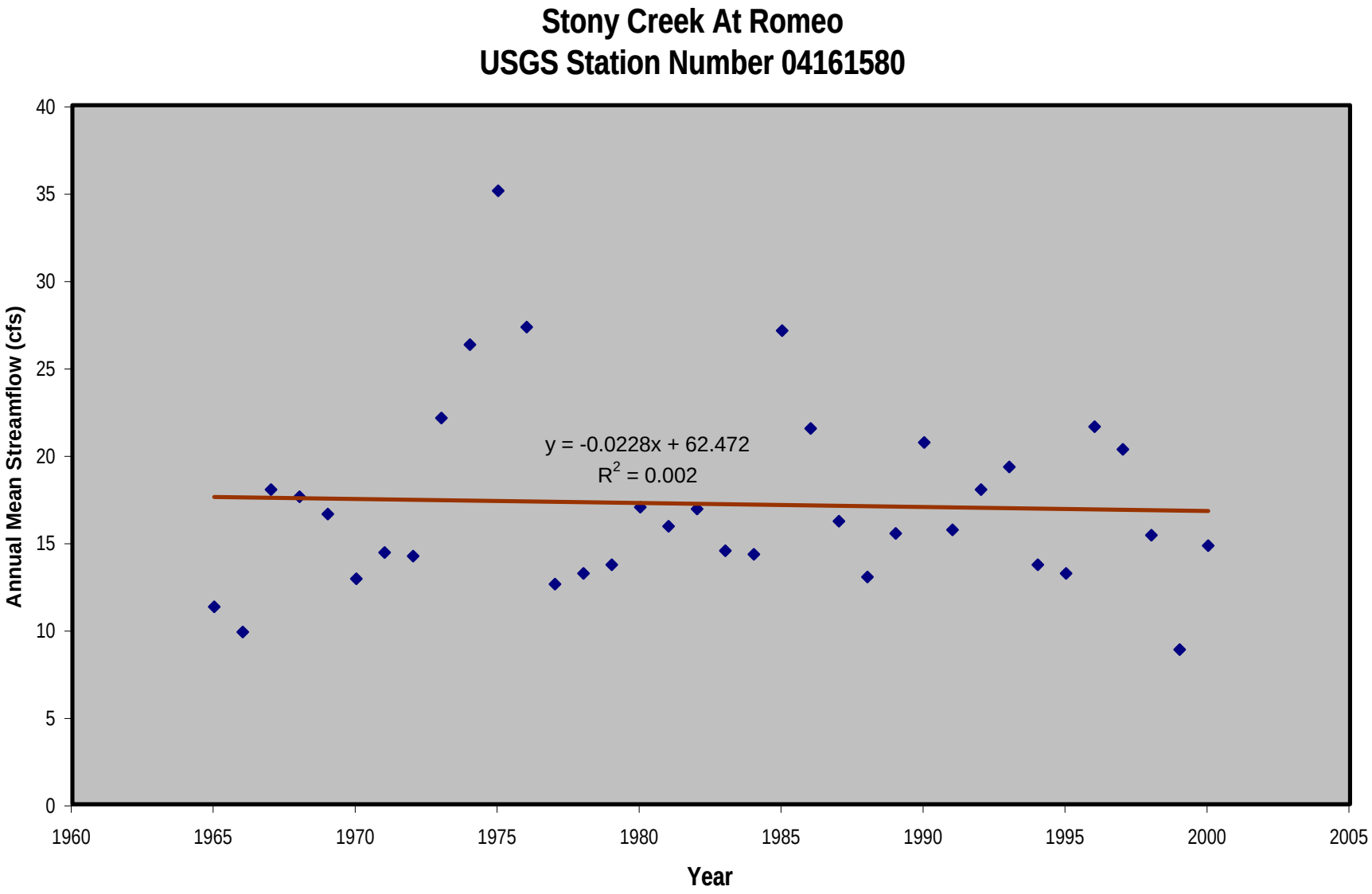

Paint Creek Near Lake Orion
USGS Station Number 04161500
Peak Streamflow (cfs)
Year
y = -1.1157x + 2376
R2 = 0.0164
0
50
100
150
200
250
300
350
400
450
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

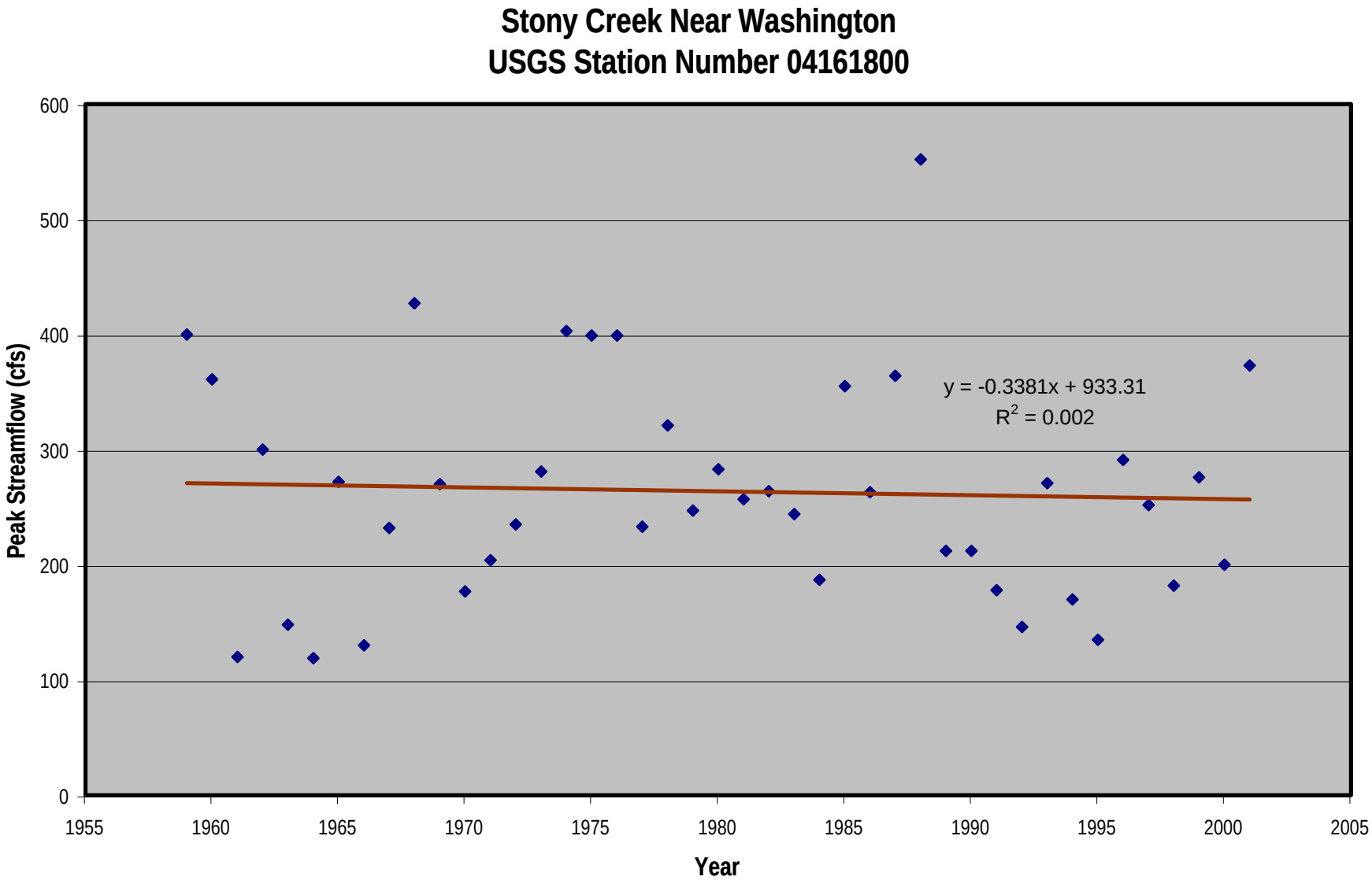

Paint Creek Near Lake Orion
USGS Station Number 04161500
Annual Mean Streamflow (cfs)
Year
y = 0.3305x - 625.7
R2 = 0.106
0
5
10
15
20
25
30
35
40
45
50
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

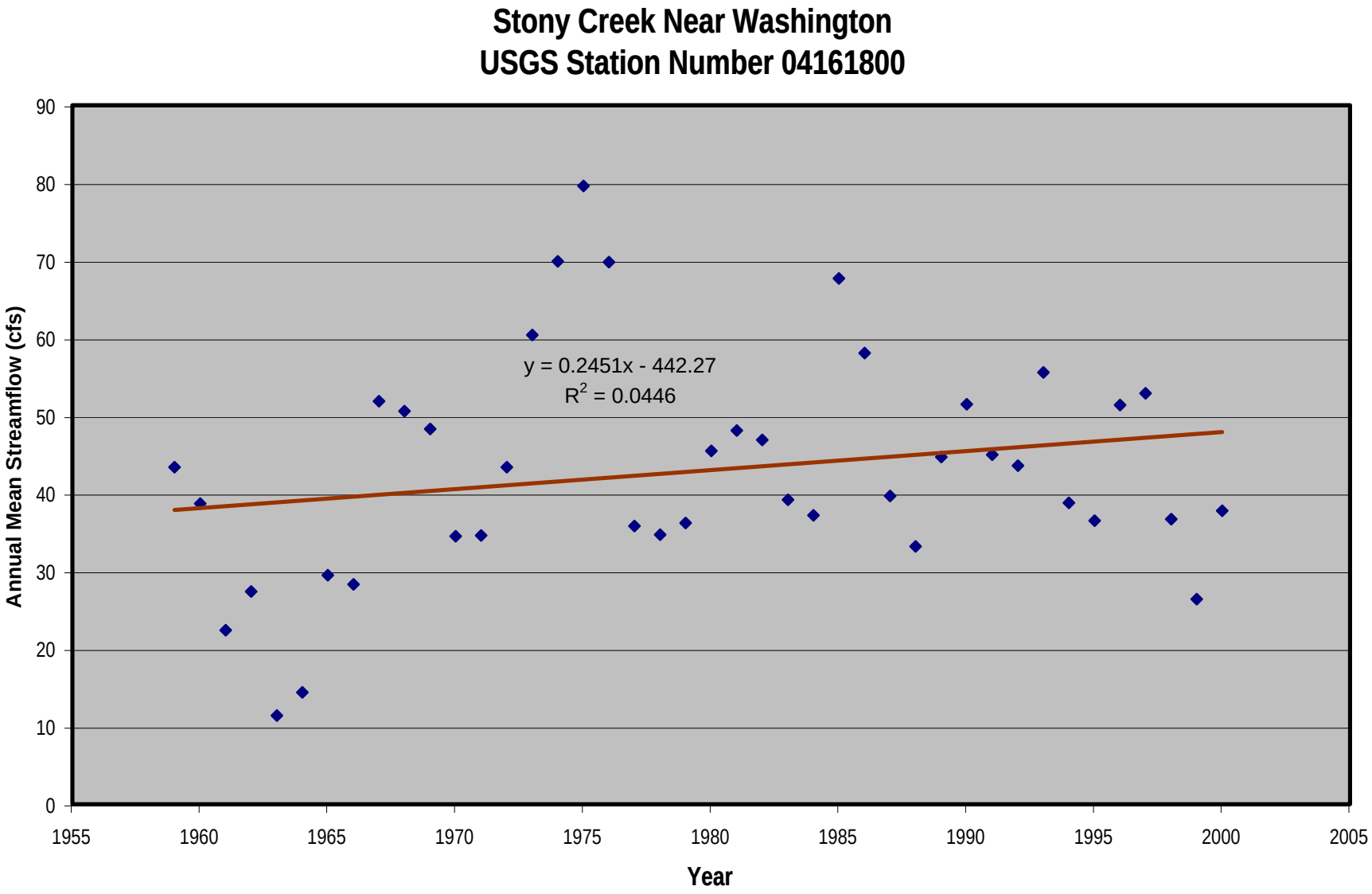

Paint Creek at Rochestor
USGS Station Number 04161540
Peak Streamflow (cfs)
1400
1200
1000
800
600
400
200
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
y = 6.0228x - 11449
R2 = 0.0923

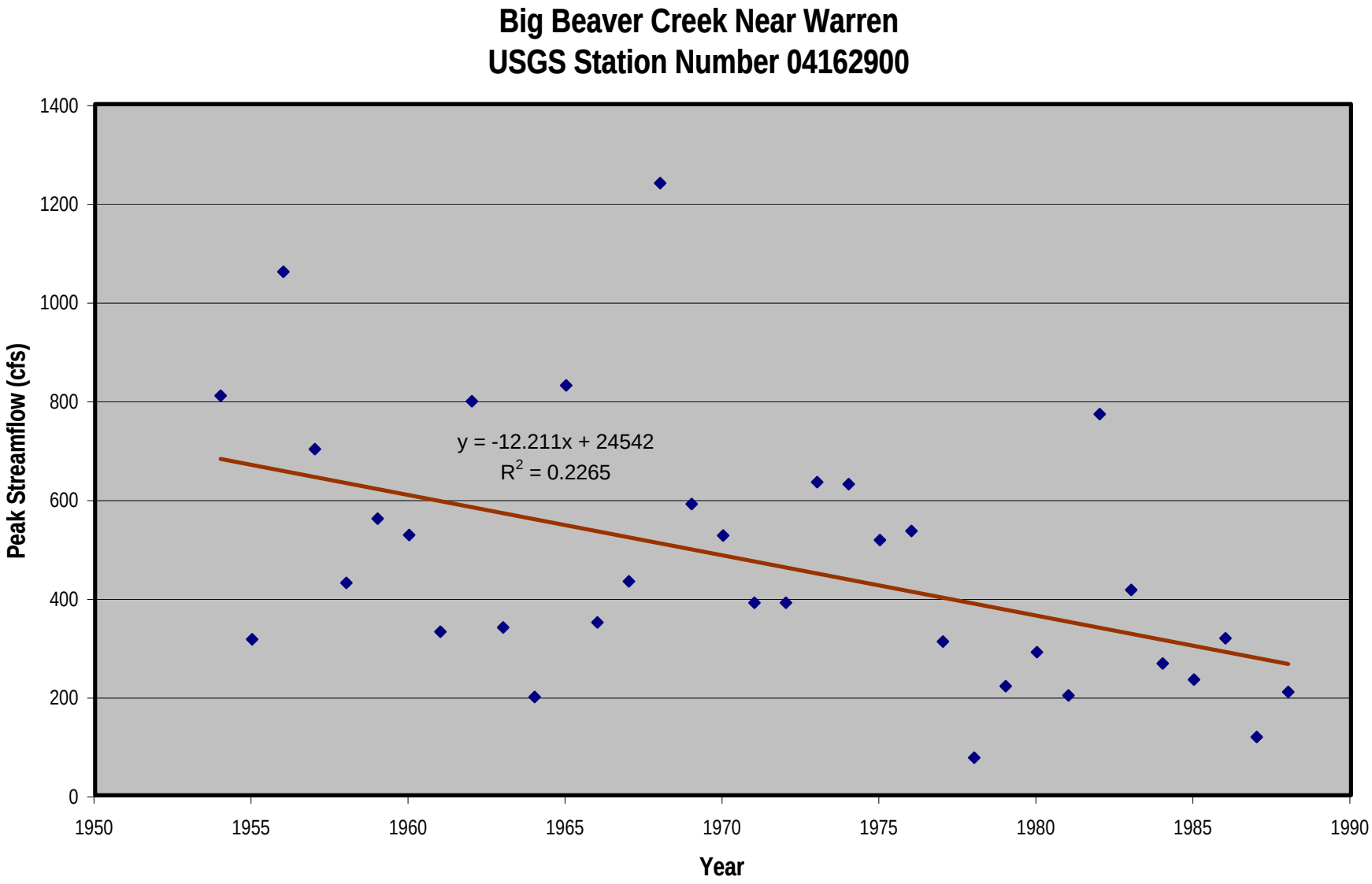

Paint Creek At Rochestor
USGS Station Number 04161540
Annual Mean Streamflow (cfs)
Year
y = 0.3662x - 671.91
R2 = 0.0808
0
10
20
30
40
50
60
70
80
90
100
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

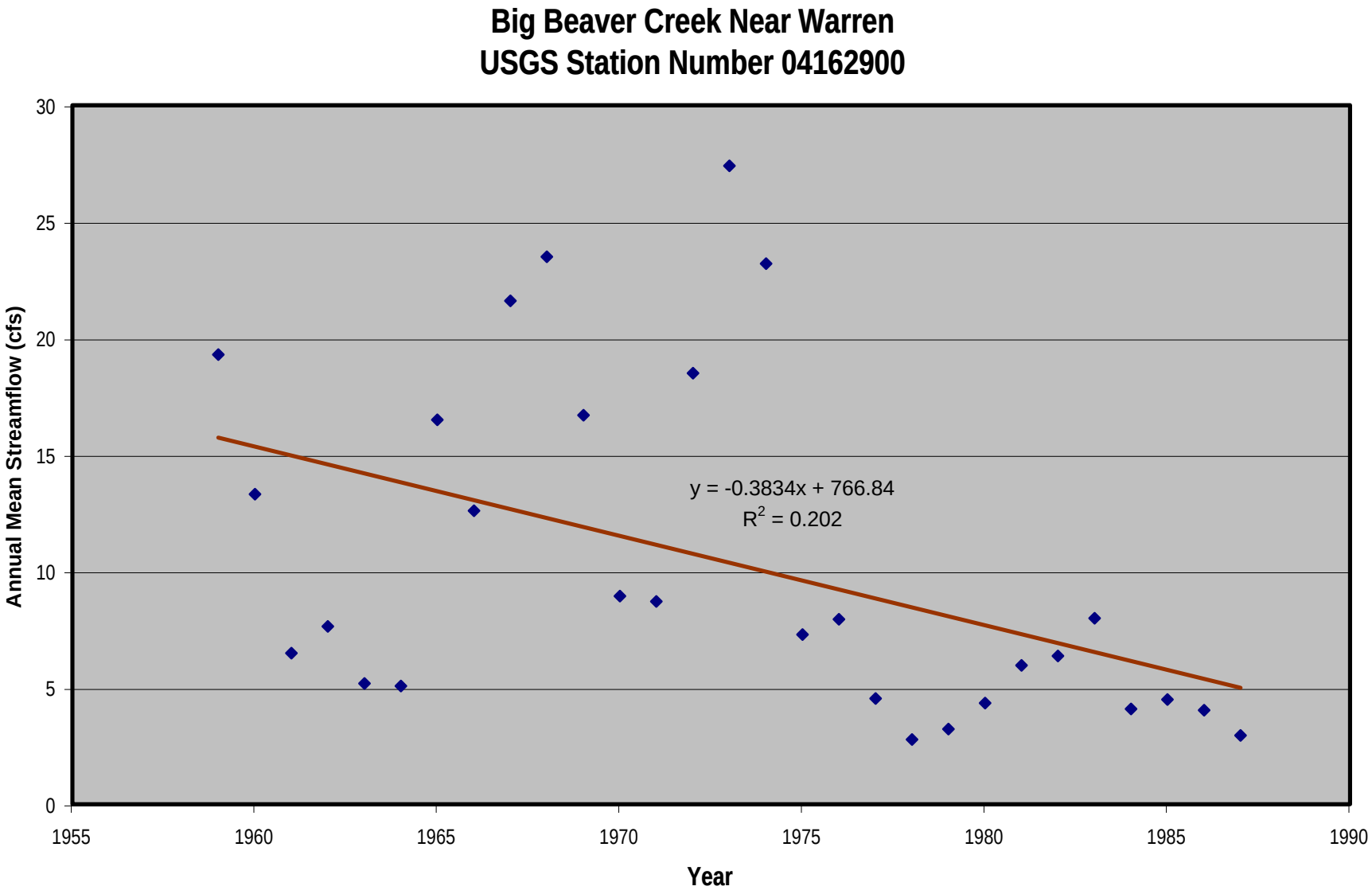

Stony Creek at Romeo
USGS Station Number 04161580
Peak Streamflow (cfs)
Year
y = -1.0664x + 2242.6
R2 = 0.0407
0
50
100
150
200
250
300
350
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

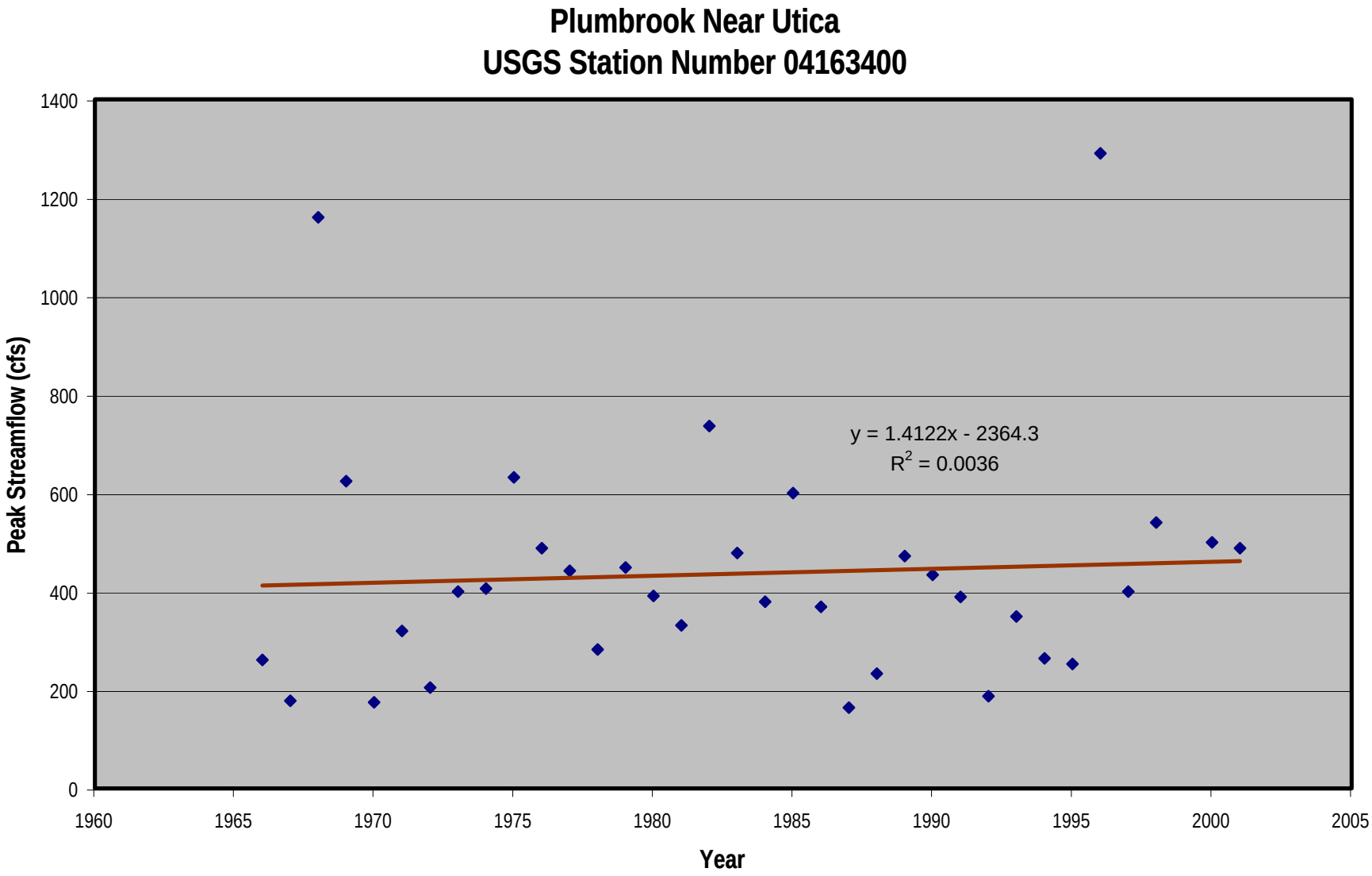

Stony Creek At Romeo
USGS Station Number 04161580
Annual Mean Streamflow (cfs)
Year
y = -0.0228x + 62.472
R2 = 0.002
0
5
10
15
20
25
30
35
40
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

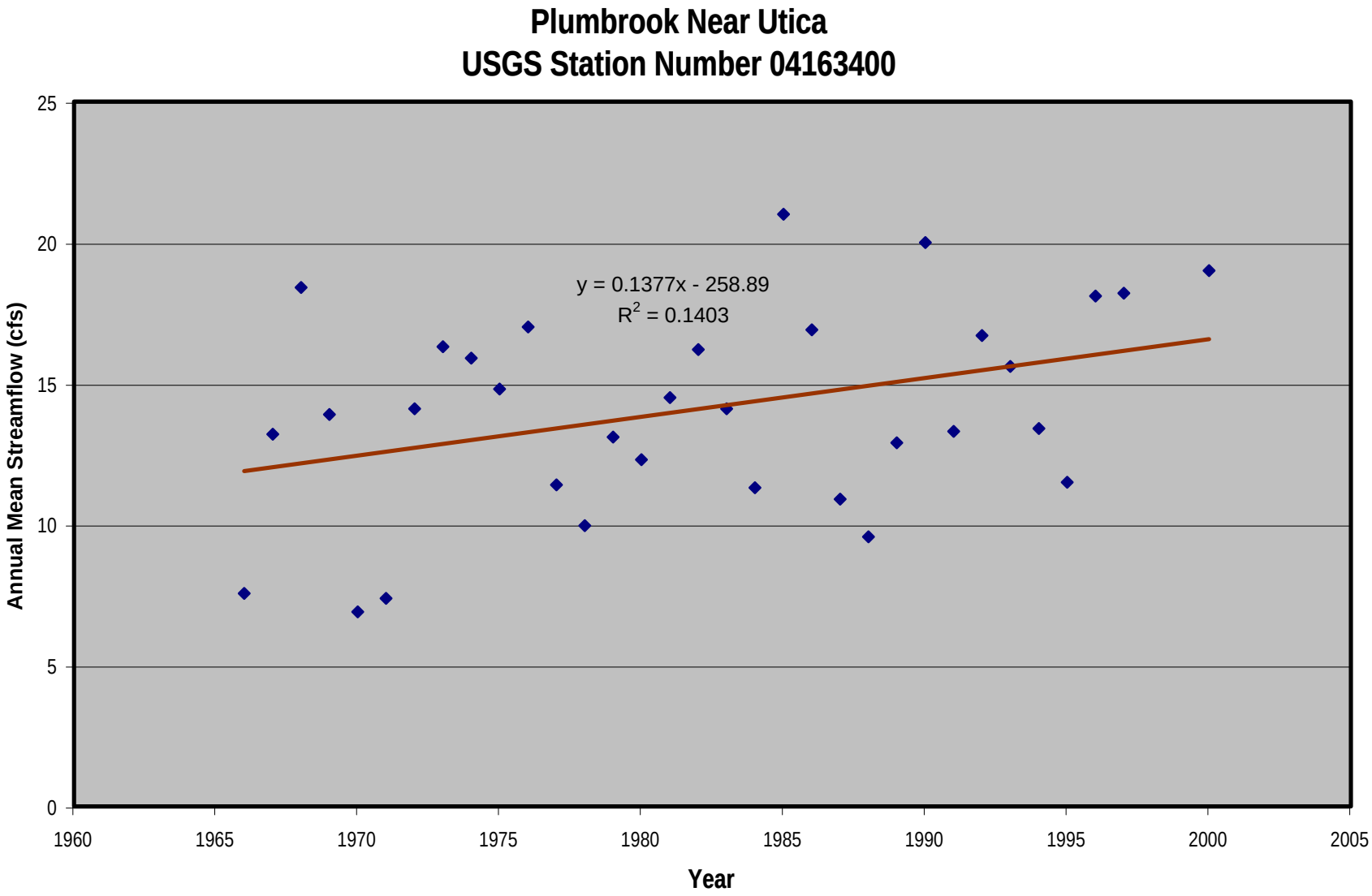

Stony Creek Near Washington
USGS Station Number 04161800
Peak Streamflow (cfs)
600
500
400
300
200
100
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
y = -0.3381x + 933.31
R2 = 0.002

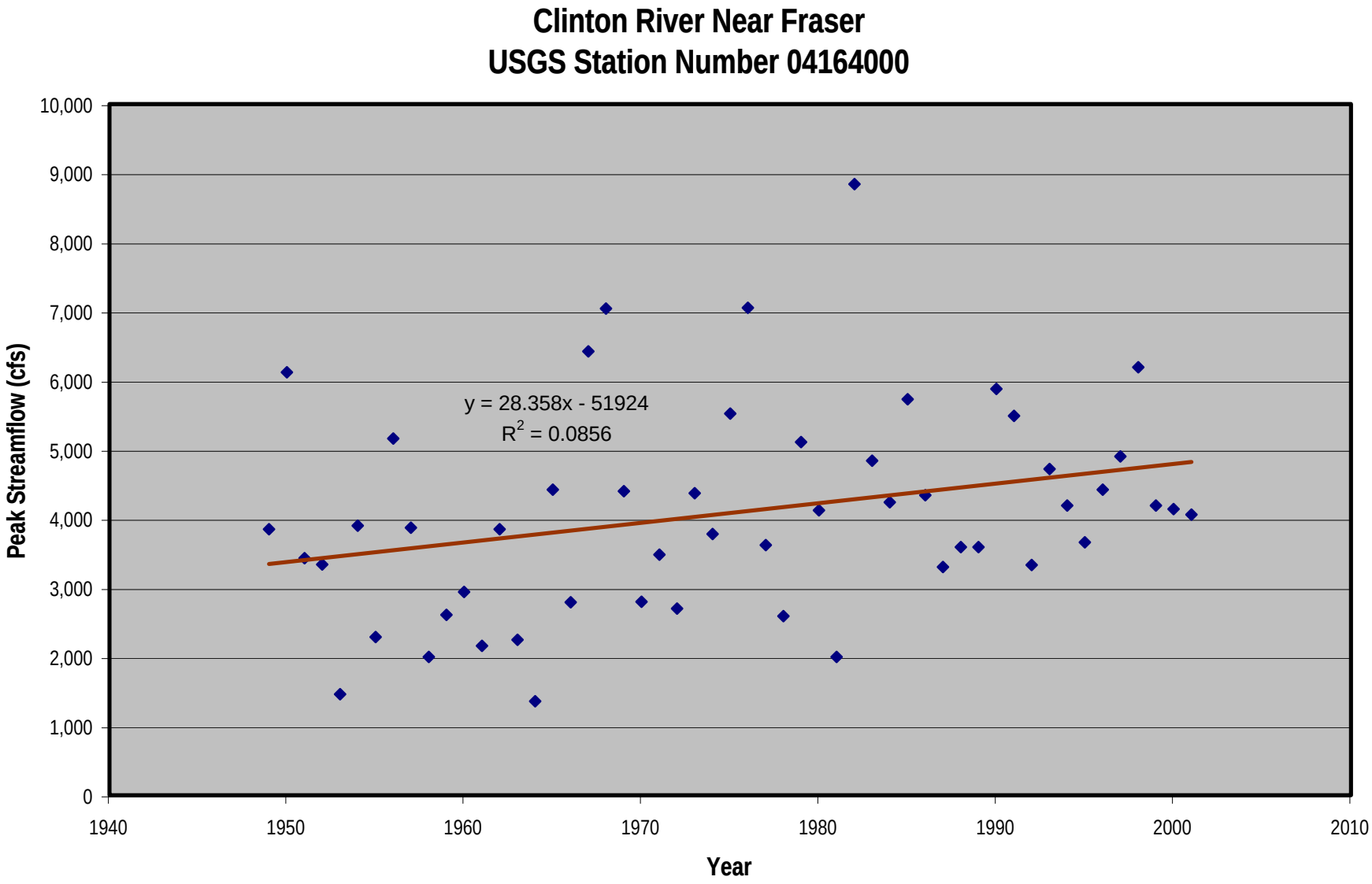

Stony Creek Near Washington
USGS Station Number 04161800
Annual Mean Streamflow (cfs)
Year
y = 0.2451x - 442.27
R2 = 0.0446
0
10
20
30
40
50
60
70
80
90
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

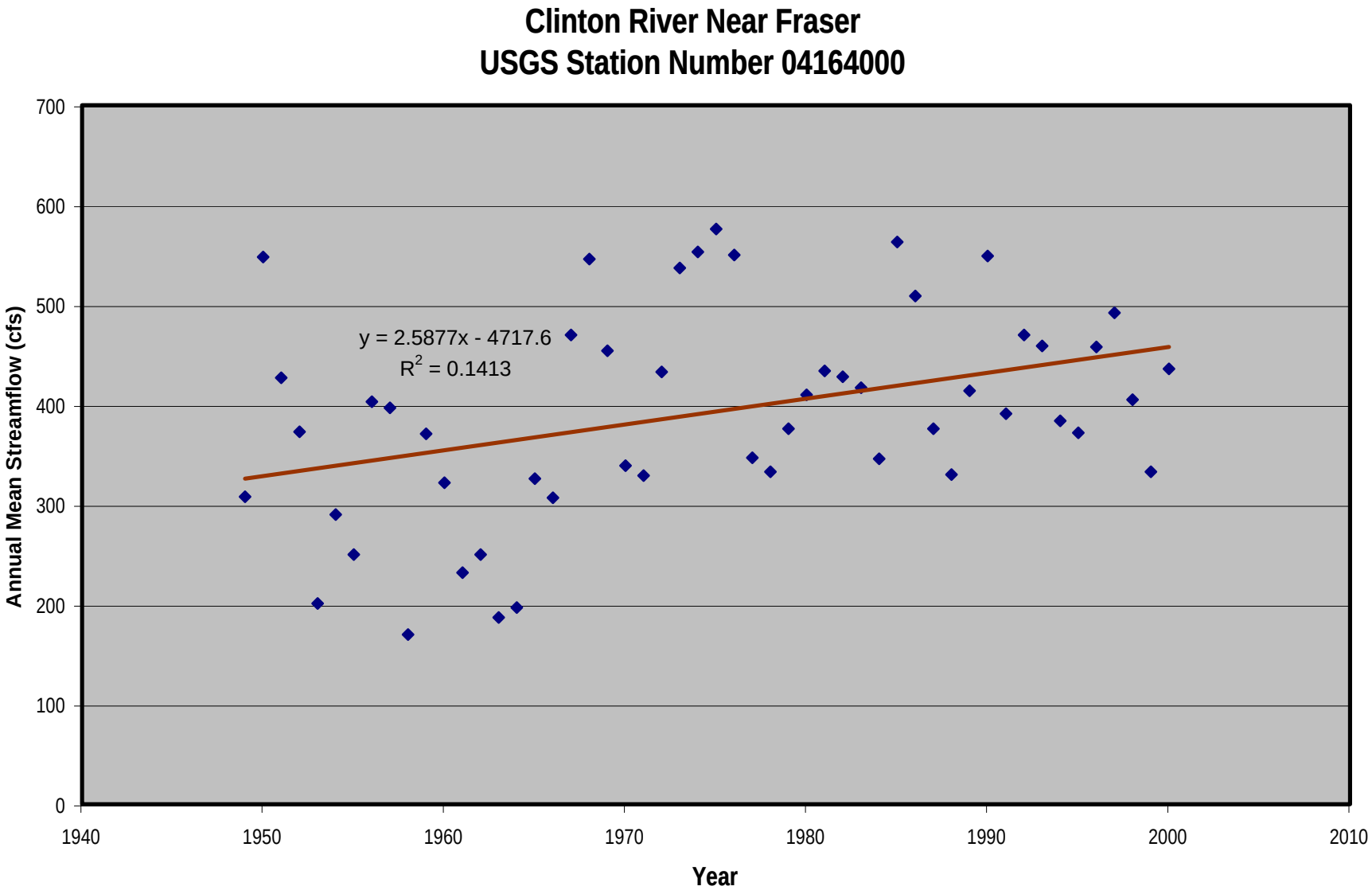

Big Beaver Creek Near Warren
USGS Station Number 04162900
Peak Streamflow (cfs)
1400
1200
1000
800
600
400
200
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
Year
y = -12.211x + 24542
R2 = 0.2265

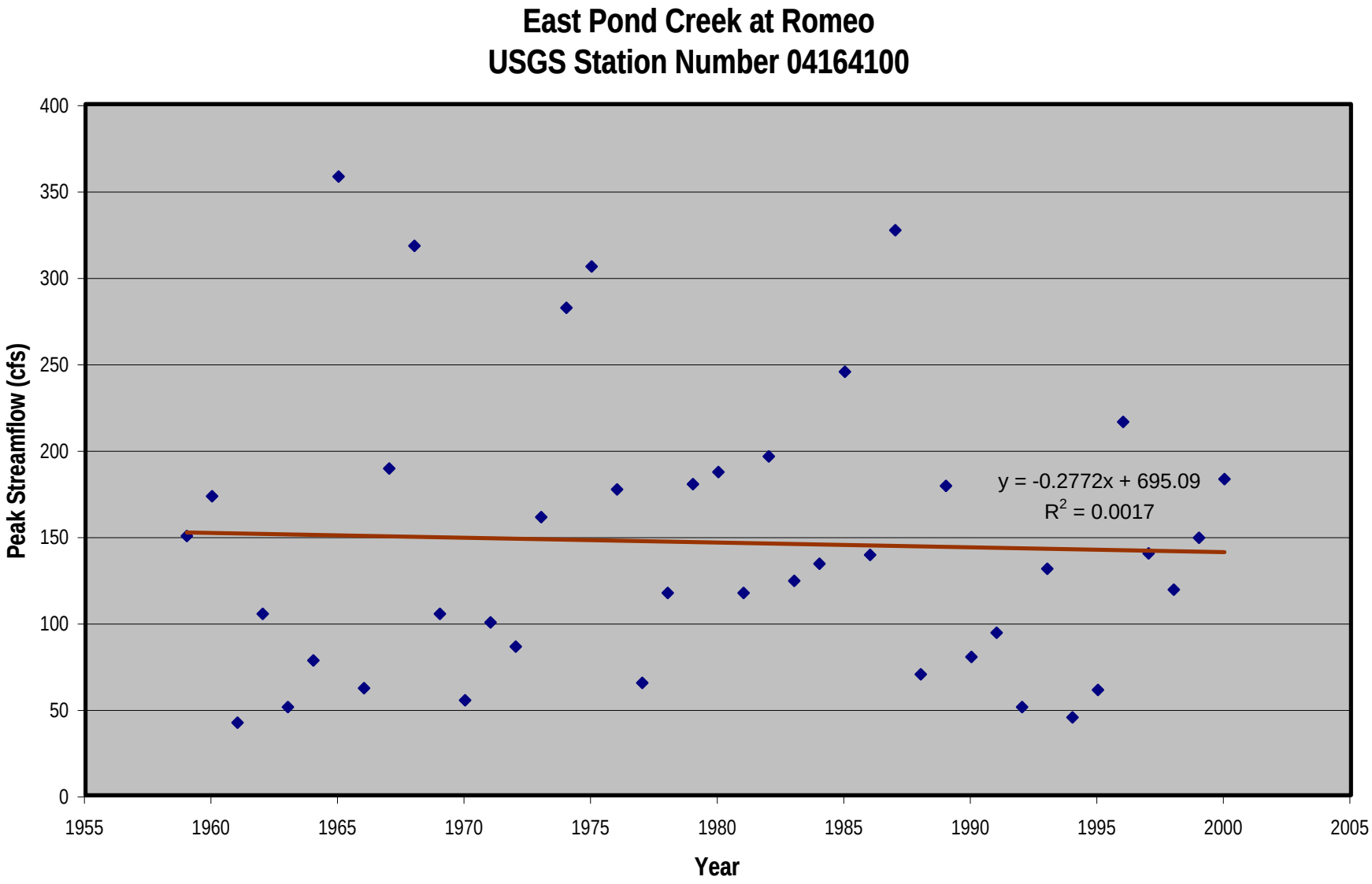

Big Beaver Creek Near Warren
USGS Station Number 04162900
Annual Mean Streamflow (cfs)
30
25
20
15
10
5
0
1955
1960
1965
1970
1975
1980
1985
1990
Year
y = -0.3834x + 766.84
R2 = 0.202

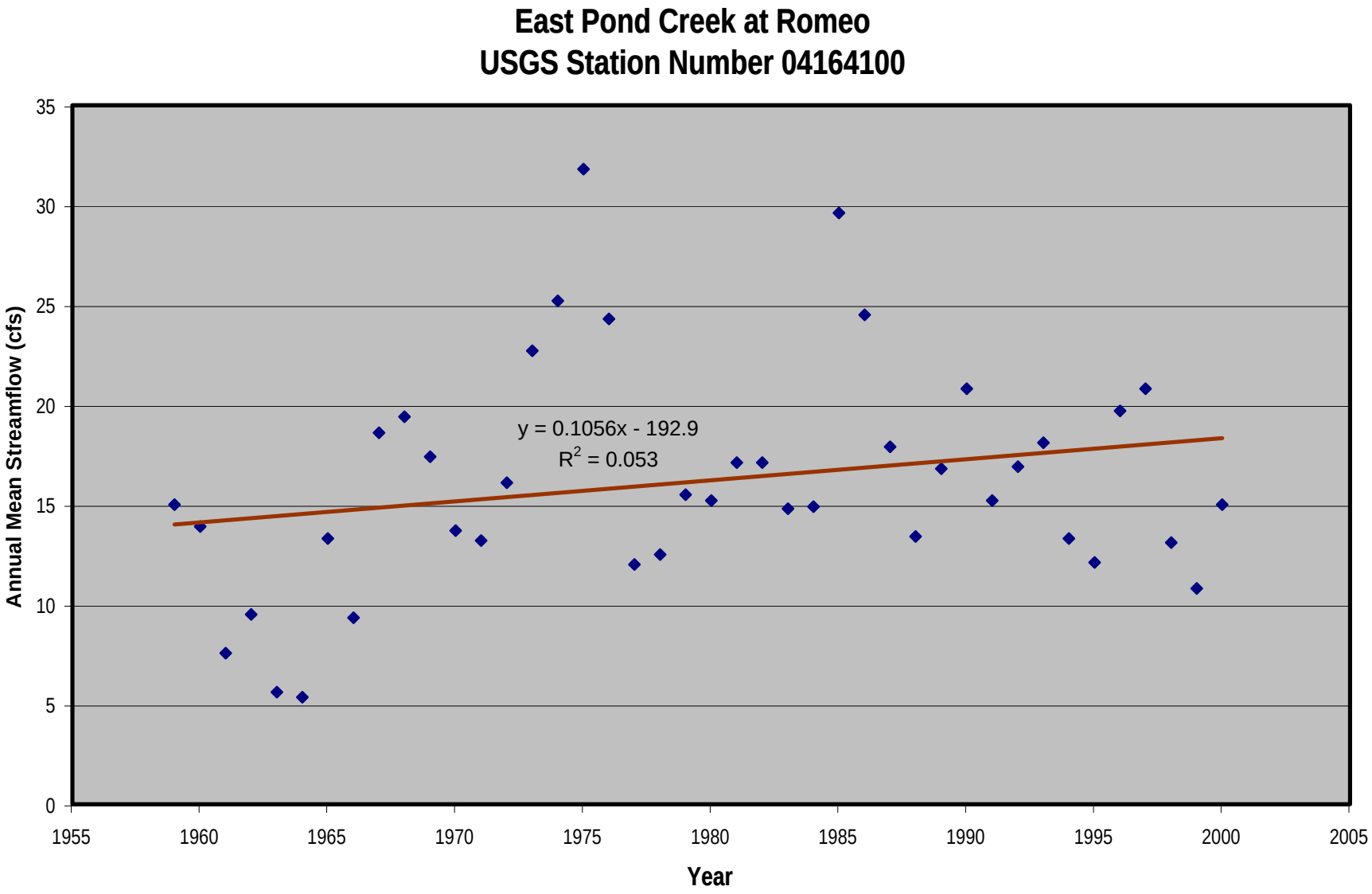

Plumbrook Near Utica
USGS Station Number 04163400
Peak Streamflow (cfs)
Year
y = 1.4122x - 2364.3
R2 = 0.0036
0
200
400
600
800
1000
1200
1400
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

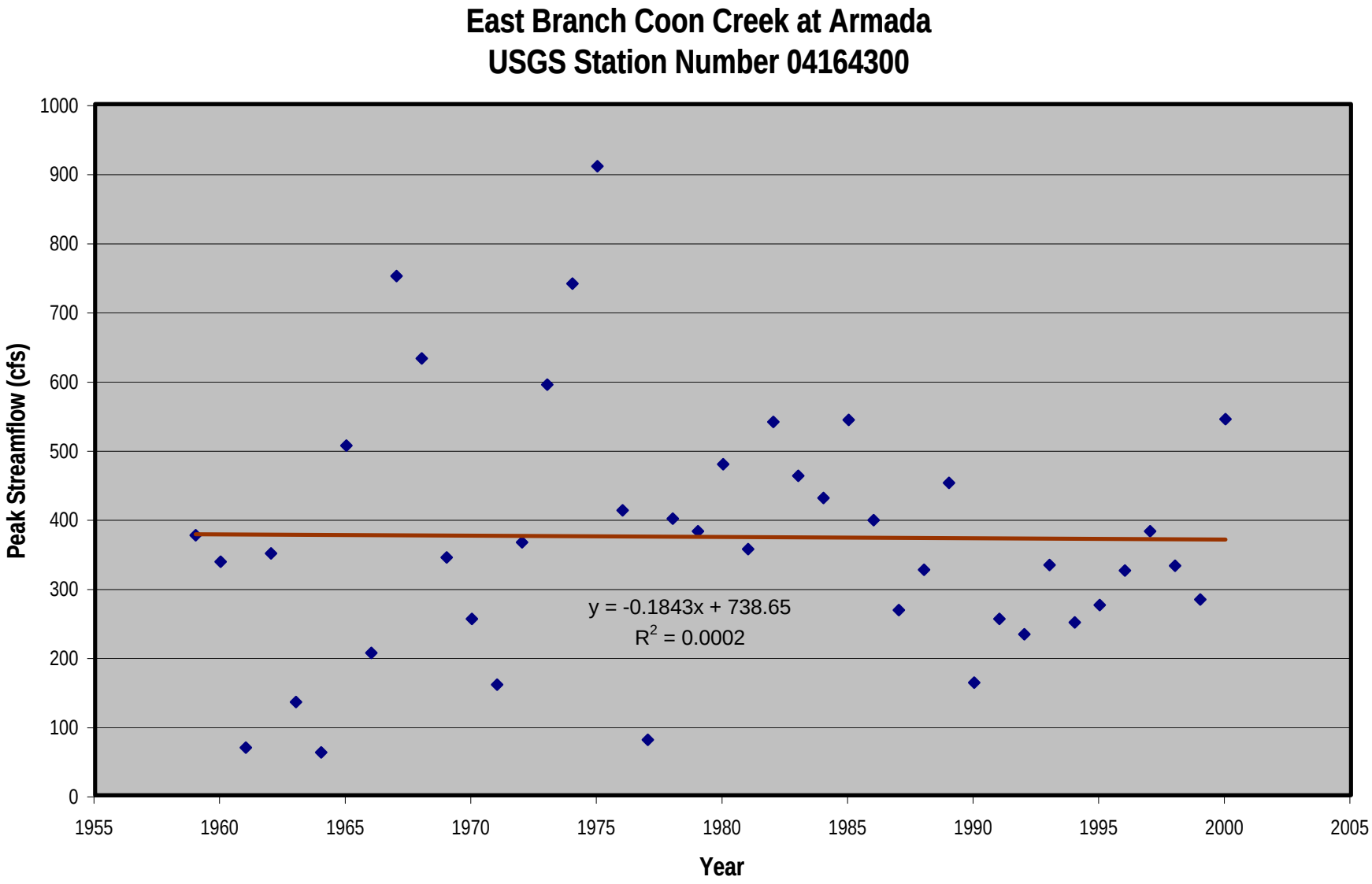

Plumbrook Near Utica
USGS Station Number 04163400
y = 0.1377x - 258.89
R2 = 0.1403
Annual Mean Streamflow (cfs)
Year
0
5
10
15
20
25
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

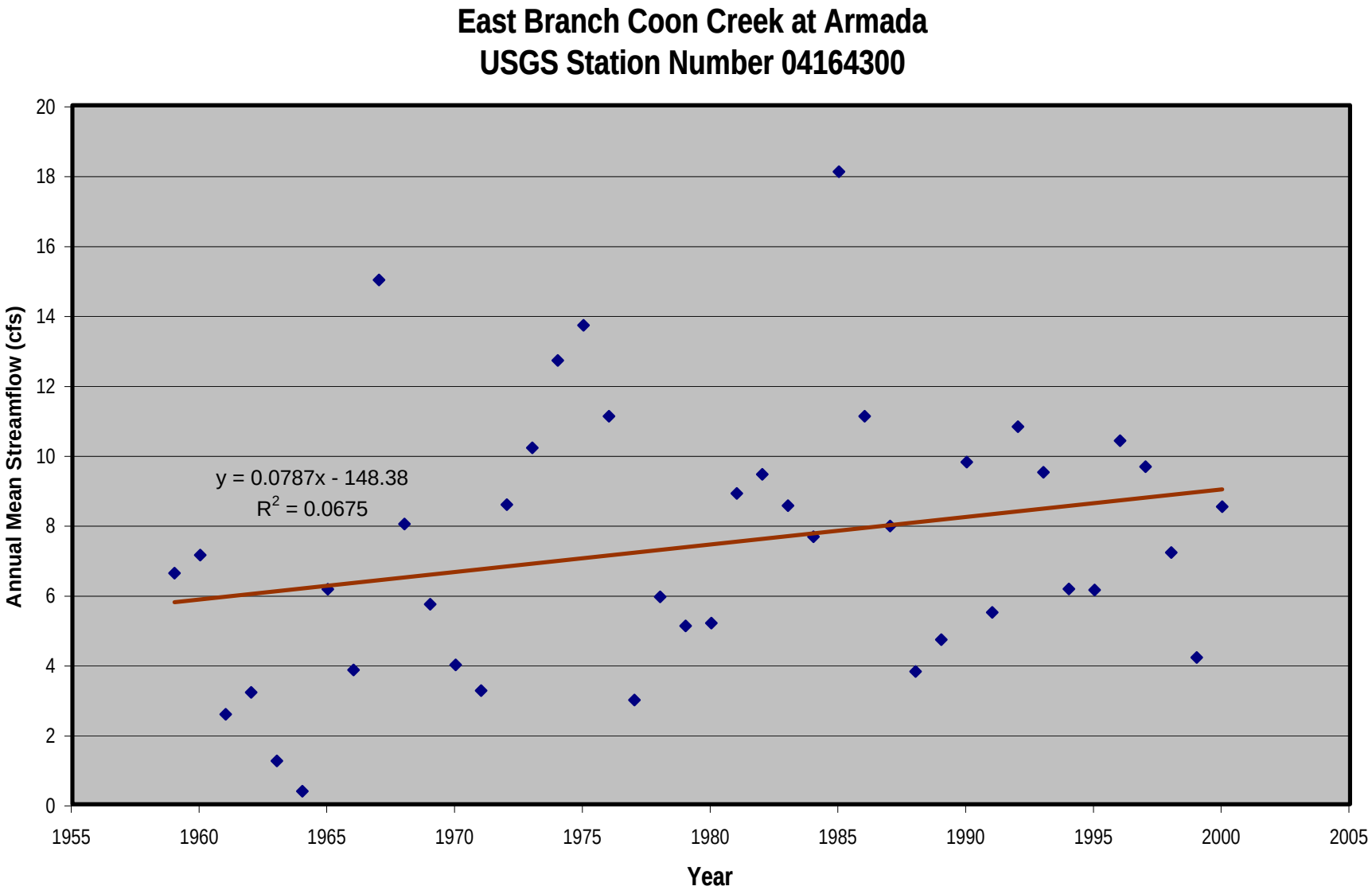

Clinton River Near Fraser
USGS Station Number 04164000
Peak Streamflow (cfs)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
y = 28.358x - 51924
R2 = 0.0856
1940
1950
1960
1970
1980
1990
2000
2010
Year

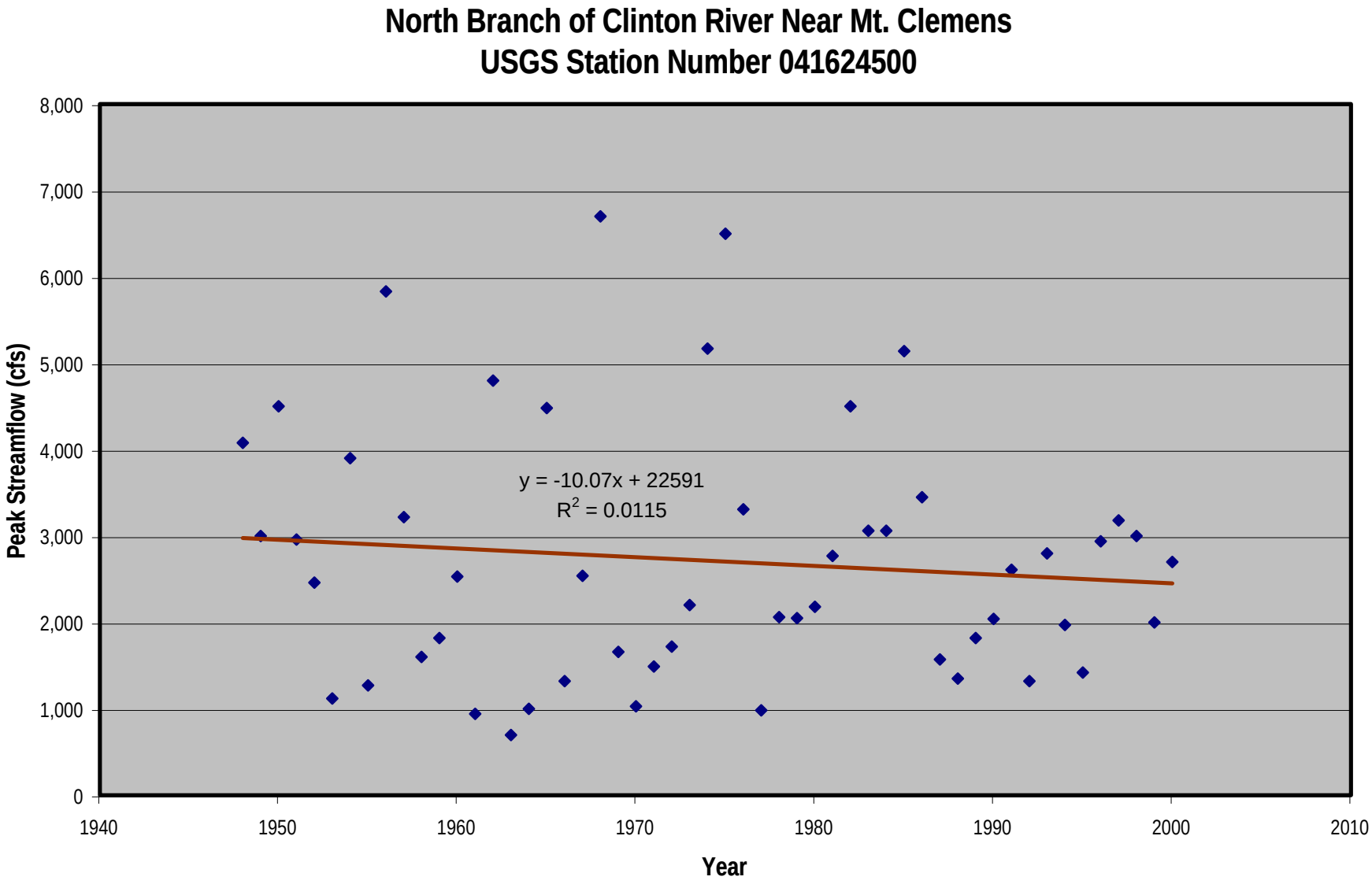

Clinton River Near Fraser
USGS Station Number 04164000
Annual Mean Streamflow (cfs)
700
600
500
400
300
200
100
0
y = 2.5877x - 4717.6
R2 = 0.1413
1940
1950
1960
1970
1980
1990
2000
2010
Year

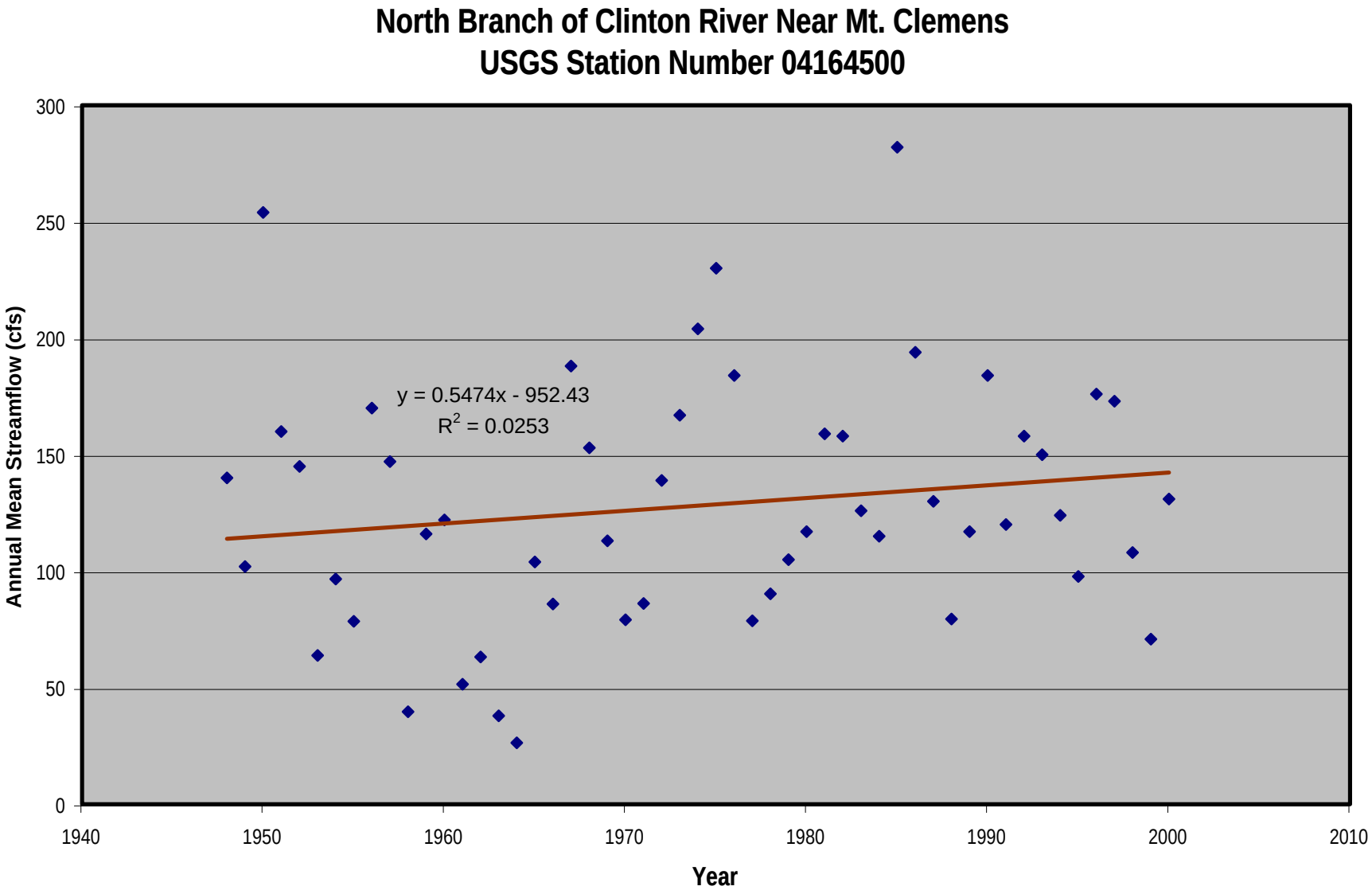

East Pond Creek at Romeo
USGS Station Number 04164100
Peak Streamflow (cfs)
Year
y = -0.2772x + 695.09
R2 = 0.0017
0
50
100
150
200
250
300
350
400
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

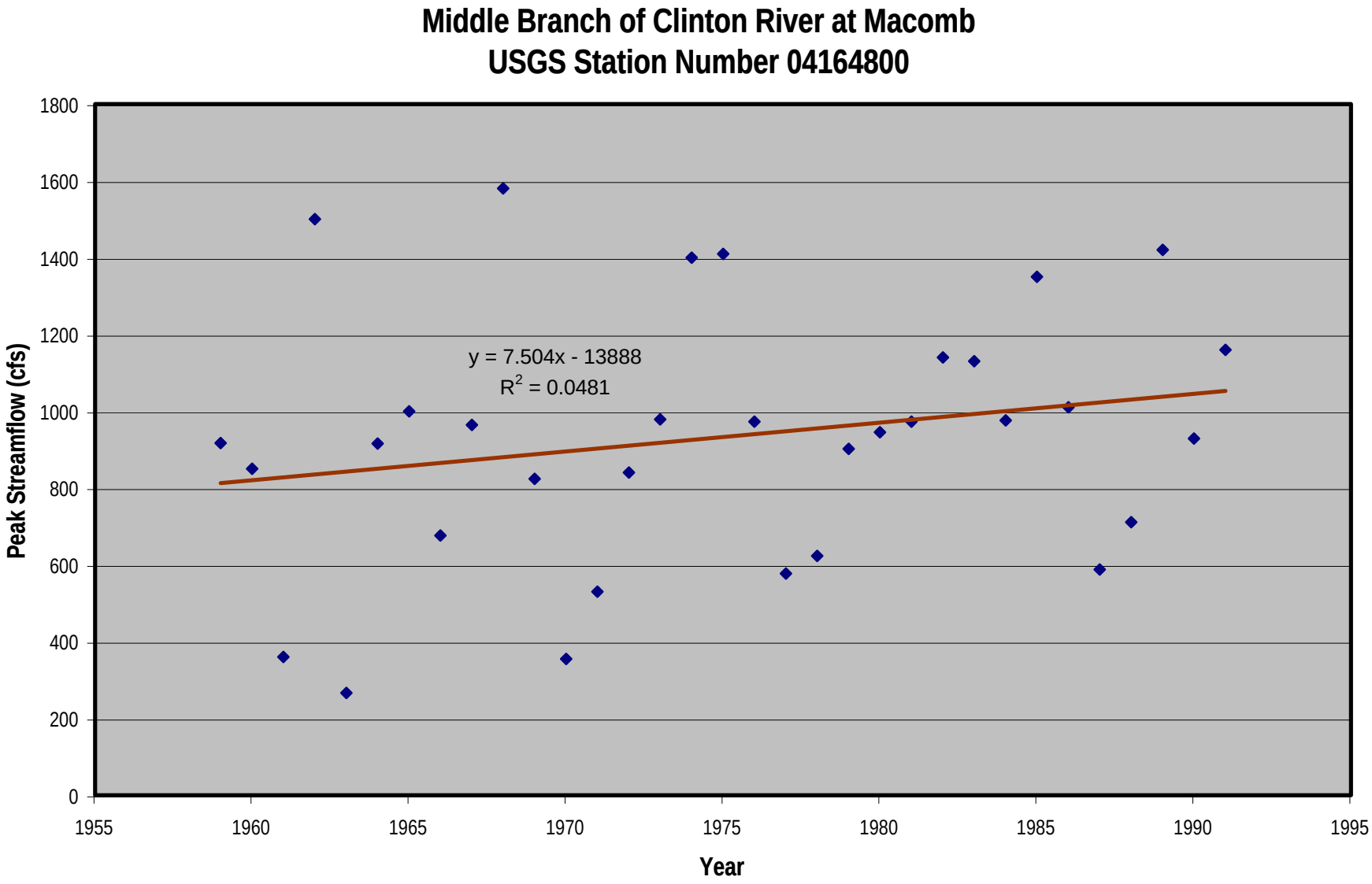

East Pond Creek at Romeo
USGS Station Number 04164100
Annual Mean Streamflow (cfs)
Year
y = 0.1056x - 192.9
R2 = 0.053
0
5
10
15
20
25
30
35
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

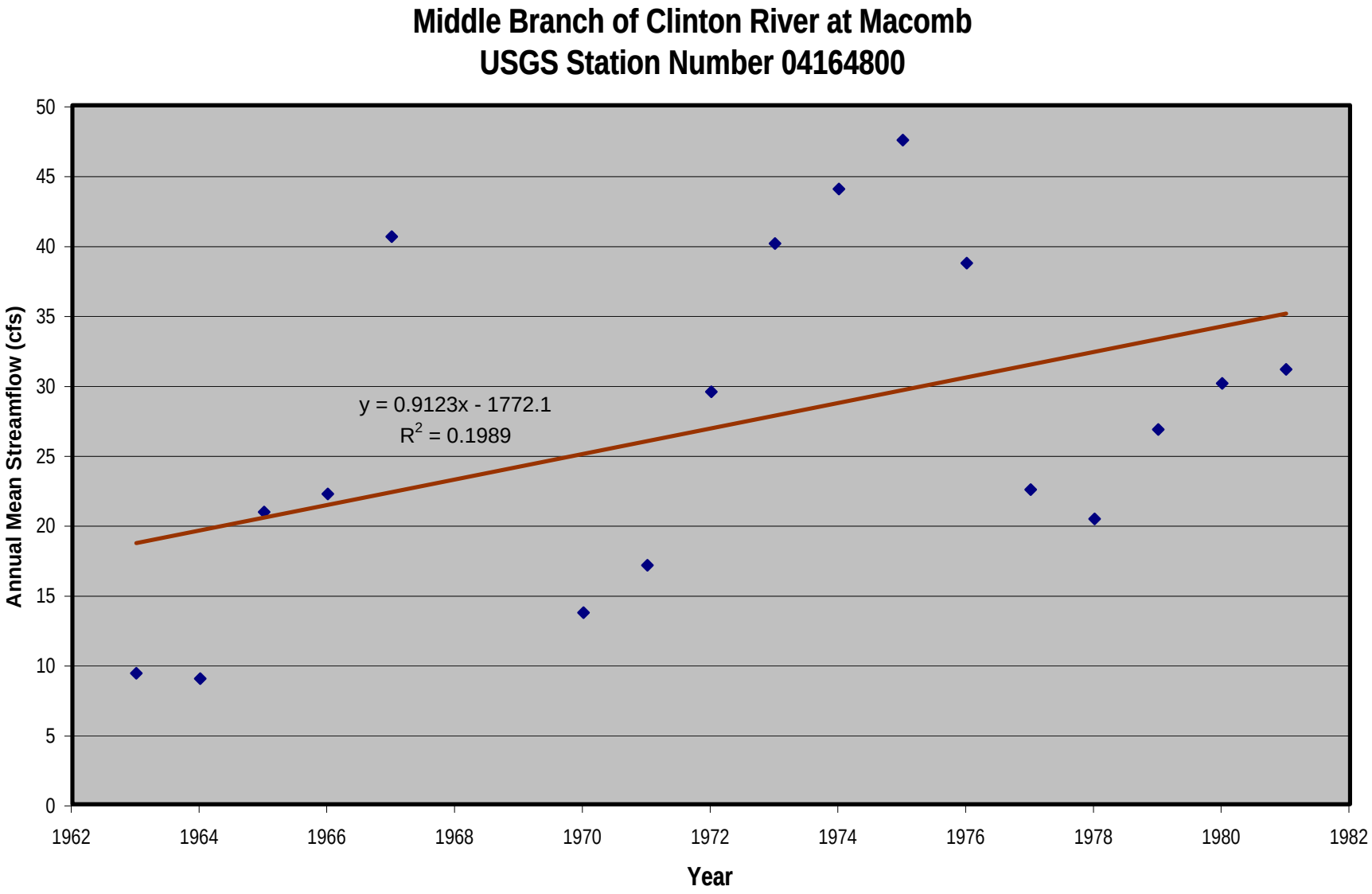

East Branch Coon Creek at Armada
USGS Station Number 04164300
Peak Streamflow (cfs)
1000
900
800
700
600
500
400
300
200
100
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
y = -0.1843x + 738.65
R2 = 0.0002

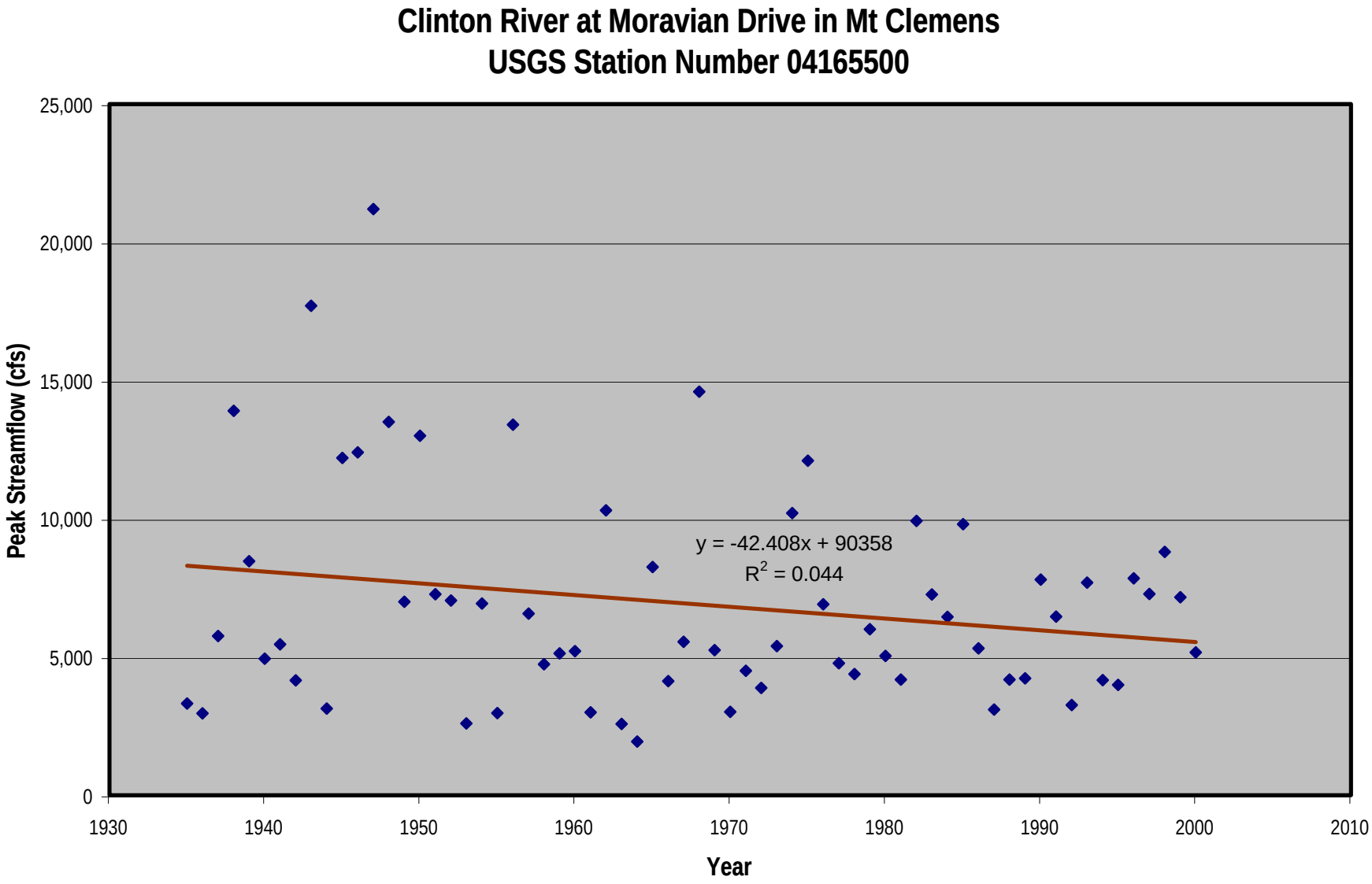

East Branch Coon Creek at Armada
USGS Station Number 04164300
Annual Mean Streamflow (cfs)
Year
y = 0.0787x - 148.38
R2 = 0.0675
0
2
4
6
8
10
12
14
16
18
20
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

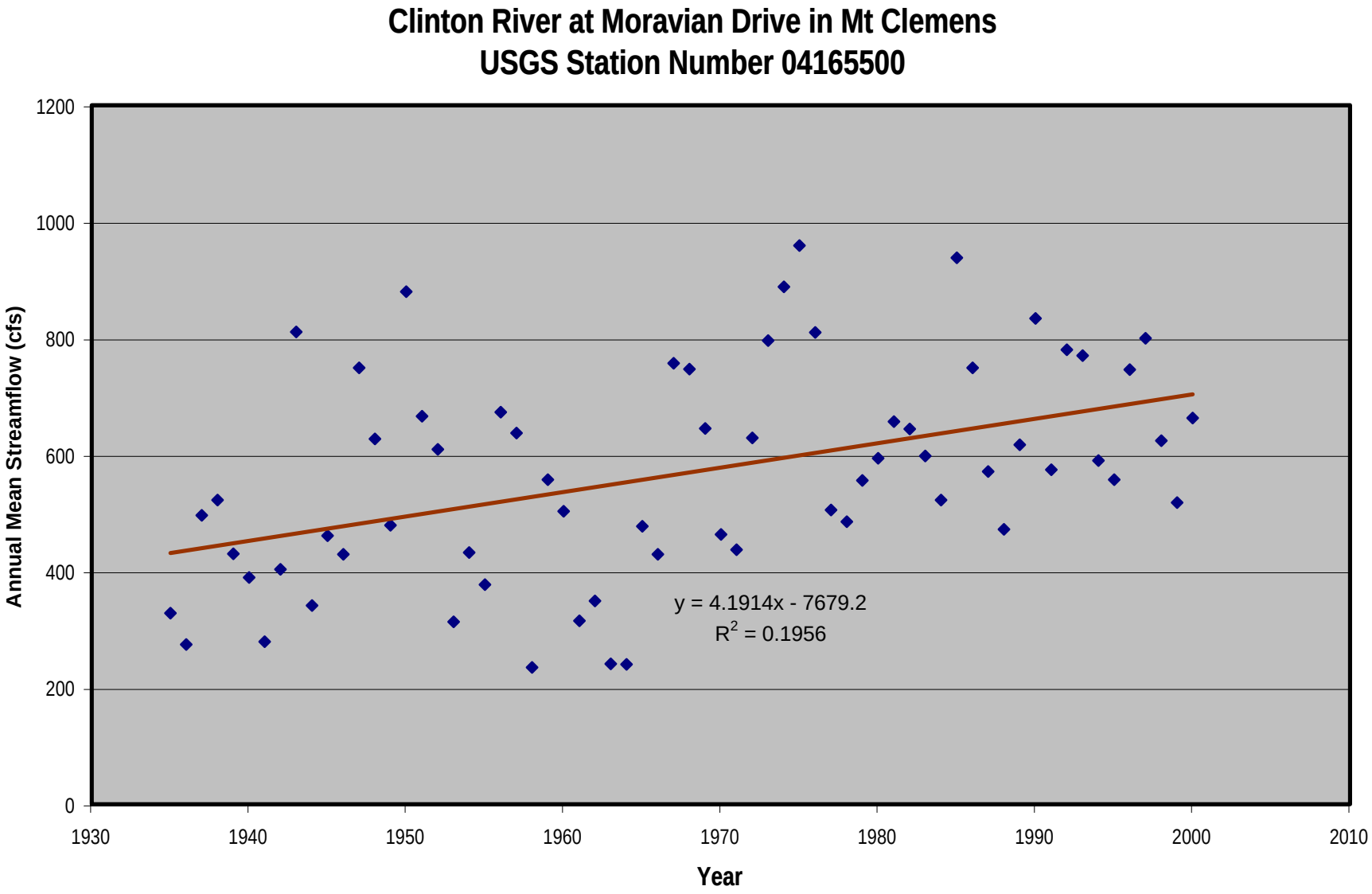

North Branch of Clinton River Near Mt. Clemens
USGS Station Number 041624500
Peak Streamflow (cfs)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
y = -10.07x + 22591
R2 = 0.0115

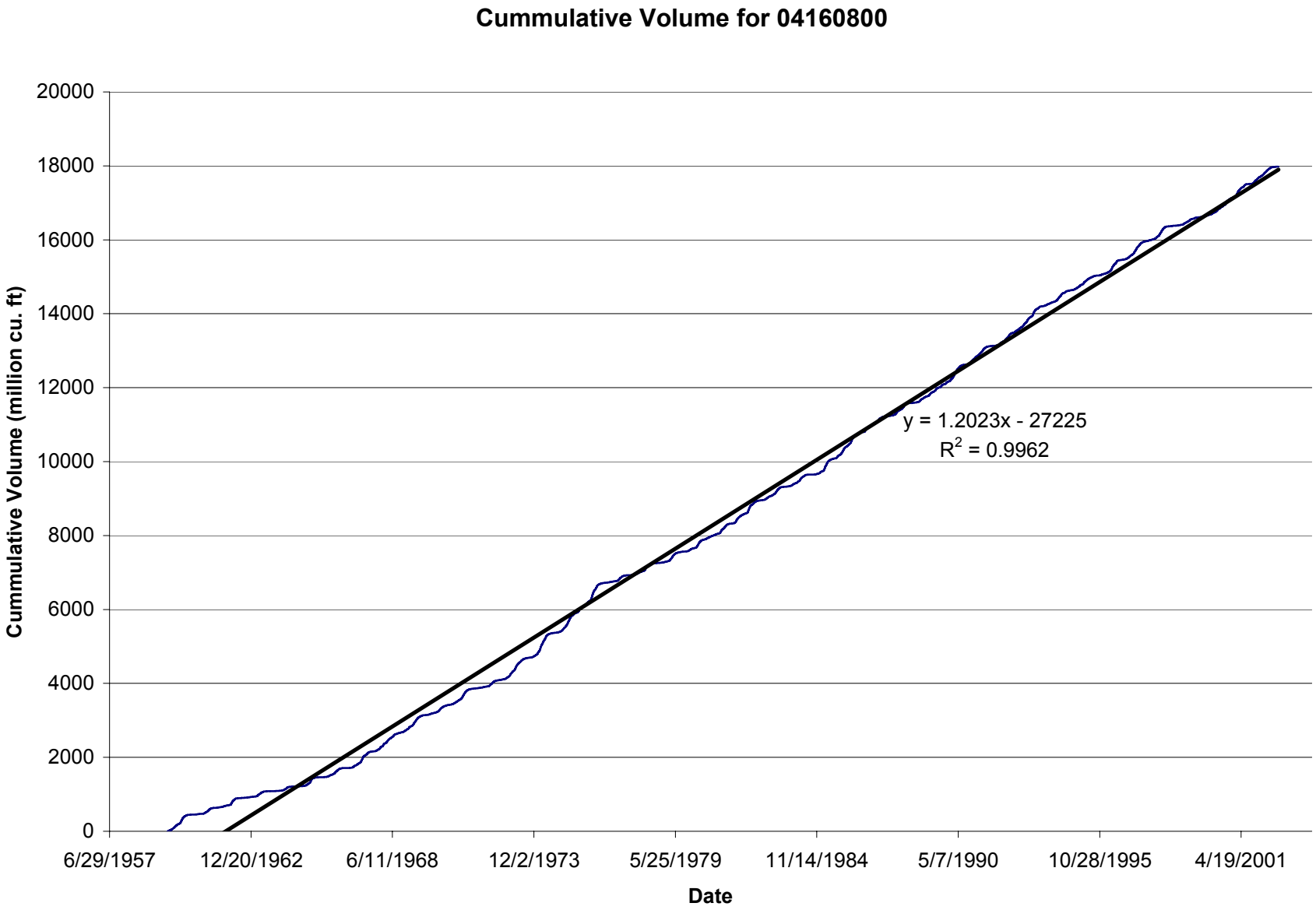

North Branch of Clinton River Near Mt. Clemens
USGS Station Number 04164500
Annual Mean Streamflow (cfs)
300
250
200
150
100
50
0
y = 0.5474x - 952.43
R2 = 0.0253
1940
1950
1960
1970
1980
1990
2000
2010
Year


Middle Branch of Clinton River at Macomb
USGS Station Number 04164800
Peak Streamflow (cfs)
Year
y = 7.504x - 13888
R2 = 0.0481
0
200
400
600
800
1000
1200
1400
1600
1800
1955
1960
1965
1970
1975
1980
1985
1990
1995

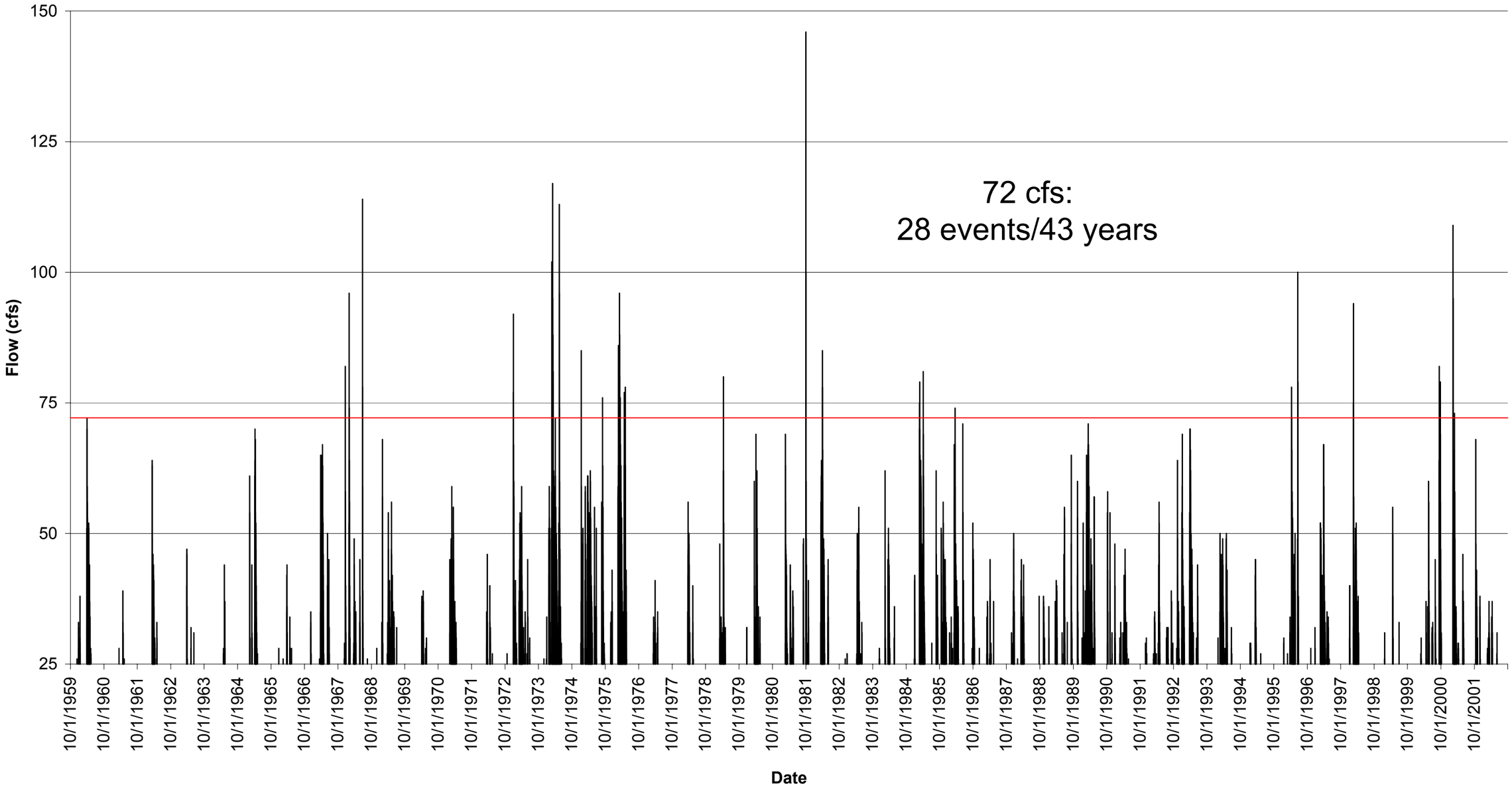

Middle Branch of Clinton River at Macomb
USGS Station Number 04164800
Annual Mean Streamflow (cfs)
Year
y = 0.9123x - 1772.1
R2 = 0.1989
0
5
10
15
20
25
30
35
40
45
50
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982

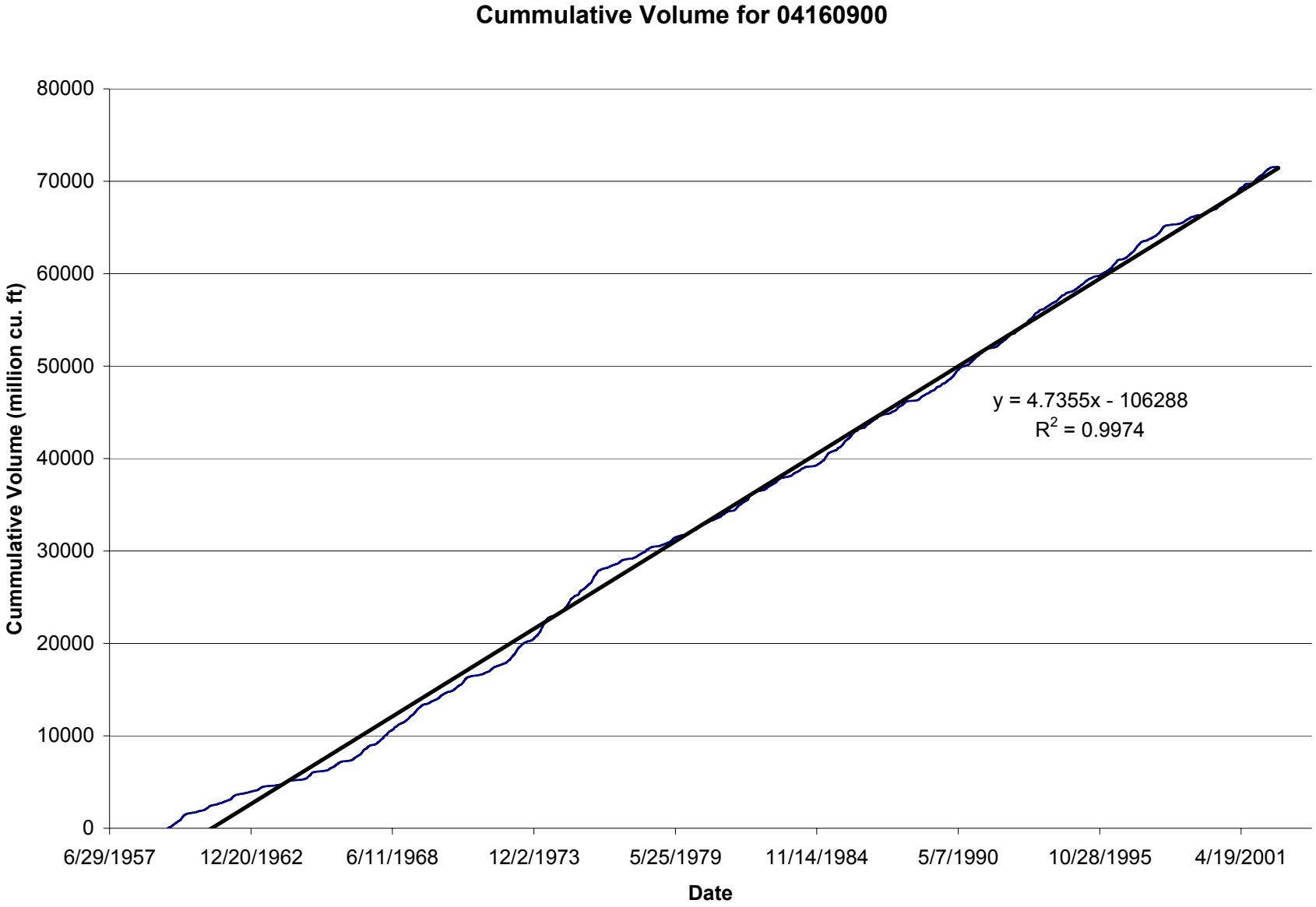

Clinton River at Moravian Drive in Mt Clemens
USGS Station Number 04165500
Peak Streamflow (cfs)
25,000
20,000
15,000
10,000
5,000
0
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year
y = -42.408x + 90358
R2 = 0.044


Clinton River at Moravian Drive in Mt Clemens
USGS Station Number 04165500
Annual Mean Streamflow (cfs)
1200
1000
800
600
400
200
0
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year
y = 4.1914x - 7679.2
R2 = 0.1956

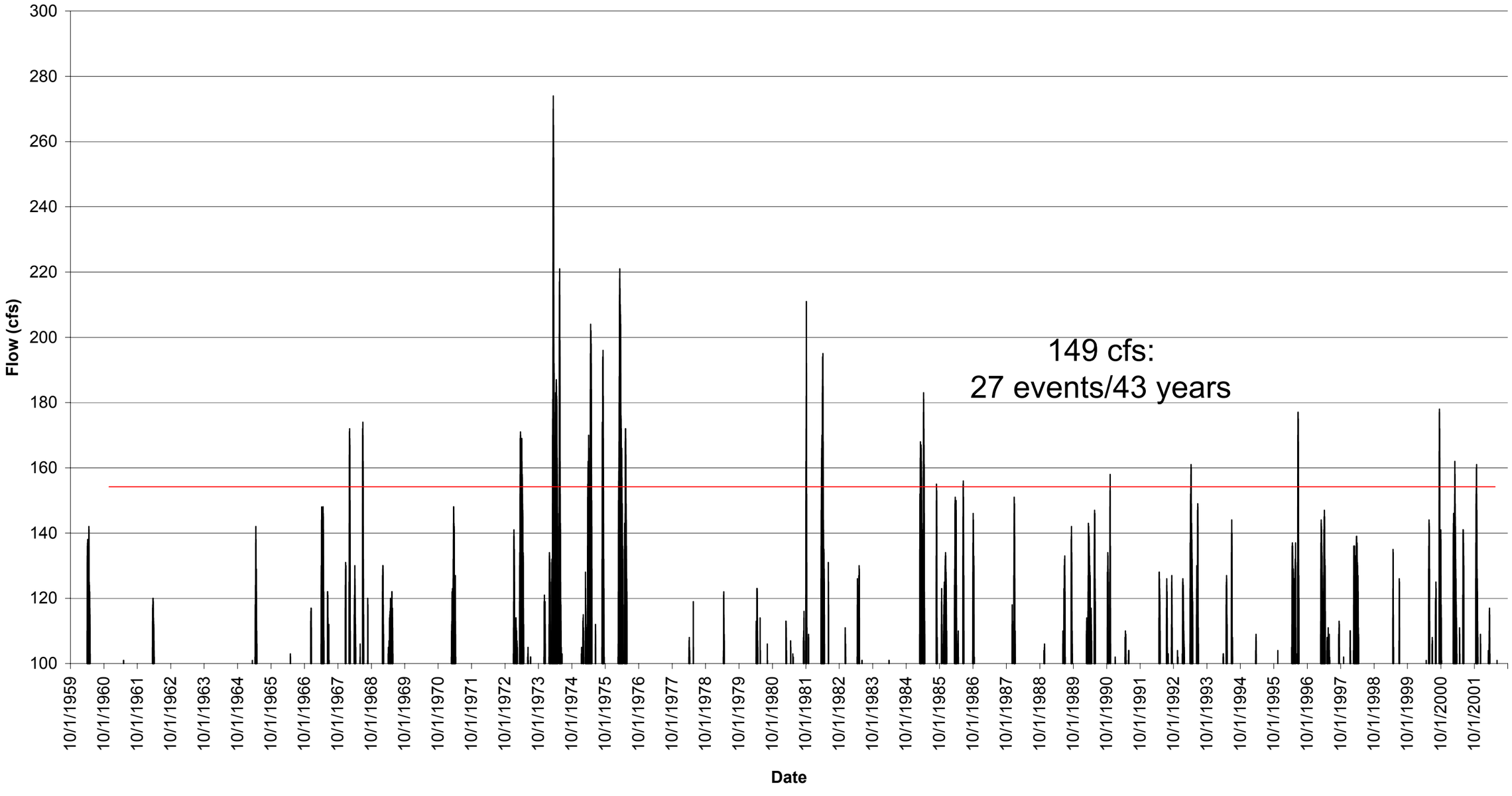

Cummulative Volume for 04160800
Cummulative Volume (million cu. ft)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
y = 1.2023x - 27225
R2 = 0.9962
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date

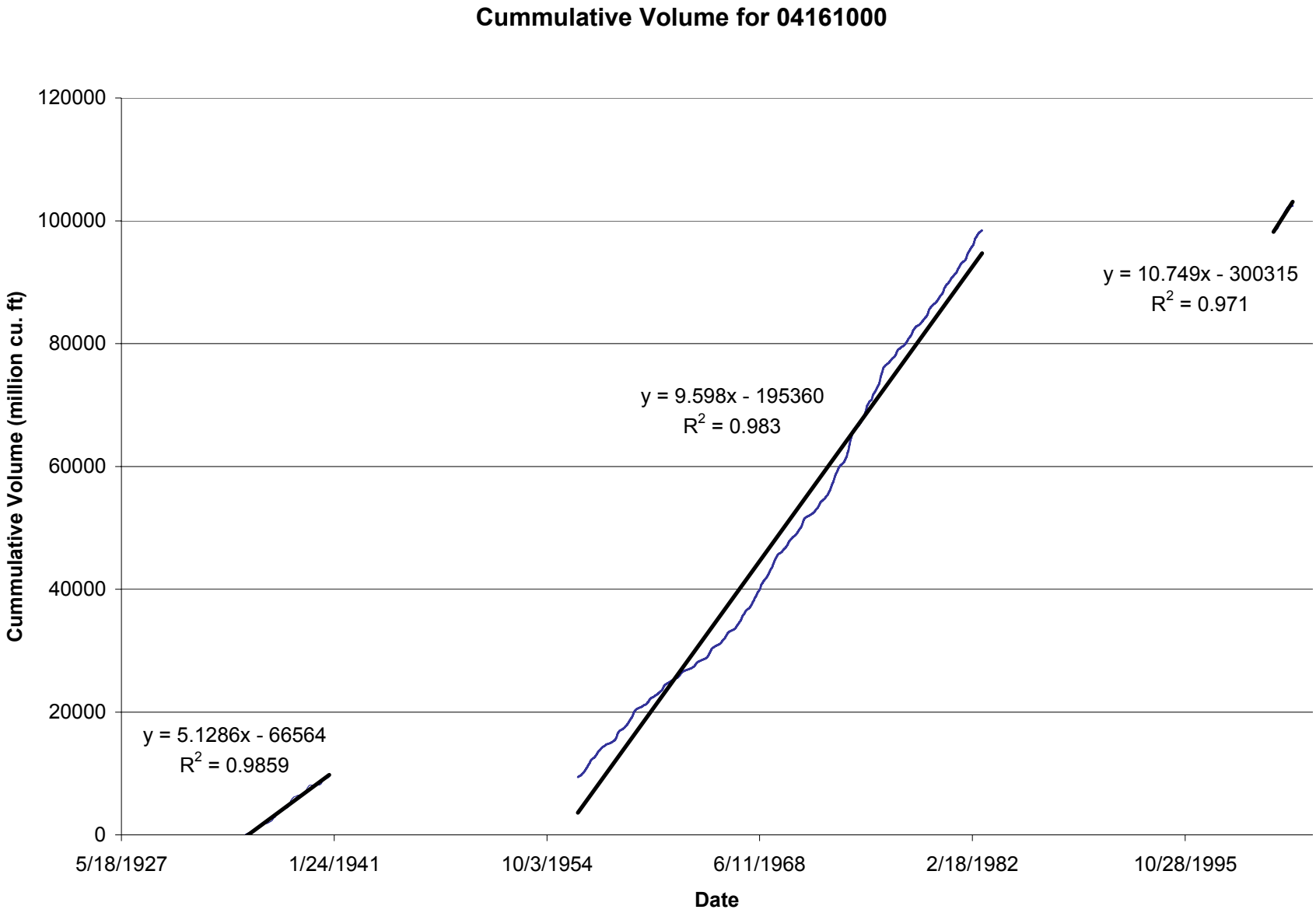
## Mean Daily Flows for 04160800



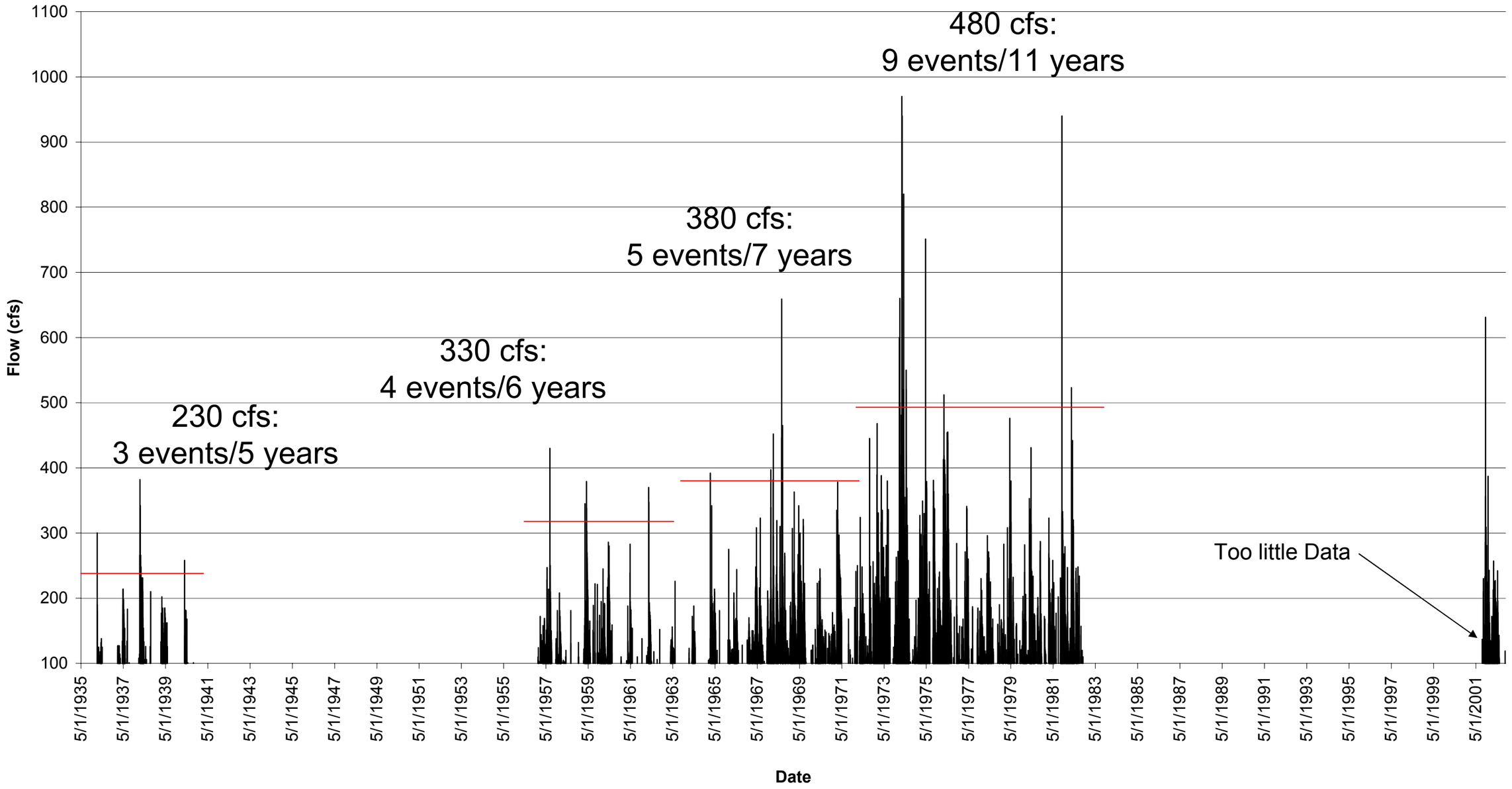

Cummulative Volume for 04160900
80000
70000
60000
50000
40000
30000
20000
10000
0
Cummulative Volume (million cu. ft)
y = 4.7355x - 106288
R2 = 0.9974
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date

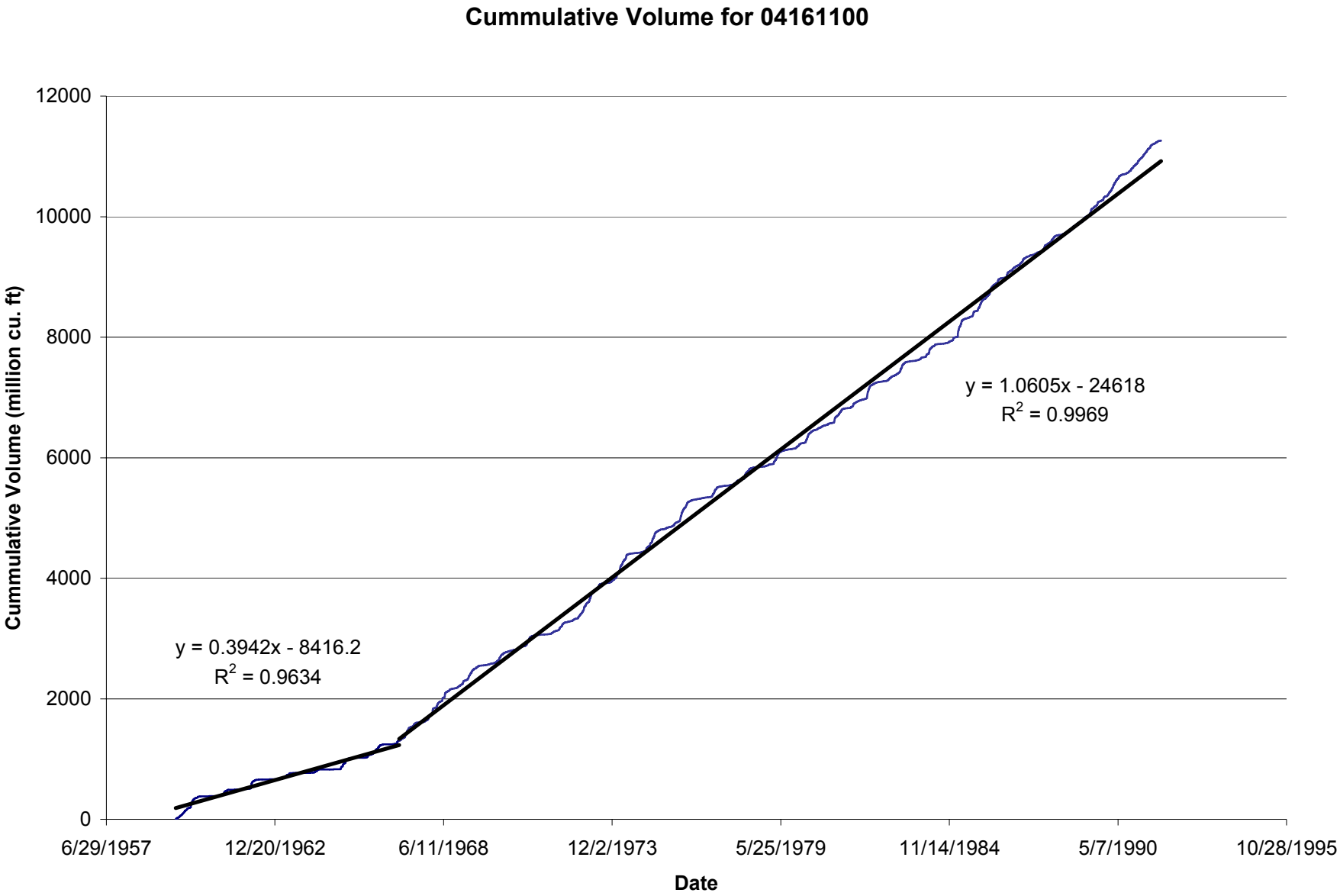
## Mean Daily Flows for 04160900



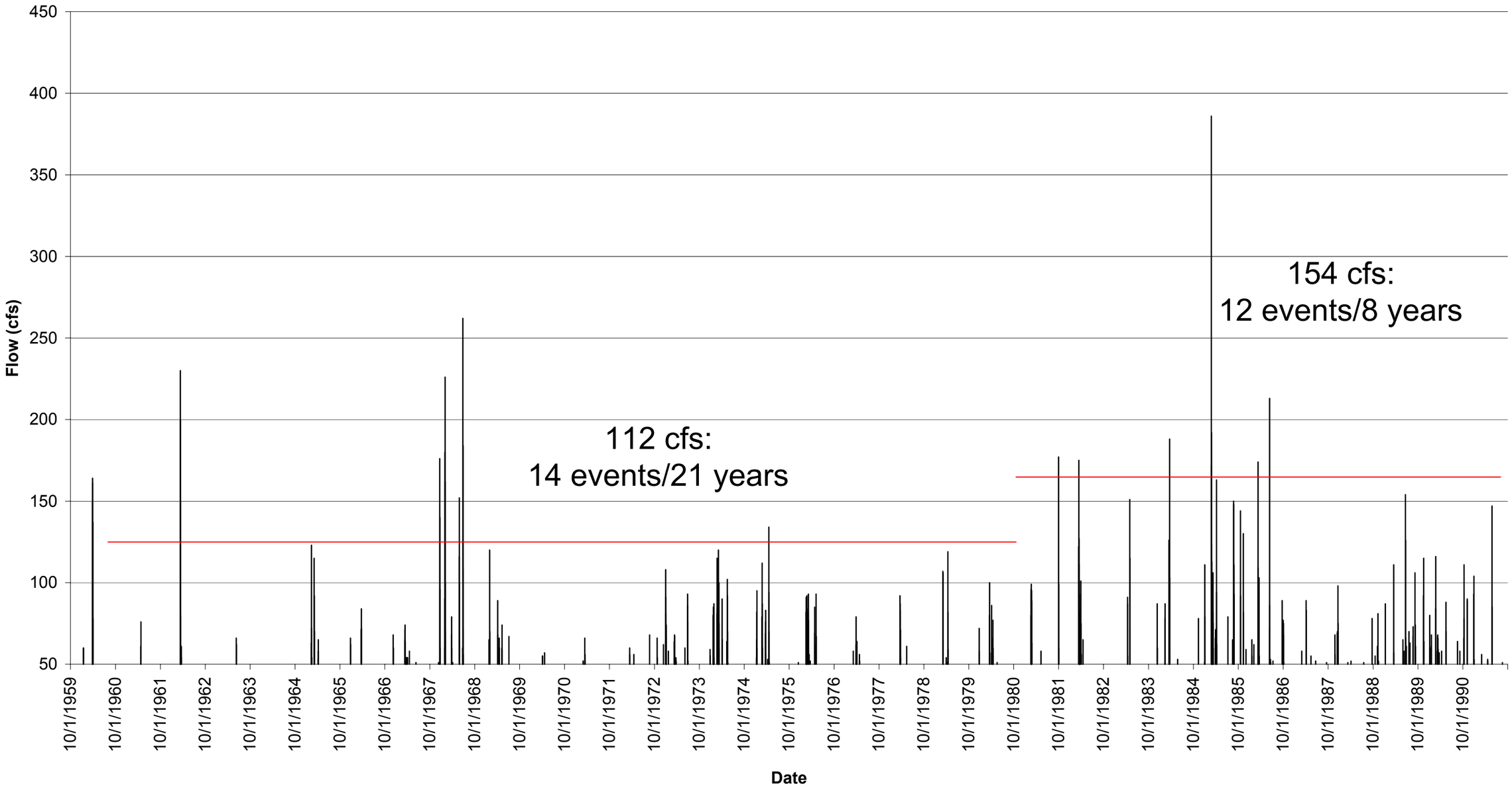

Cummulative Volume for 04161000
120000
100000
80000
60000
40000
20000
0
Cummulative Volume (million cu. ft)
y = 5.1286x - 66564
R2 = 0.9859
y = 9.598x - 195360
R2 = 0.983
y = 10.749x - 300315
R2 = 0.971
5/18/1927
1/24/1941
10/3/1954
6/11/1968
2/18/1982
10/28/1995
Date

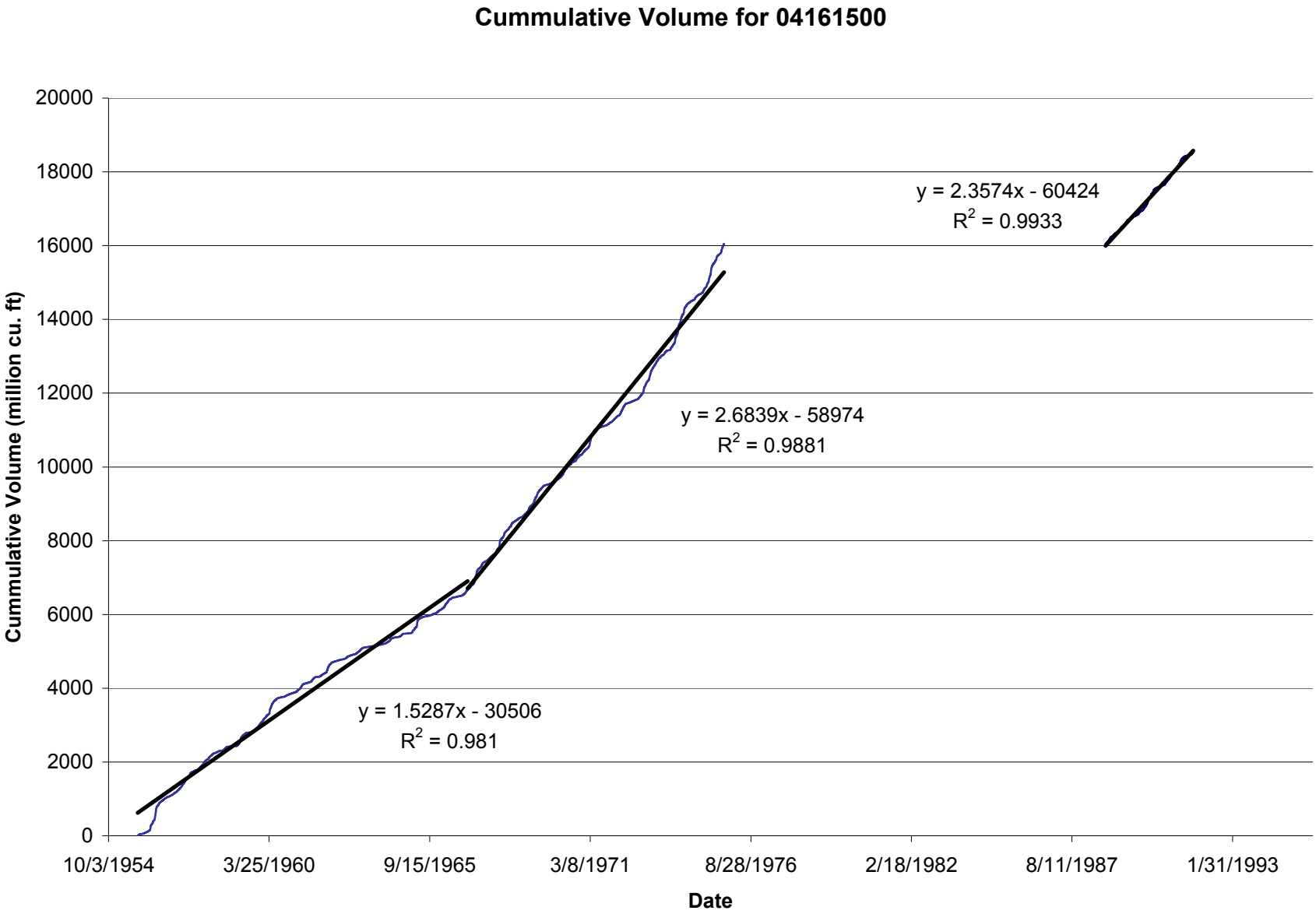
**Mean Daily Flows for 04161000**



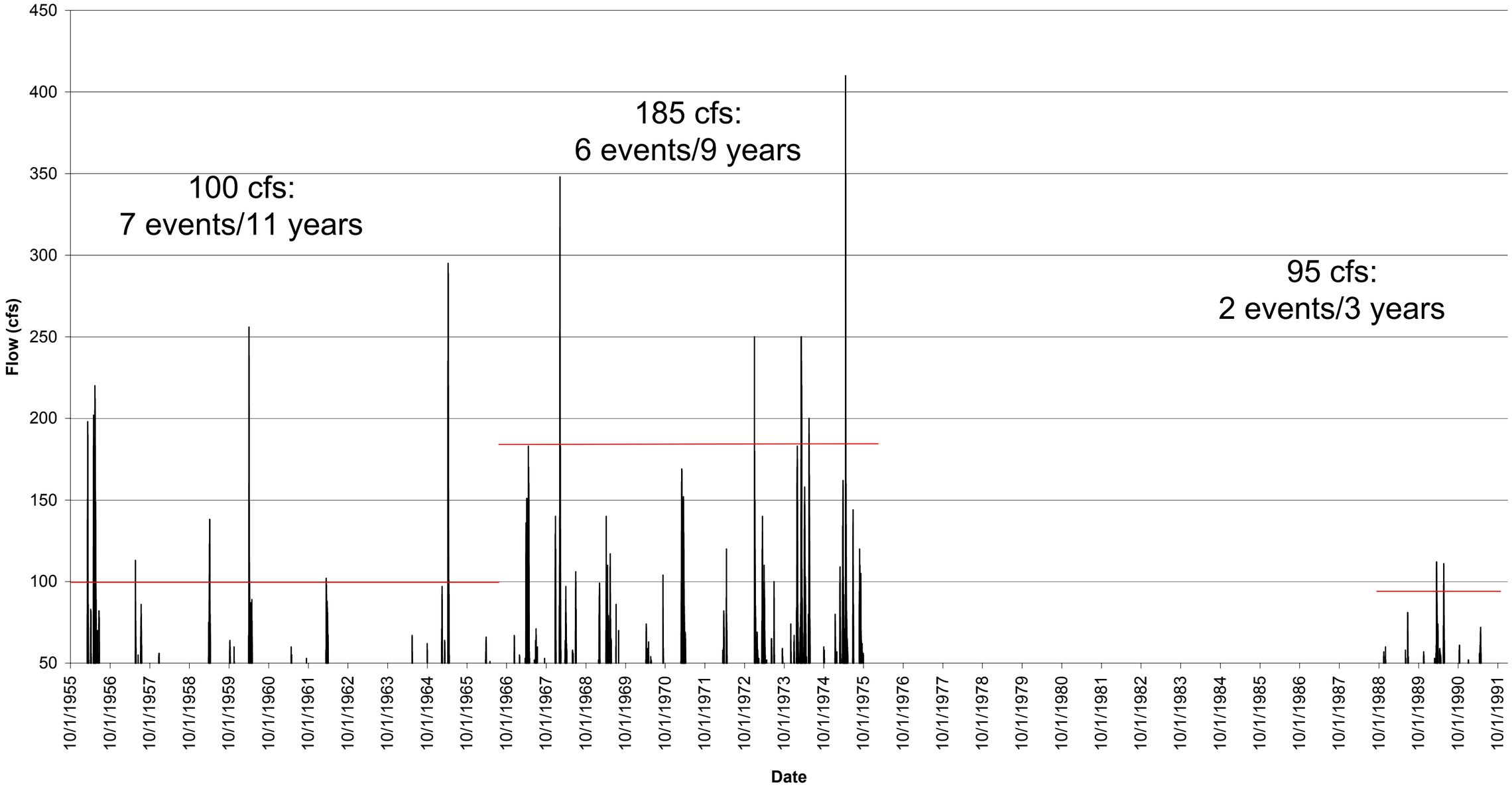

Cummulative Volume for 04161100
Cummulative Volume (million cu. ft)
12000
10000
8000
6000
4000
2000
0
y = 0.3942x - 8416.2
R2 = 0.9634
y = 1.0605x - 24618
R2 = 0.9969
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
Date

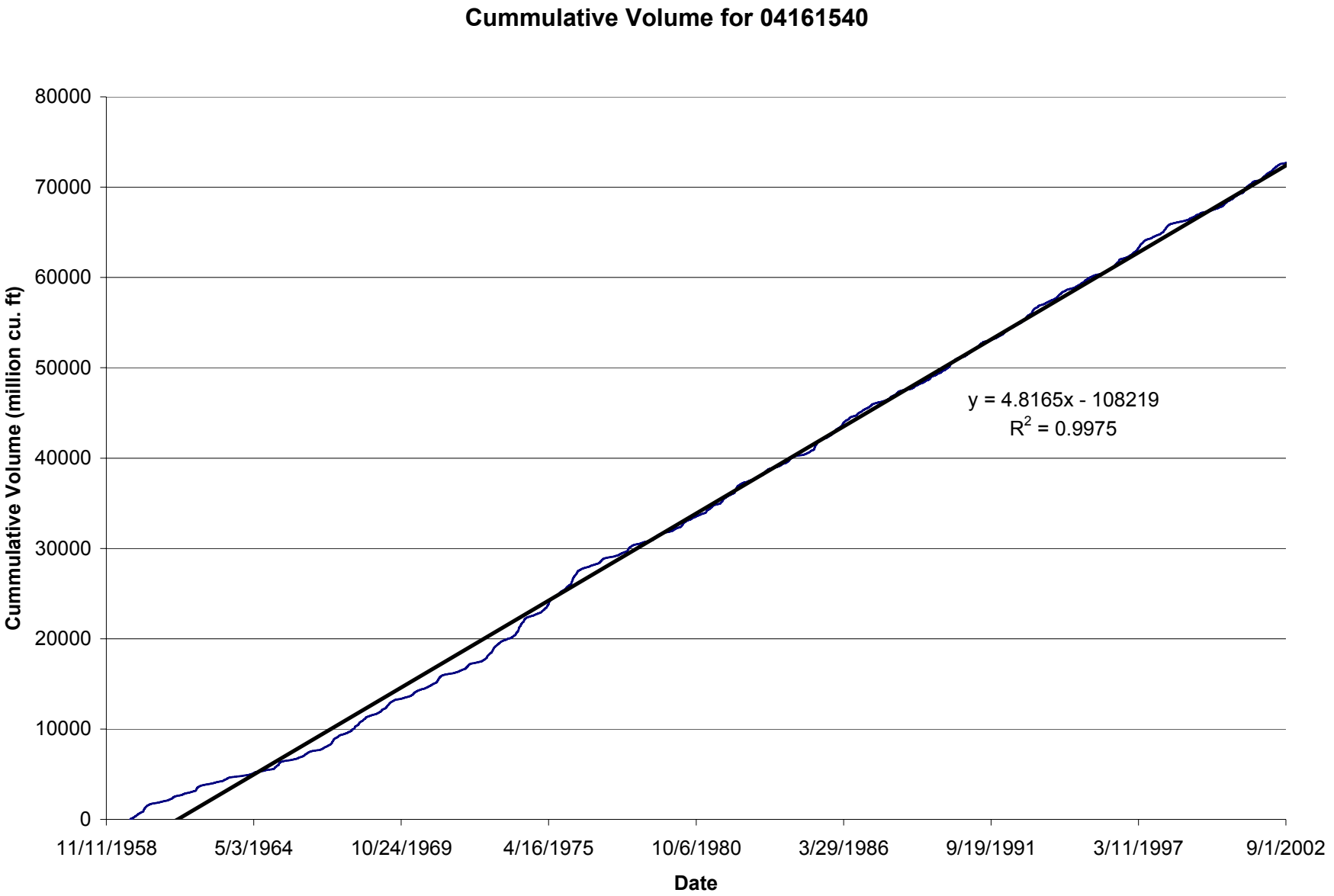
## Mean Daily Flows for 04161100



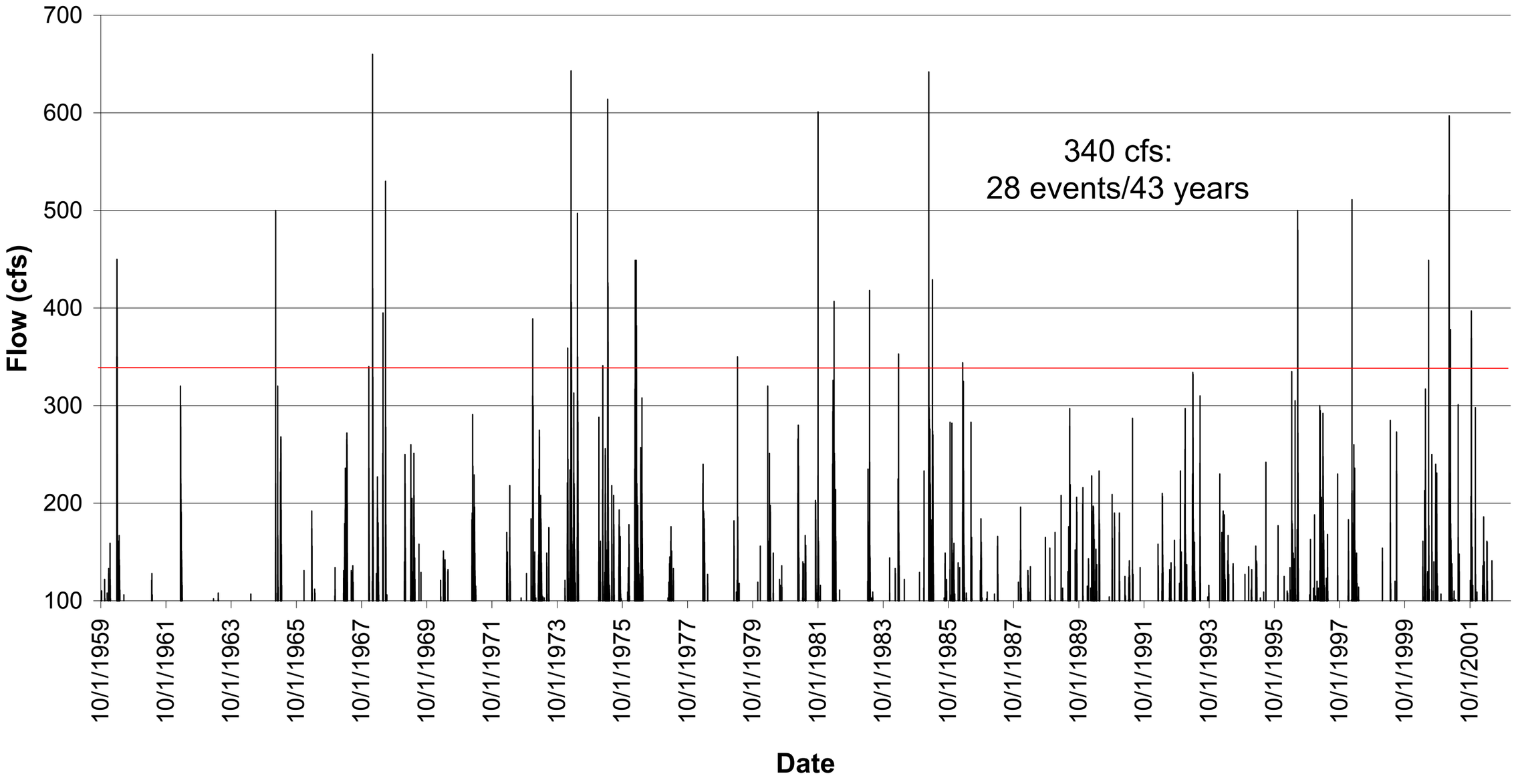

Cummulative Volume for 04161500
Cummulative Volume (million cu. ft)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
y = 2.3574x - 60424
R2 = 0.9933
y = 2.6839x - 58974
R2 = 0.9881
y = 1.5287x - 30506
R2 = 0.981
10/3/1954
3/25/1960
9/15/1965
3/8/1971
8/28/1976
2/18/1982
8/11/1987
1/31/1993
Date

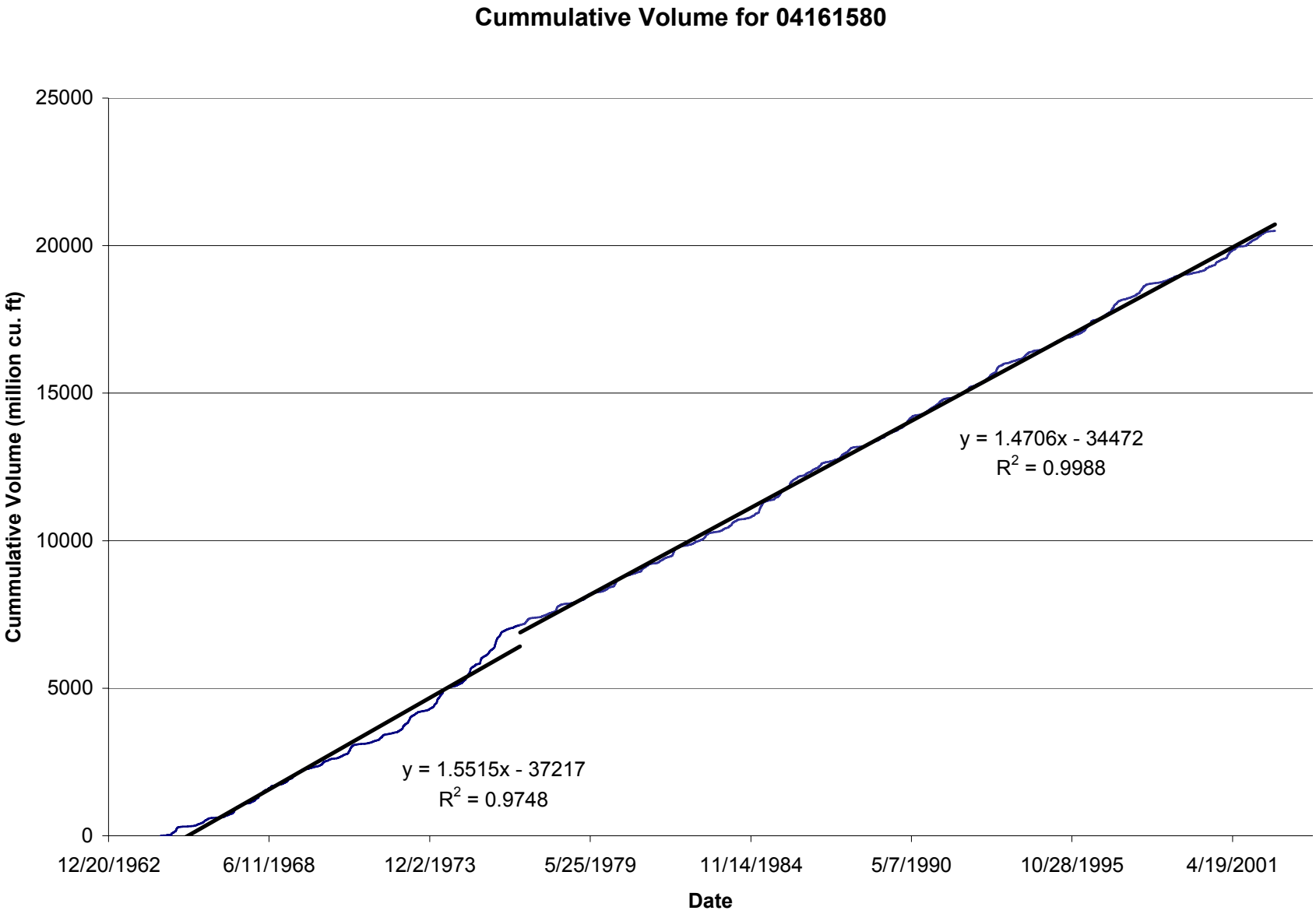
**Mean Daily Flows for 04161500**



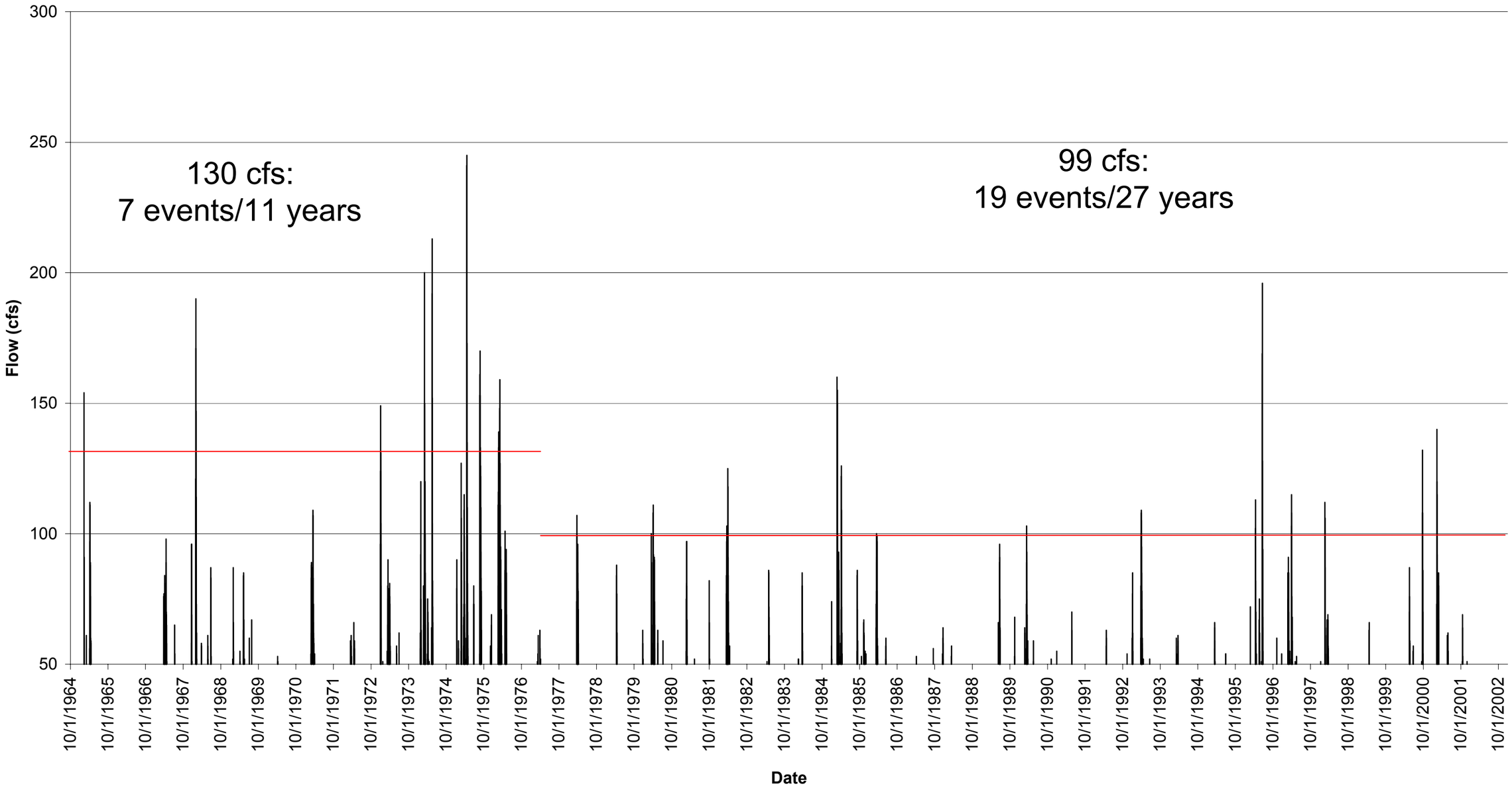

Cummulative Volume for 04161540
Cummulative Volume (million cu. ft)
80000
70000
60000
50000
40000
30000
20000
10000
0
y = 4.8165x - 108219
R2 = 0.9975
11/11/1958
5/3/1964
10/24/1969
4/16/1975
10/6/1980
3/29/1986
9/19/1991
3/11/1997
9/1/2002
Date

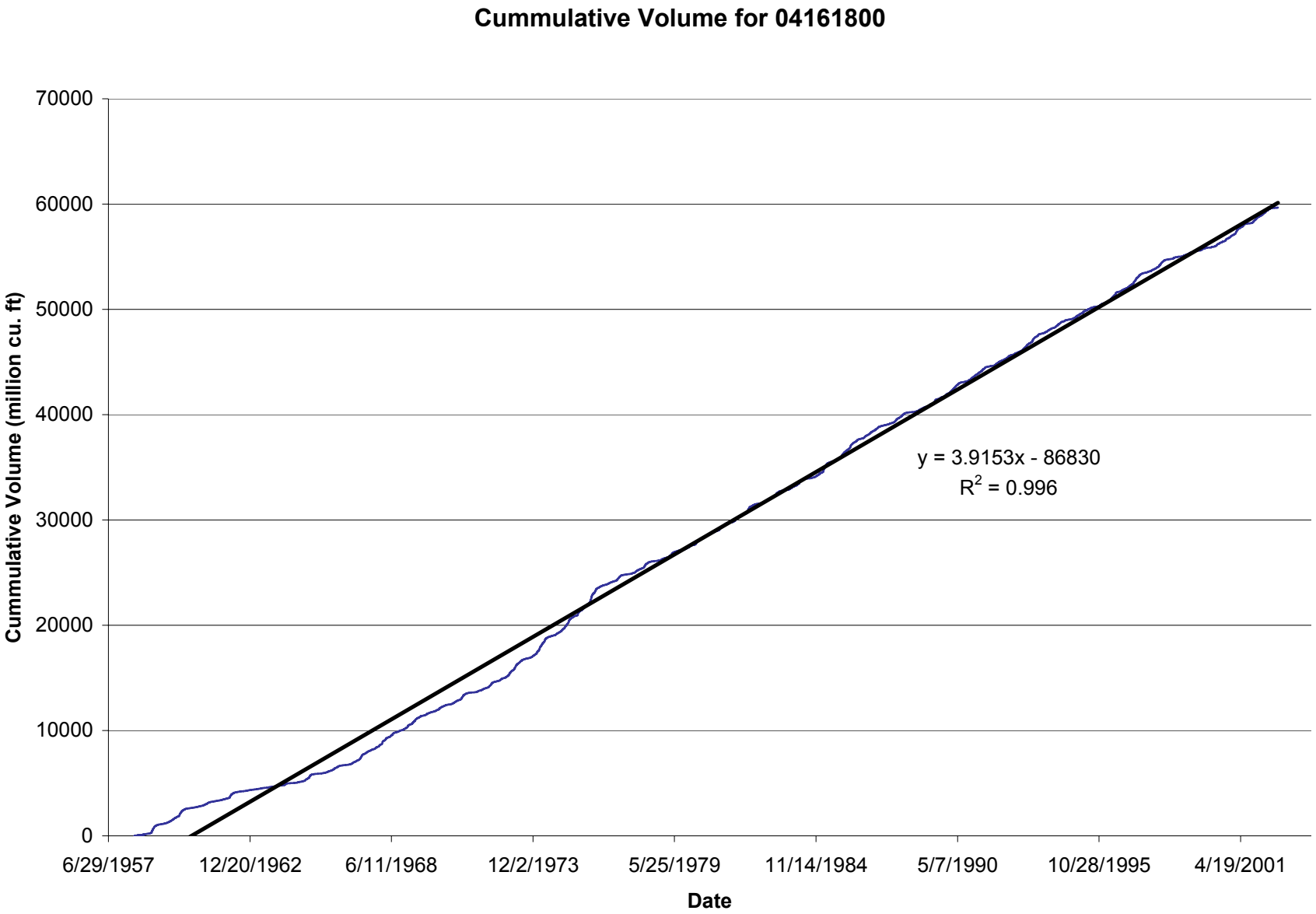
## Mean Daily Flows for 04161540



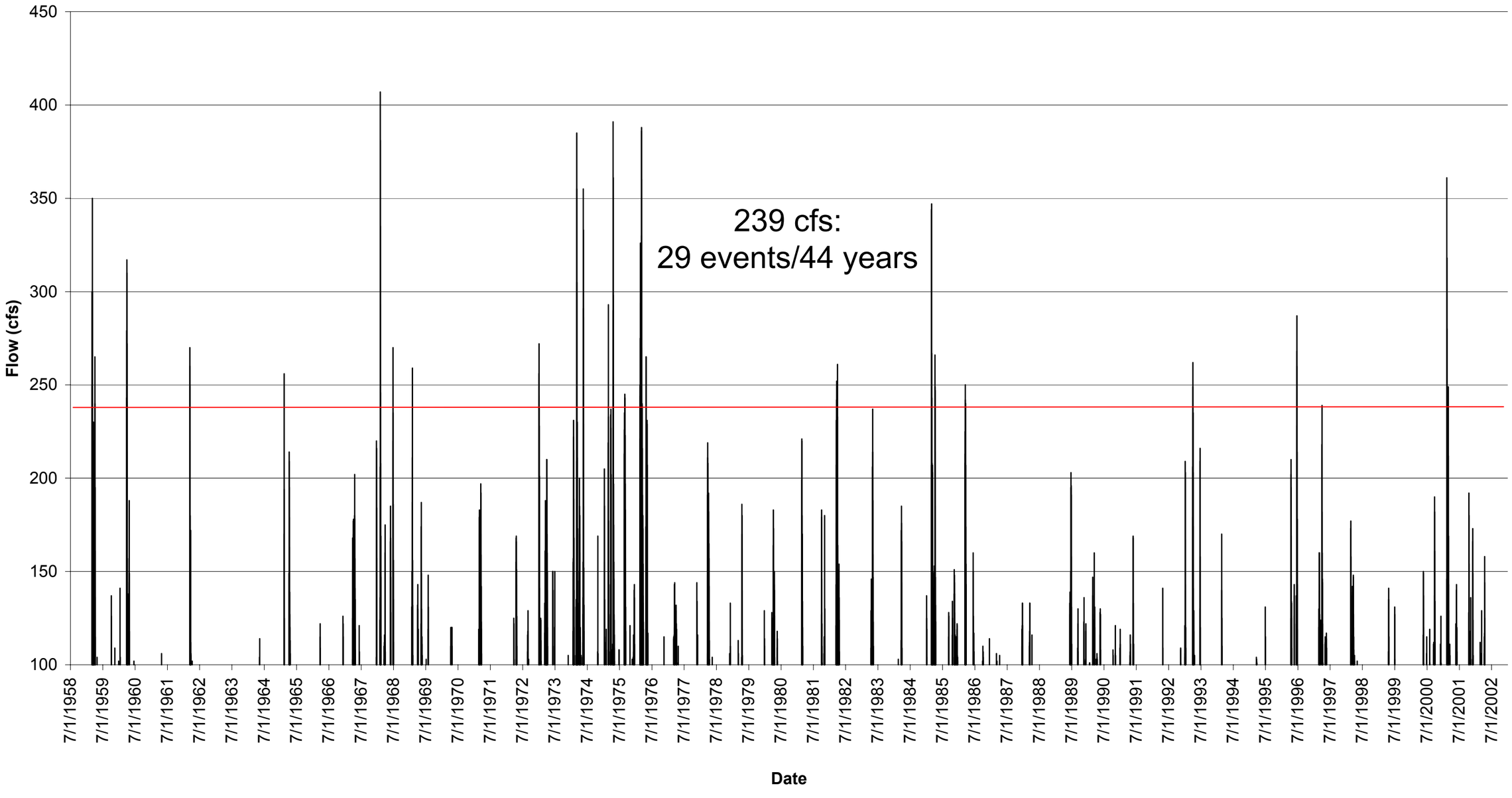

Cummulative Volume for 04161580
Cummulative Volume (million cu. ft)
25000
20000
15000
10000
5000
0
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date
y = 1.4706x - 34472
R2 = 0.9988
y = 1.5515x - 37217
R2 = 0.9748

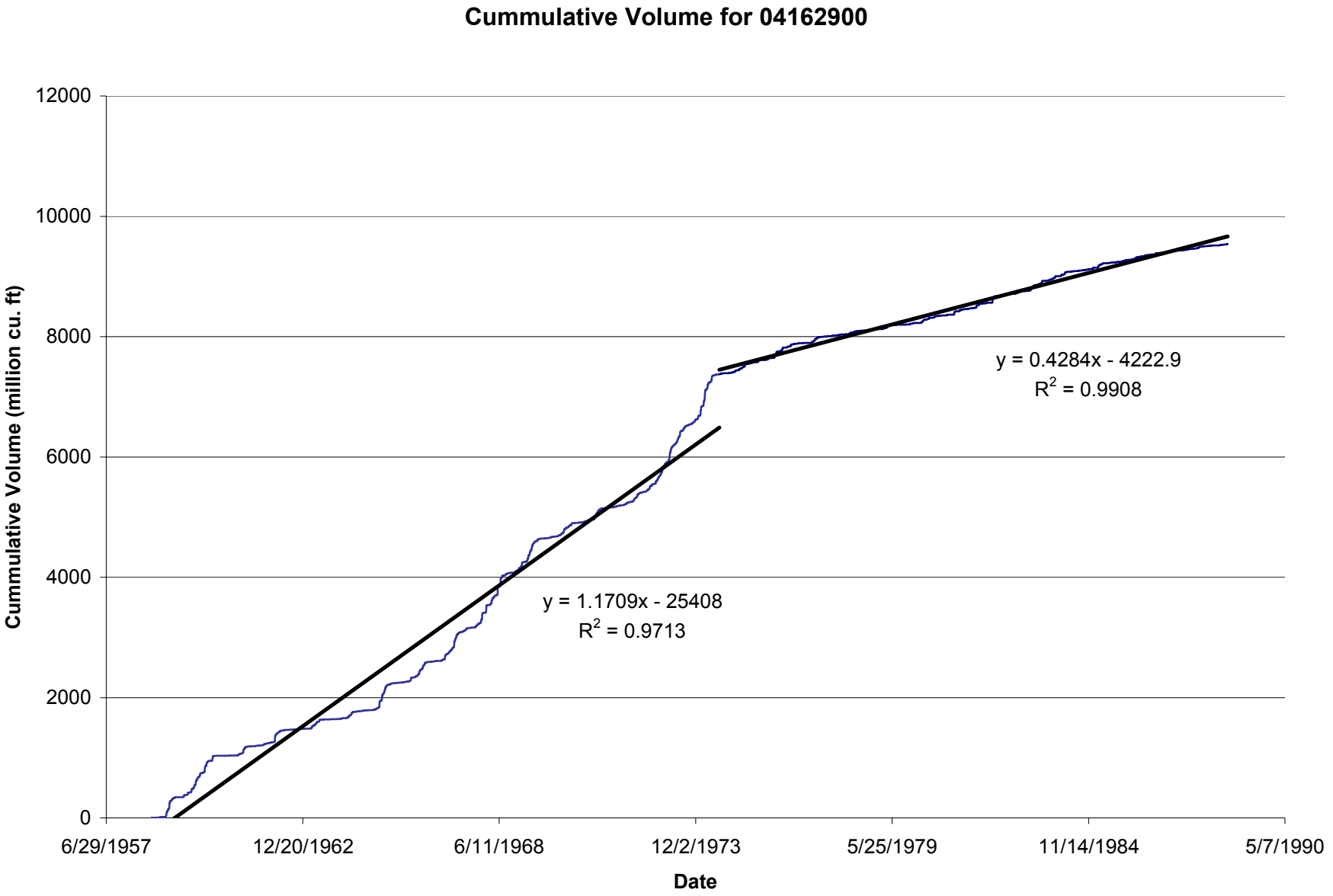
**Mean Daily Flows for 04161580**



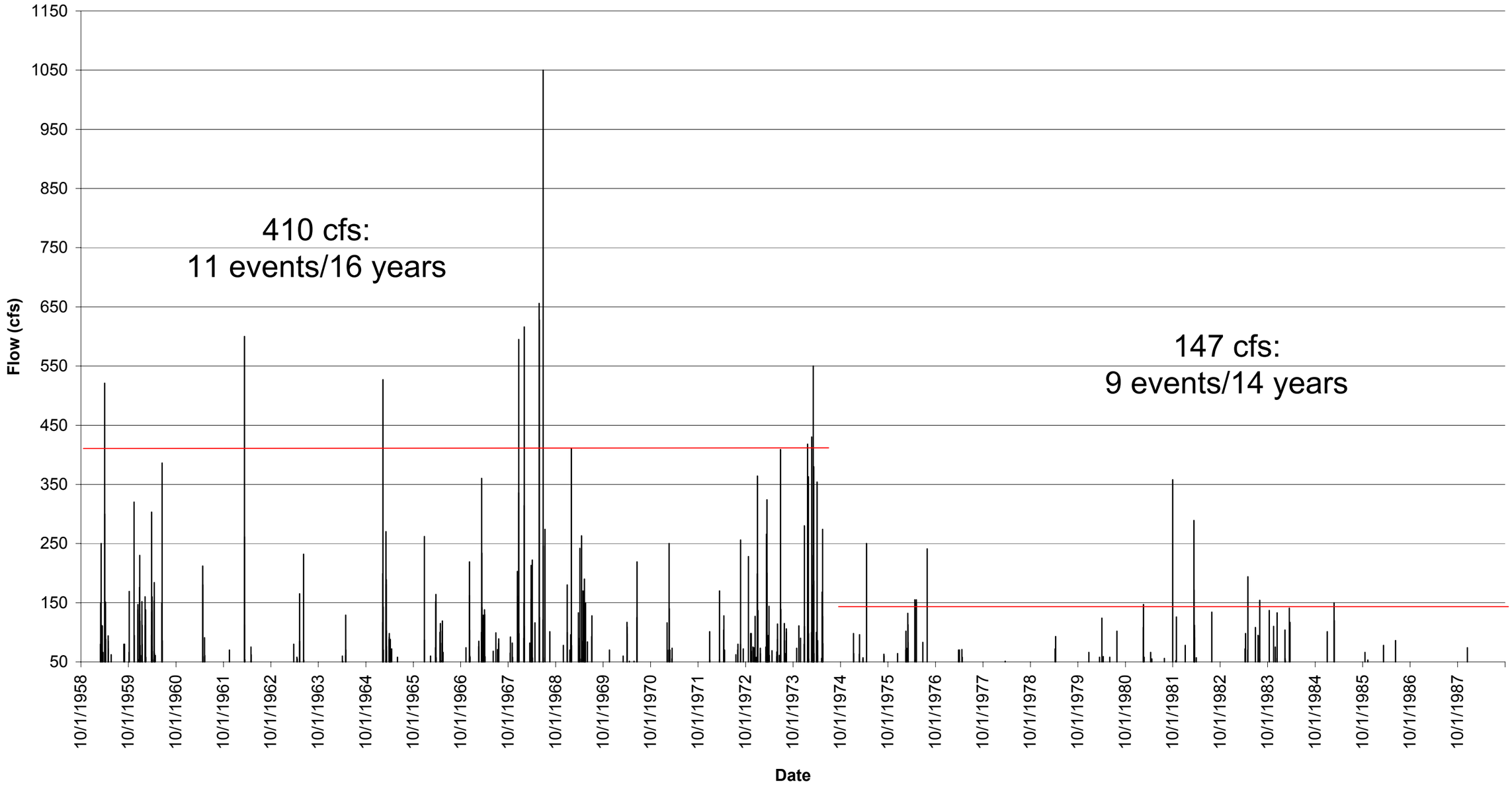

Cummulative Volume for 04161800
70000
60000
50000
40000
30000
20000
10000
0
Cummulative Volume (million cu. ft)
y = 3.9153x - 86830
R2 = 0.996
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date

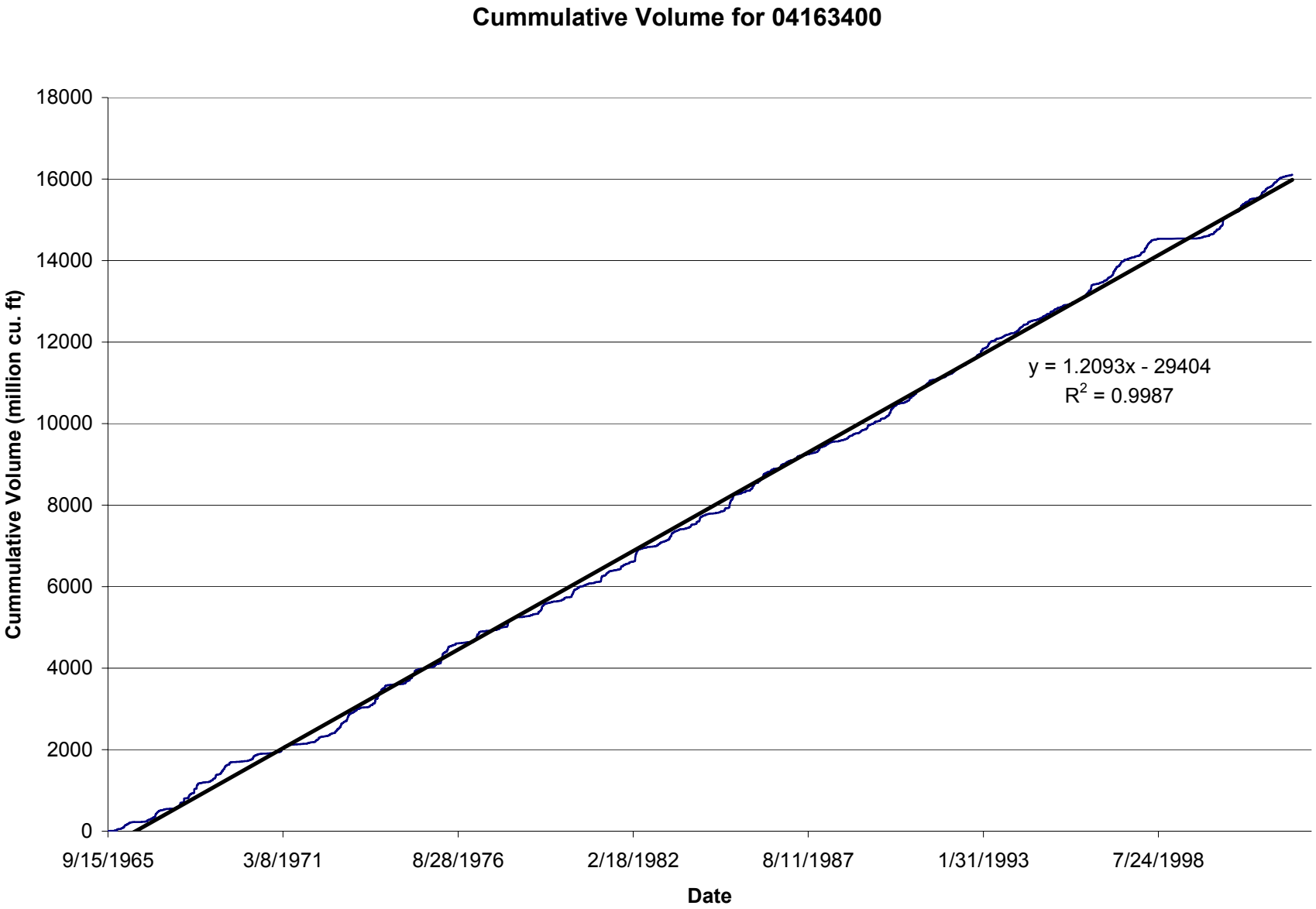
## Mean Daily Flows for 04161800



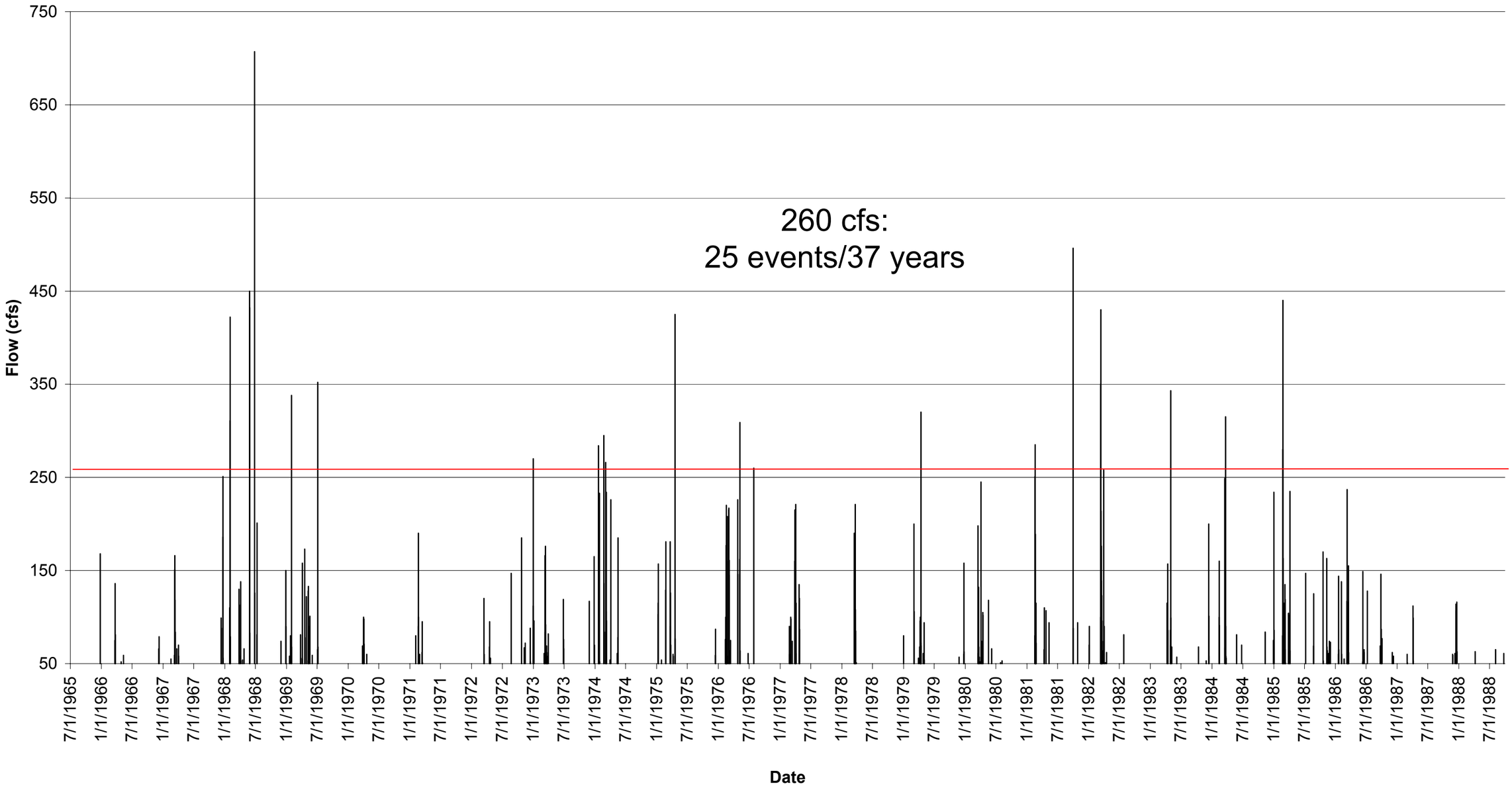

Cummulative Volume for 04162900
12000
10000
8000
6000
4000
2000
0
Cummulative Volume (million cu. ft)
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
Date
y = 1.1709x - 25408
R2 = 0.9713
y = 0.4284x - 4222.9
R2 = 0.9908

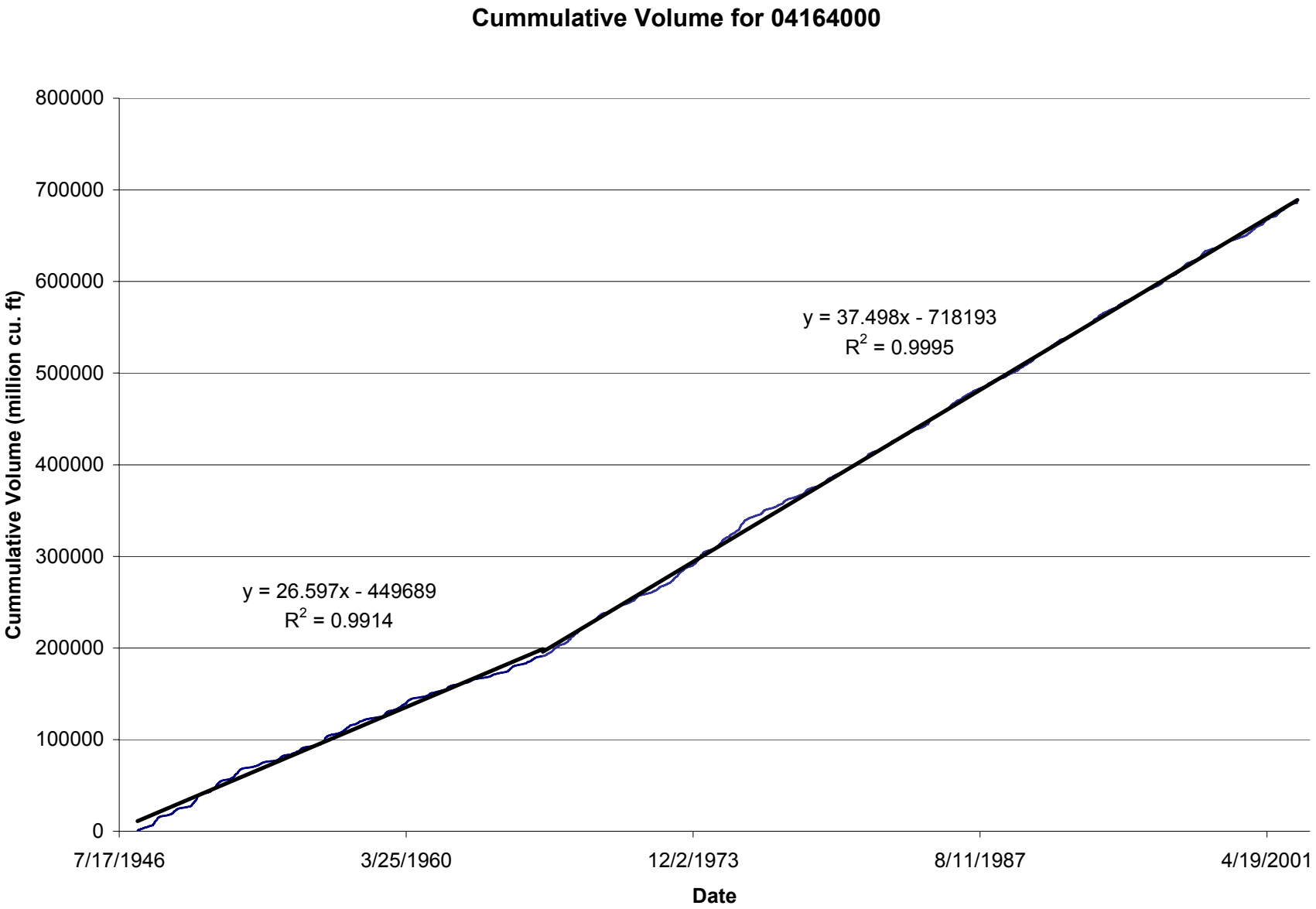
## Mean Daily Flows for 04162900



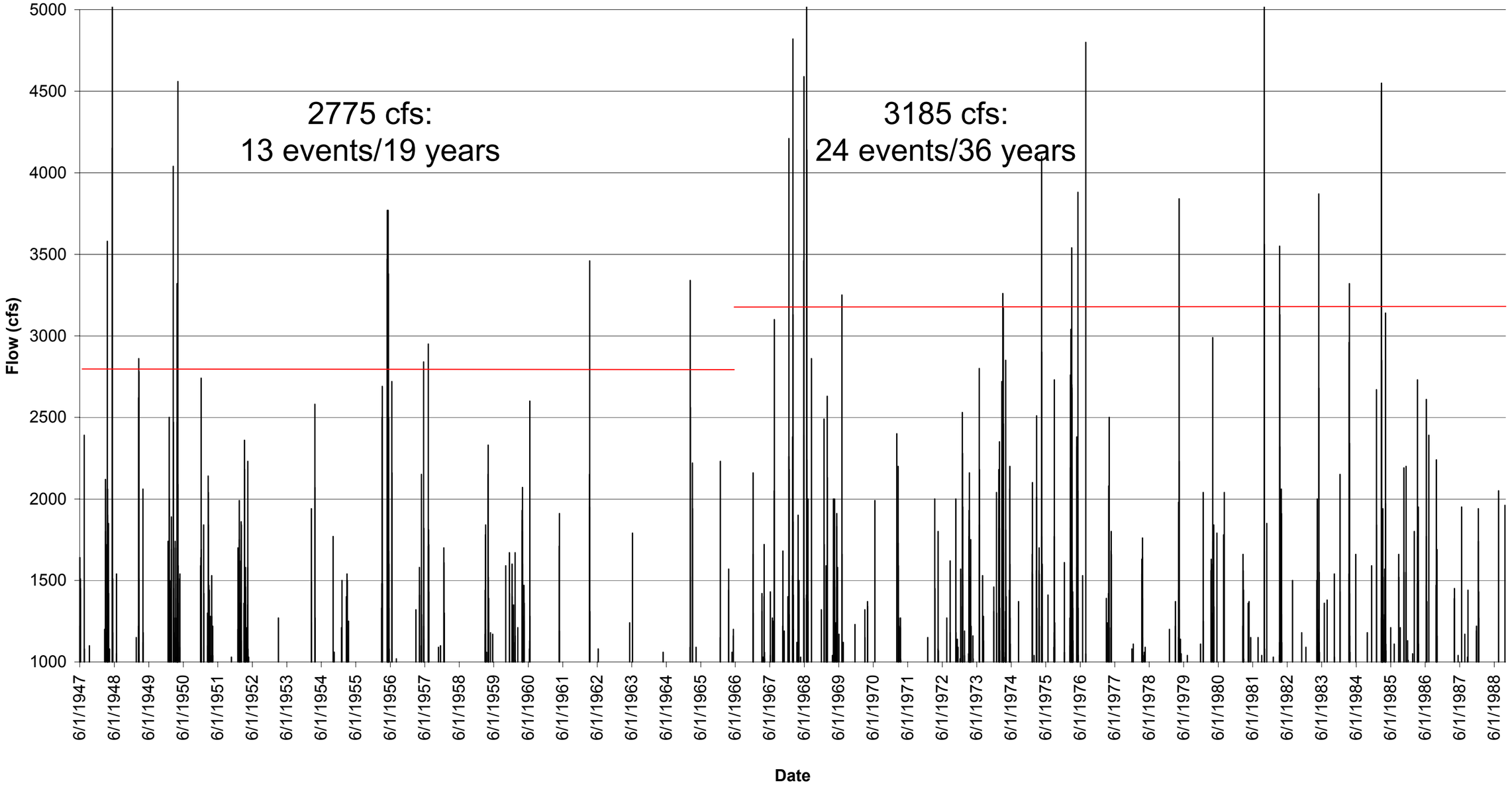

Cummulative Volume for 04163400
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Cummulative Volume (million cu. ft)
y = 1.2093x - 29404
R2 = 0.9987
9/15/1965
3/8/1971
8/28/1976
2/18/1982
8/11/1987
1/31/1993
7/24/1998
Date

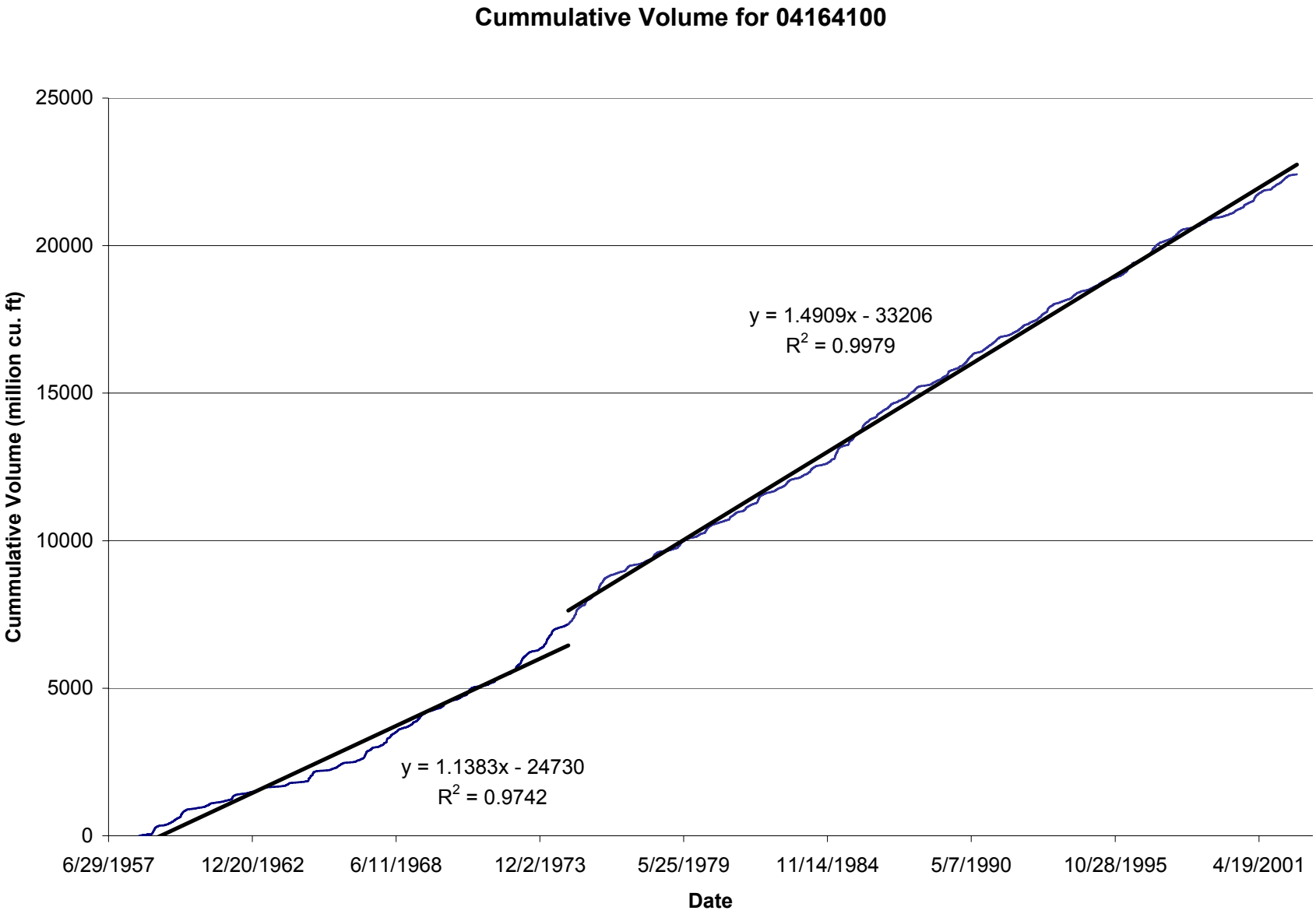
## Mean Daily Flows for 04163400



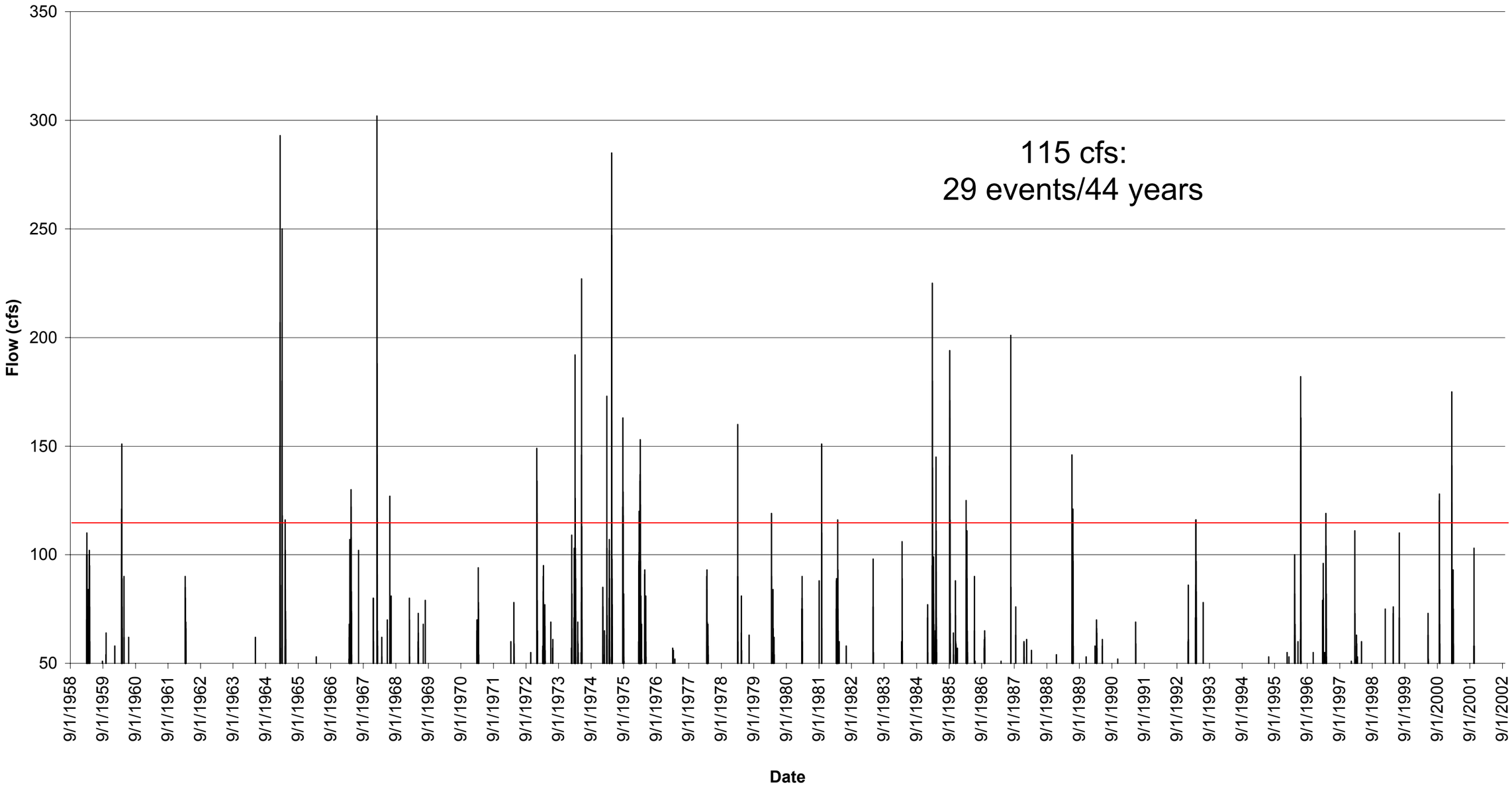

Cummulative Volume for 04164000
800000
700000
600000
500000
400000
300000
200000
100000
0
Cummulative Volume (million cu. ft)
y = 37.498x - 718193
R2 = 0.9995
y = 26.597x - 449689
R2 = 0.9914
7/17/1946
3/25/1960
12/2/1973
8/11/1987
4/19/2001
Date

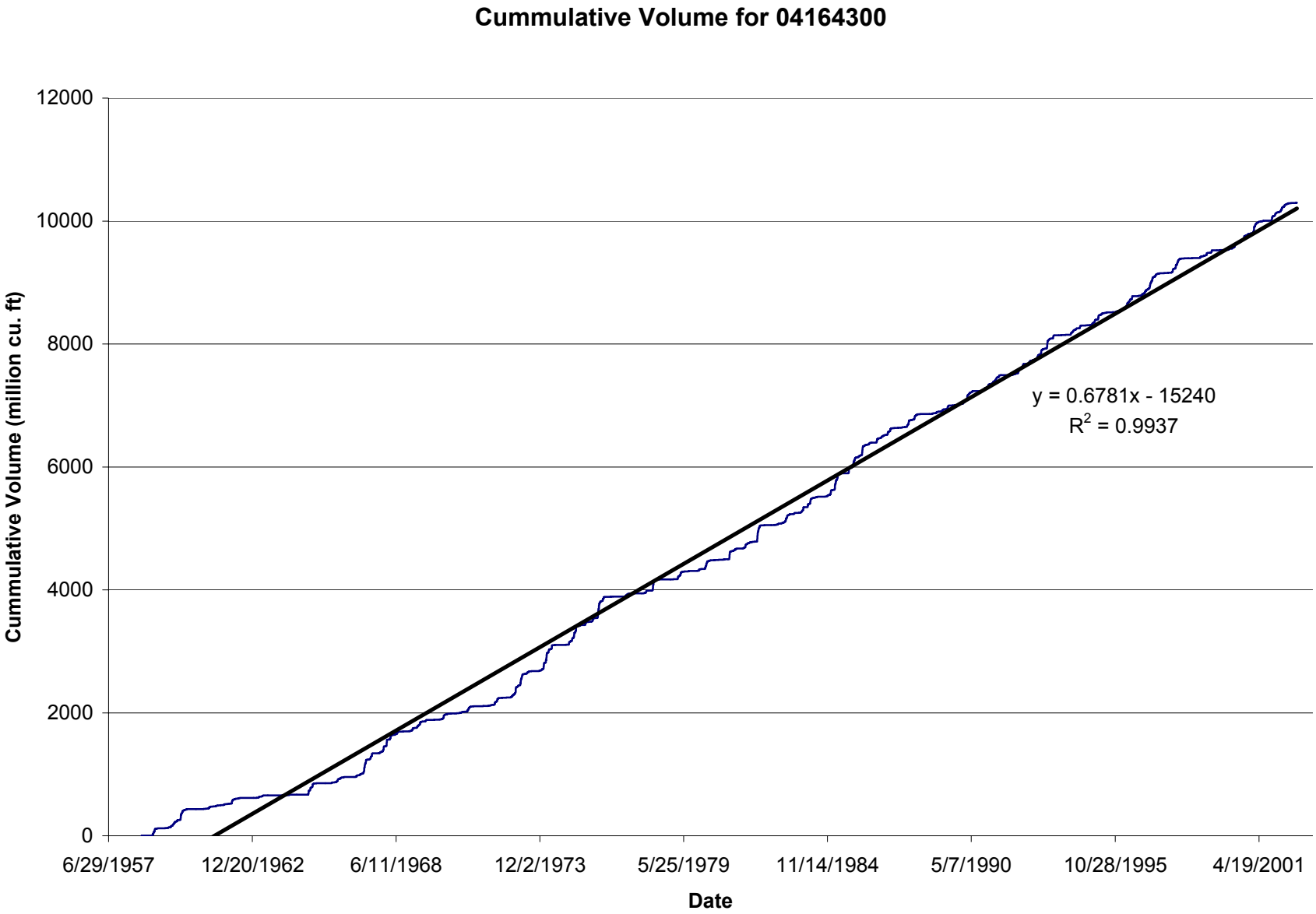
## Mean Daily Flows for 04164000



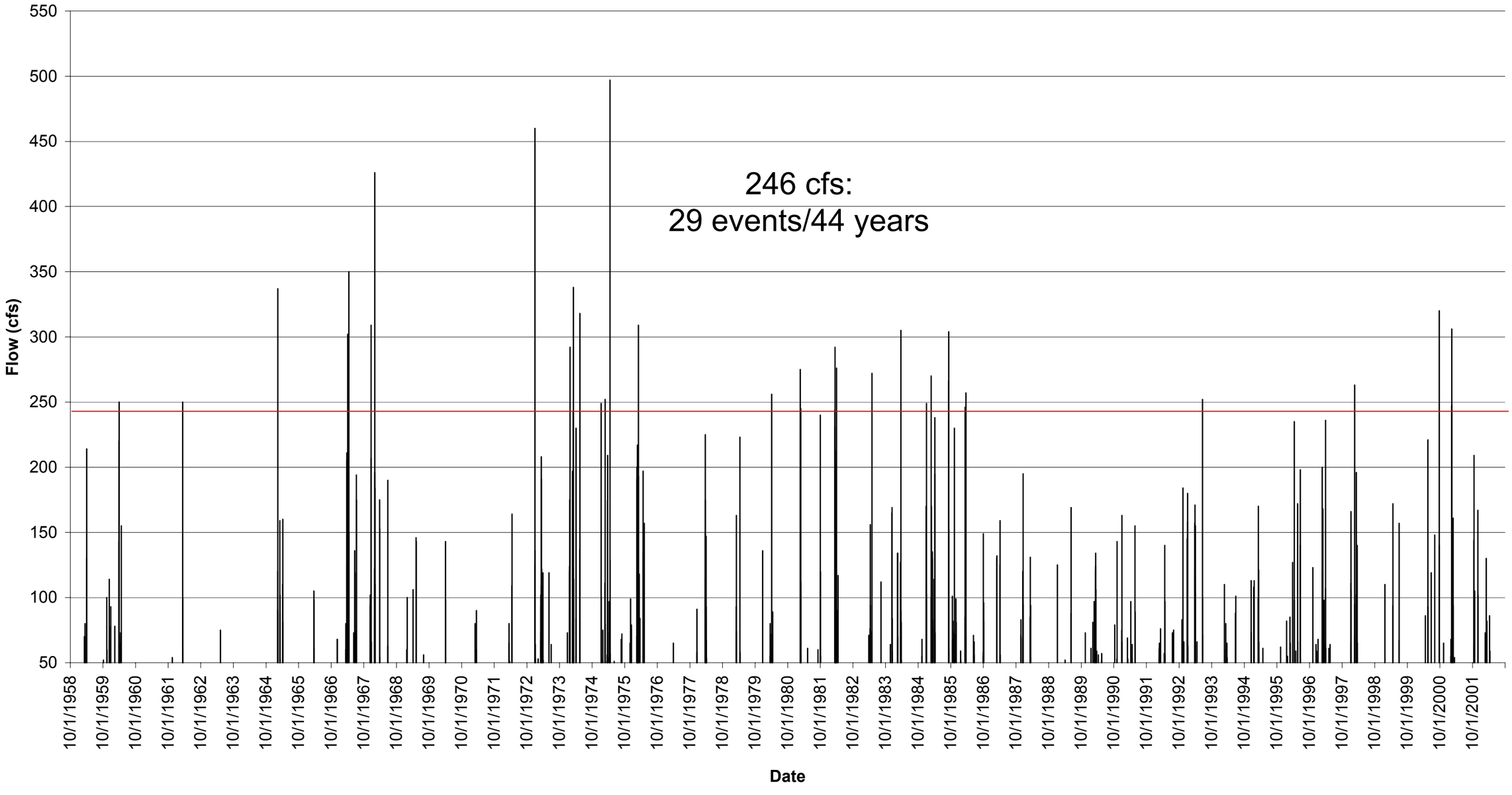

Cummulative Volume for 04164100
25000
20000
15000
10000
5000
0
Cummulative Volume (million cu. ft)
y = 1.4909x - 33206
R2 = 0.9979
y = 1.1383x - 24730
R2 = 0.9742
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date

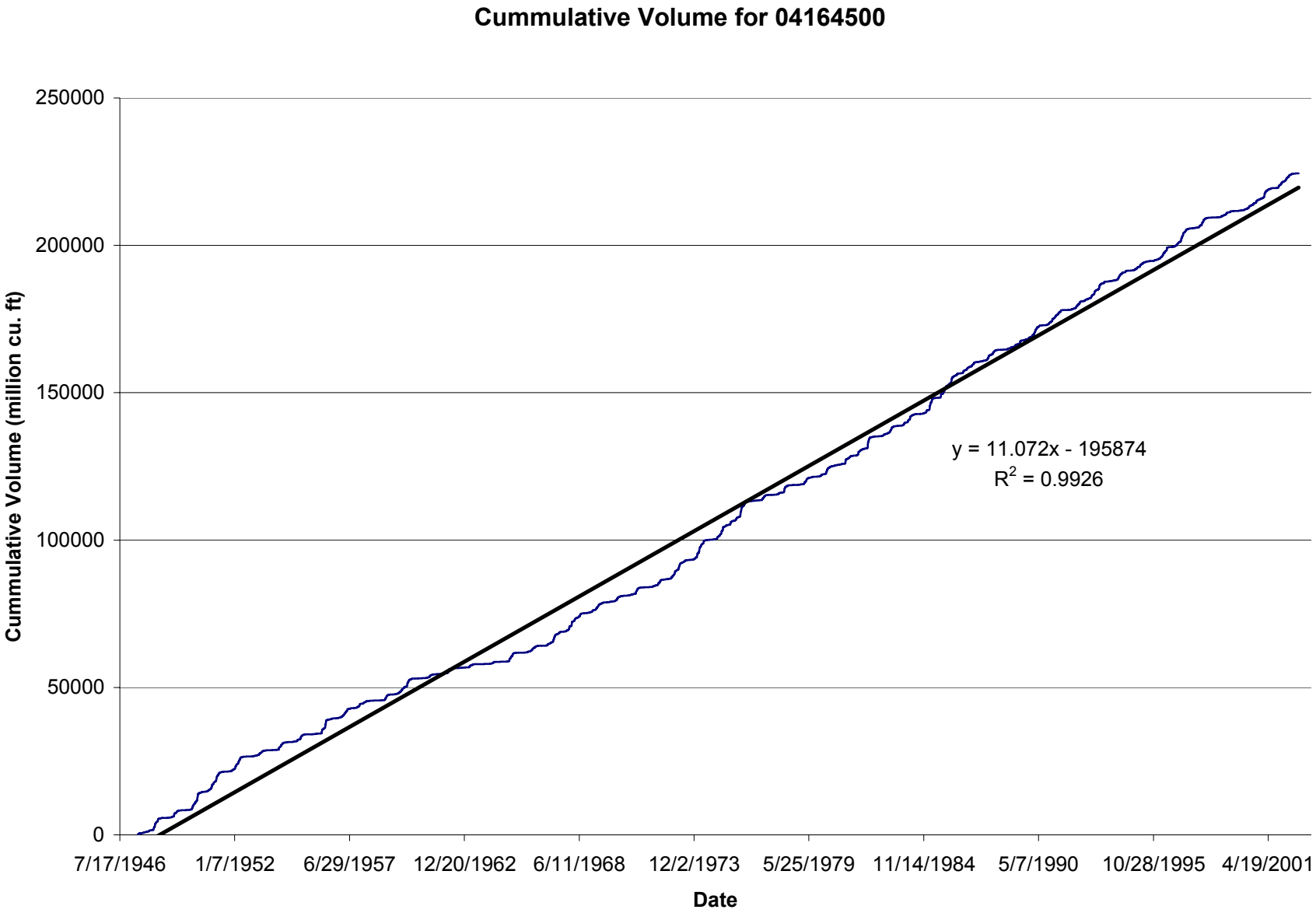
## Mean Daily Flows for 04164100



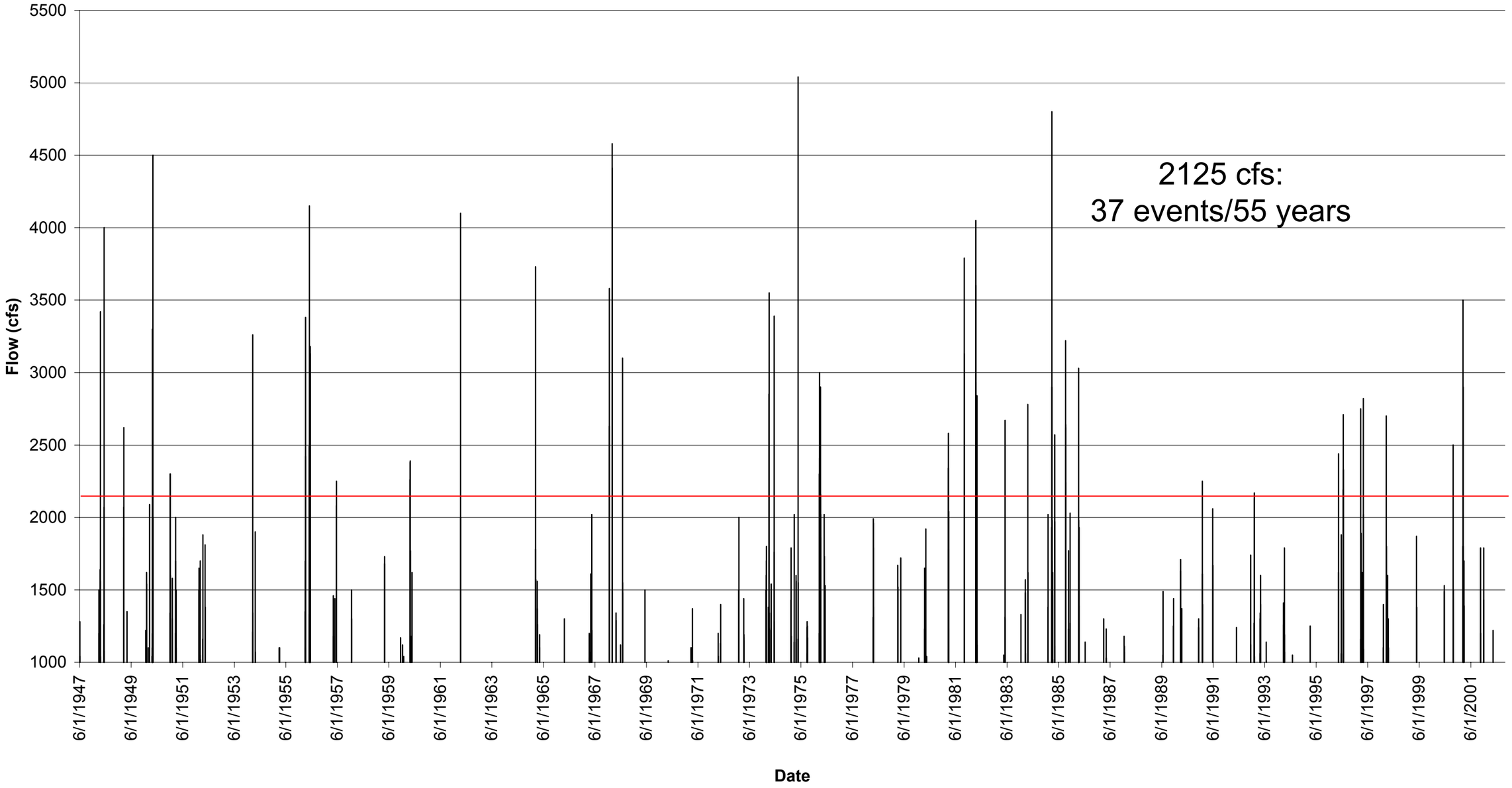

Cummulative Volume for 04164300
12000
10000
8000
6000
4000
2000
0
Cummulative Volume (million cu. ft)
y = 0.6781x - 15240
R2 = 0.9937
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date

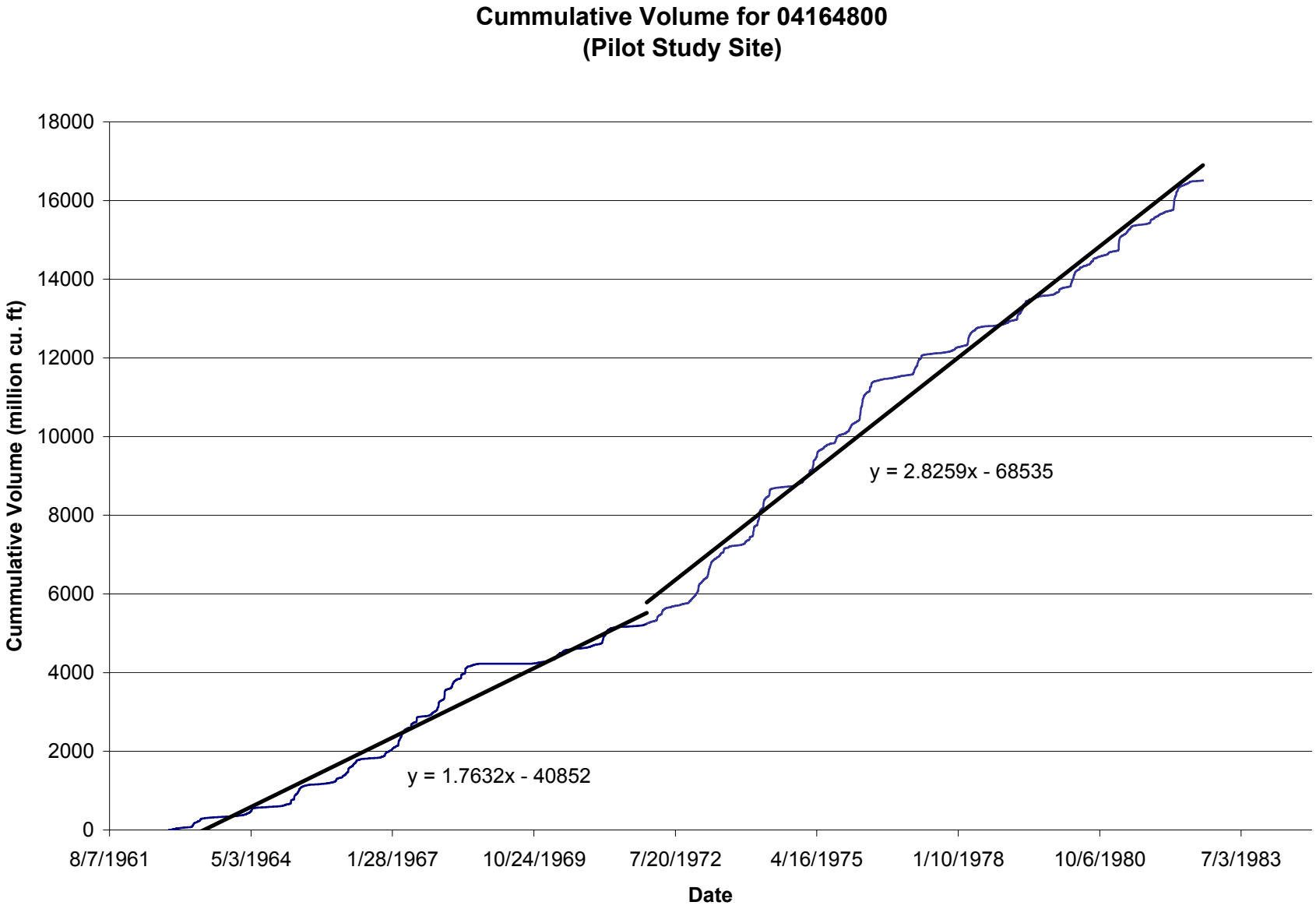
## Mean Daily Flows for 04164300

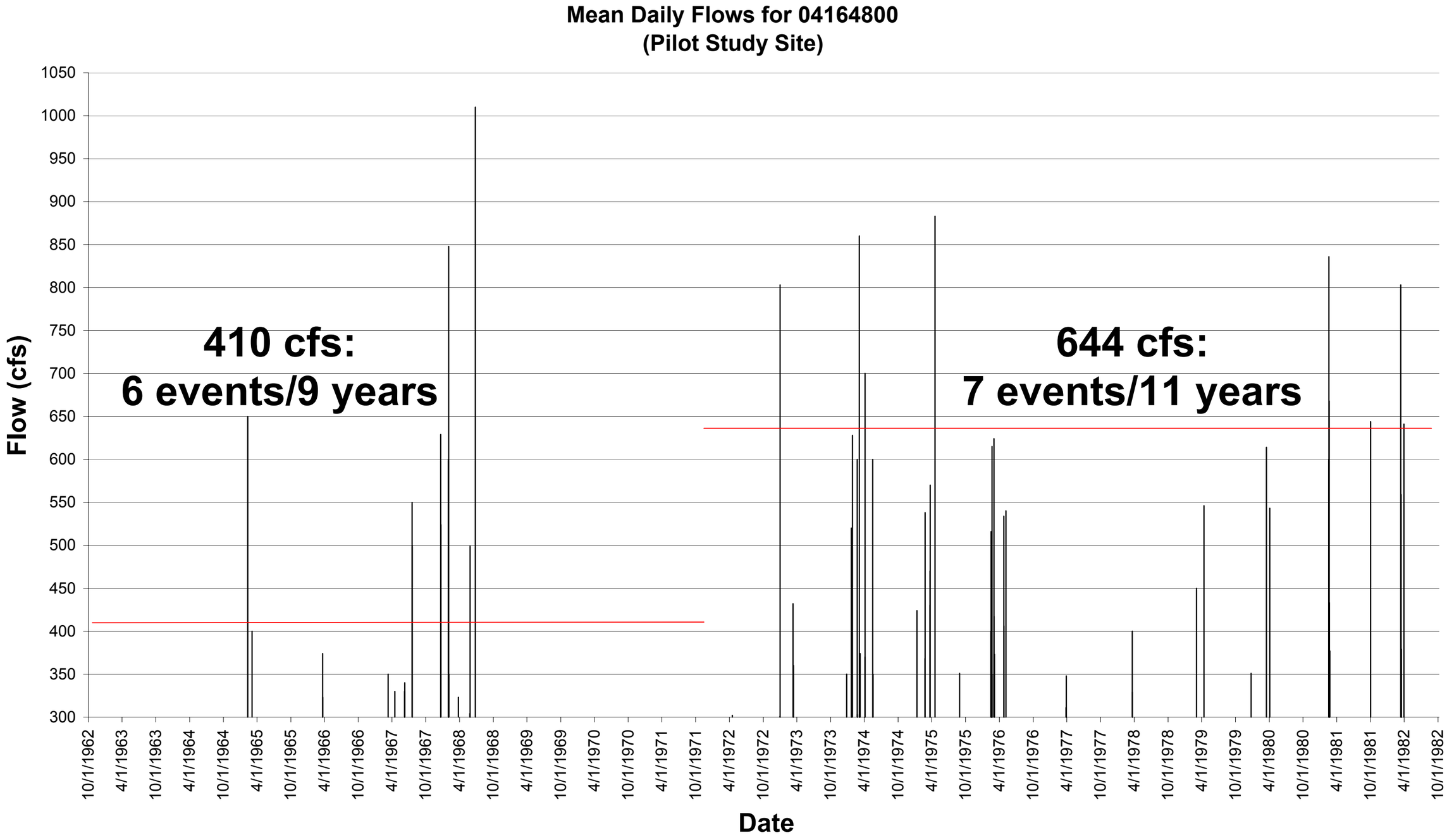


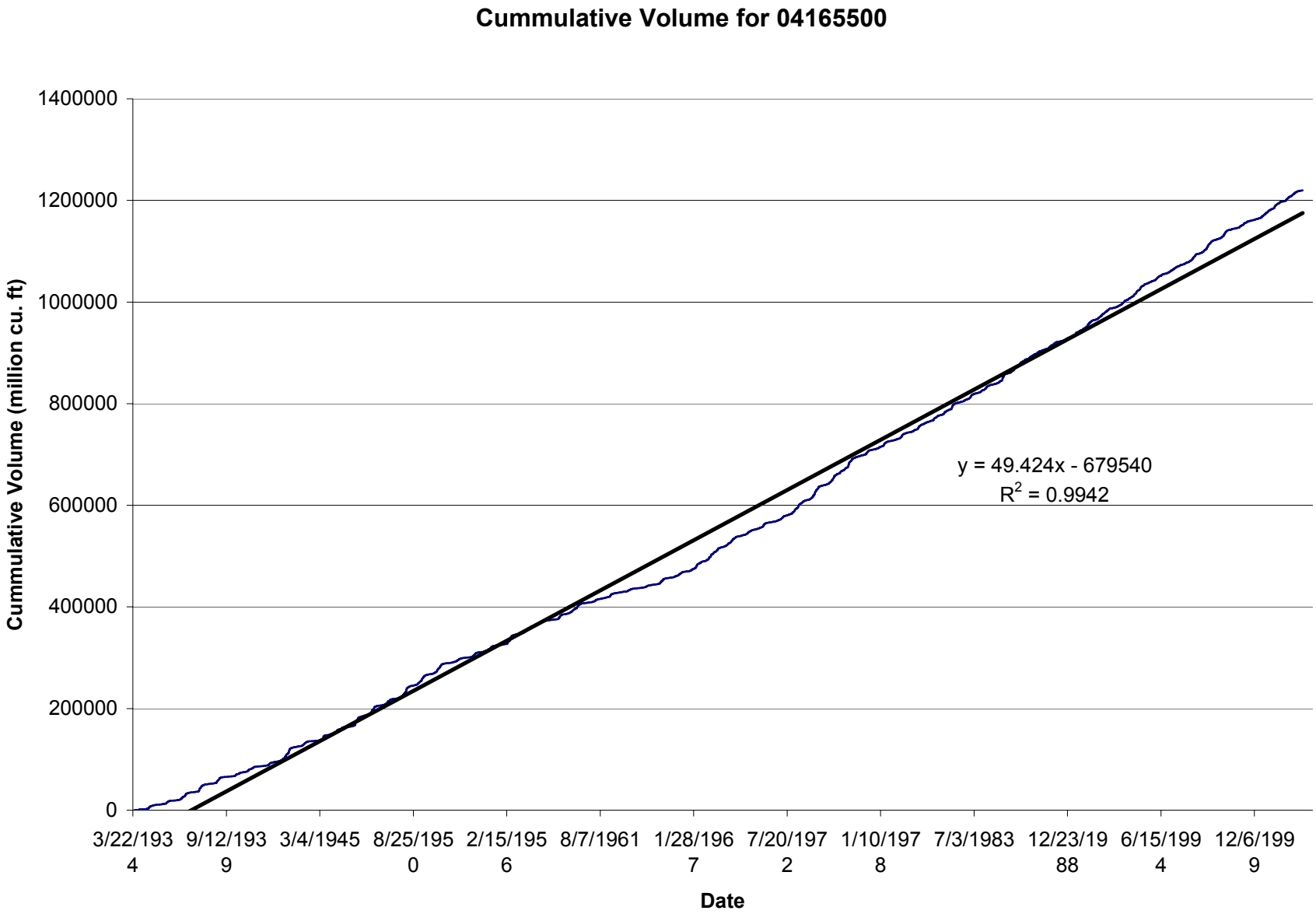

Cummulative Volume for 04164500
250000
200000
150000
100000
50000
0
Cummulative Volume (million cu. ft)
y = 11.072x - 195874
R2 = 0.9926
7/17/1946
1/7/1952
6/29/1957
12/20/1962
6/11/1968
12/2/1973
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
Date

## Mean Daily Flows for 04164500

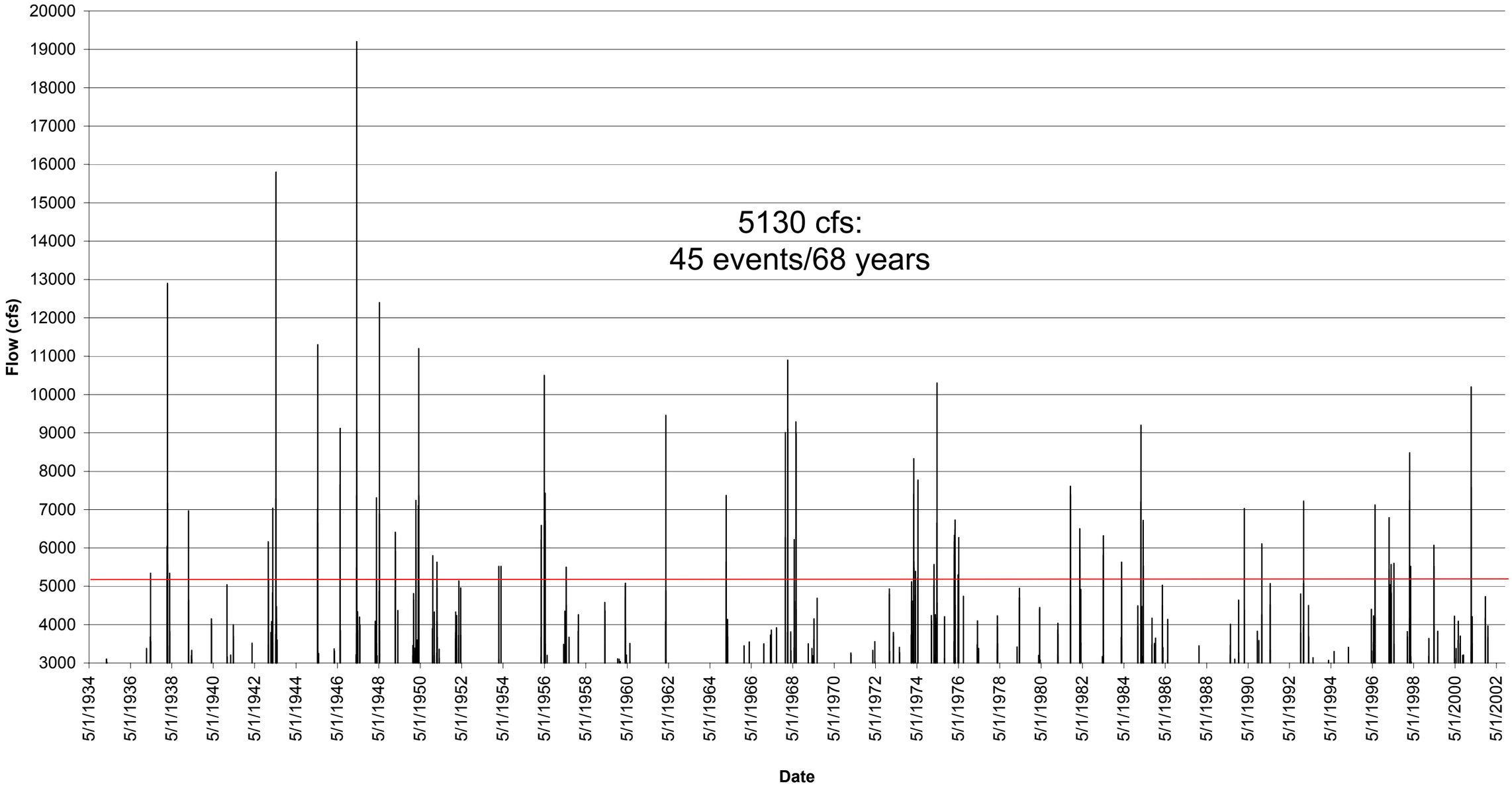



Cummulative Volume for 04164800
(Pilot Study Site)
Cummulative Volume (million cu. ft)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
8/7/1961
5/3/1964
1/28/1967
10/24/1969
7/20/1972
4/16/1975
1/10/1978
10/6/1980
7/3/1983
Date
y = 1.7632x - 40852
y = 2.8259x - 68535


Mean Daily Flows for 04164800
(Pilot Study Site)
410 cfs:
6 events/9 years
644 cfs:
7 events/11 years
Flow (cfs)
1050
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
10/1/1962
4/1/1963
10/1/1963
4/1/1964
10/1/1964
4/1/1965
10/1/1965
4/1/1966
10/1/1966
4/1/1967
10/1/1967
4/1/1968
10/1/1968
4/1/1969
10/1/1969
4/1/1970
10/1/1970
4/1/1971
10/1/1971
4/1/1972
10/1/1972
4/1/1973
10/1/1973
4/1/1974
10/1/1974
4/1/1975
10/1/1975
4/1/1976
10/1/1976
4/1/1977
10/1/1977
4/1/1978
10/1/1978
4/1/1979
10/1/1979
4/1/1980
10/1/1980
4/1/1981
10/1/1981
4/1/1982
10/1/1982
Date


Cummulative Volume for 04165500
Cummulative Volume (million cu. ft)
1400000
1200000
1000000
800000
600000
400000
200000
0
y = 49.424x - 679540
R2 = 0.9942
3/22/1934
9/12/1939
3/4/1945
8/25/1950
2/15/1956
8/7/1961
1/28/1967
7/20/1972
1/10/1978
7/3/1983
12/23/1988
6/15/1994
12/6/1999
Date

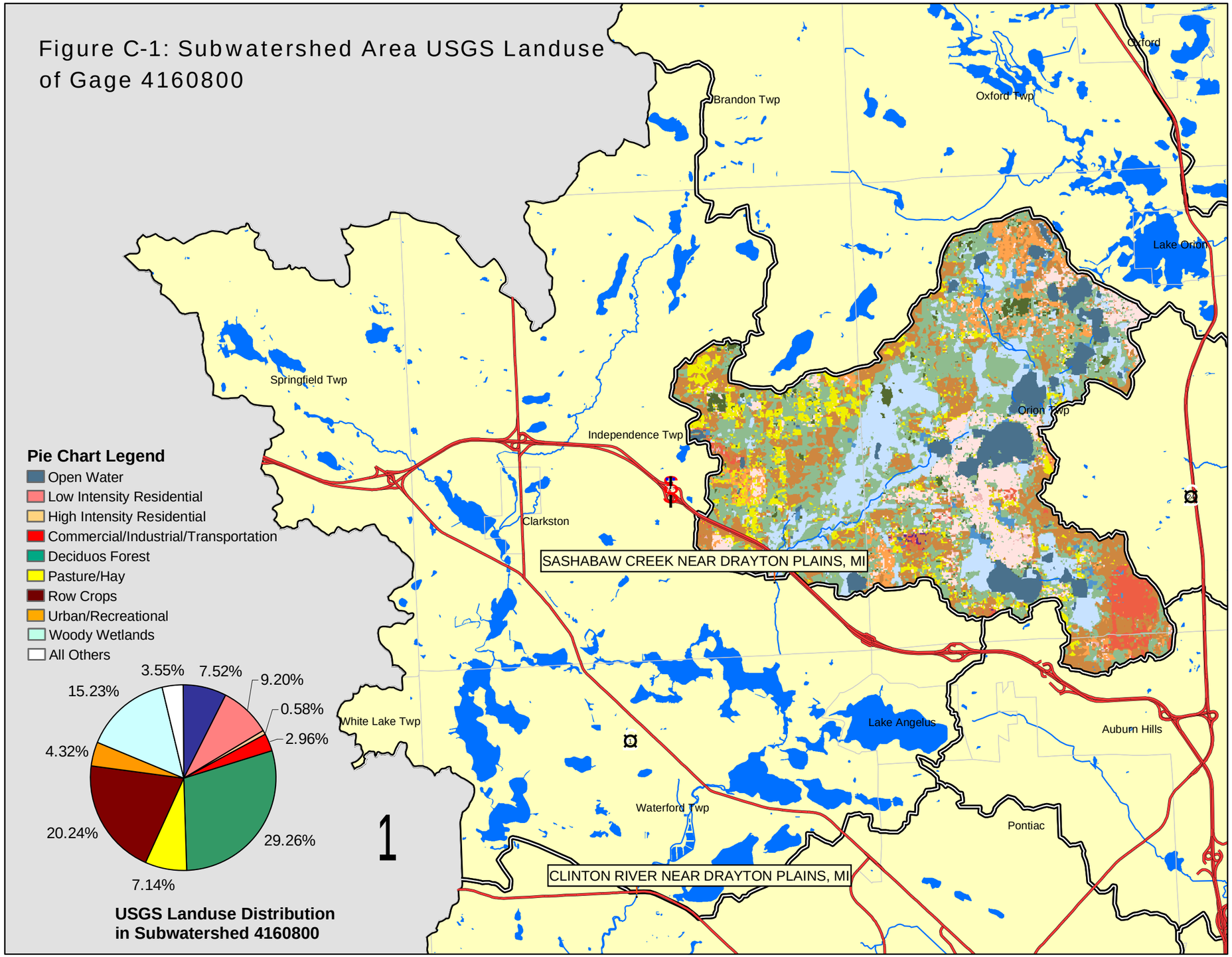
## Mean Daily Flows for 04165500



# APPENDIX C

## USGS Land Cover Class Definitions (NLCD) for the Clinton River Subwatersheds

# Figure C-1: Subwatershed Area USGS Landuse of Gage 4160800




**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others




**USGS Landuse Distribution in Subwatershed 4160800**

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

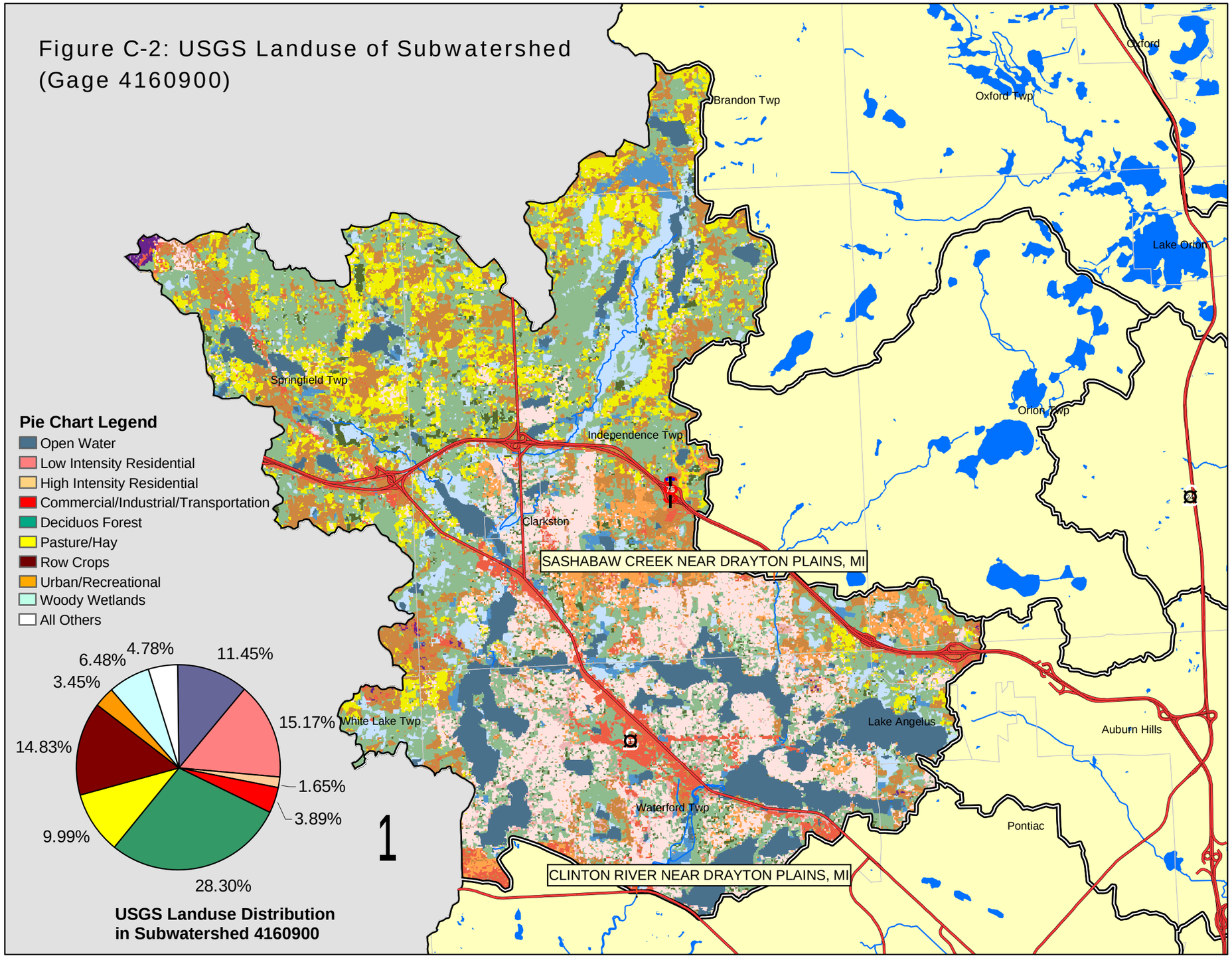
0 1 2 4 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*

# Figure C-2: USGS Landuse of Subwatershed (Gage 4160900)




**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others




**USGS Landuse Distribution in Subwatershed 4160900**

1

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

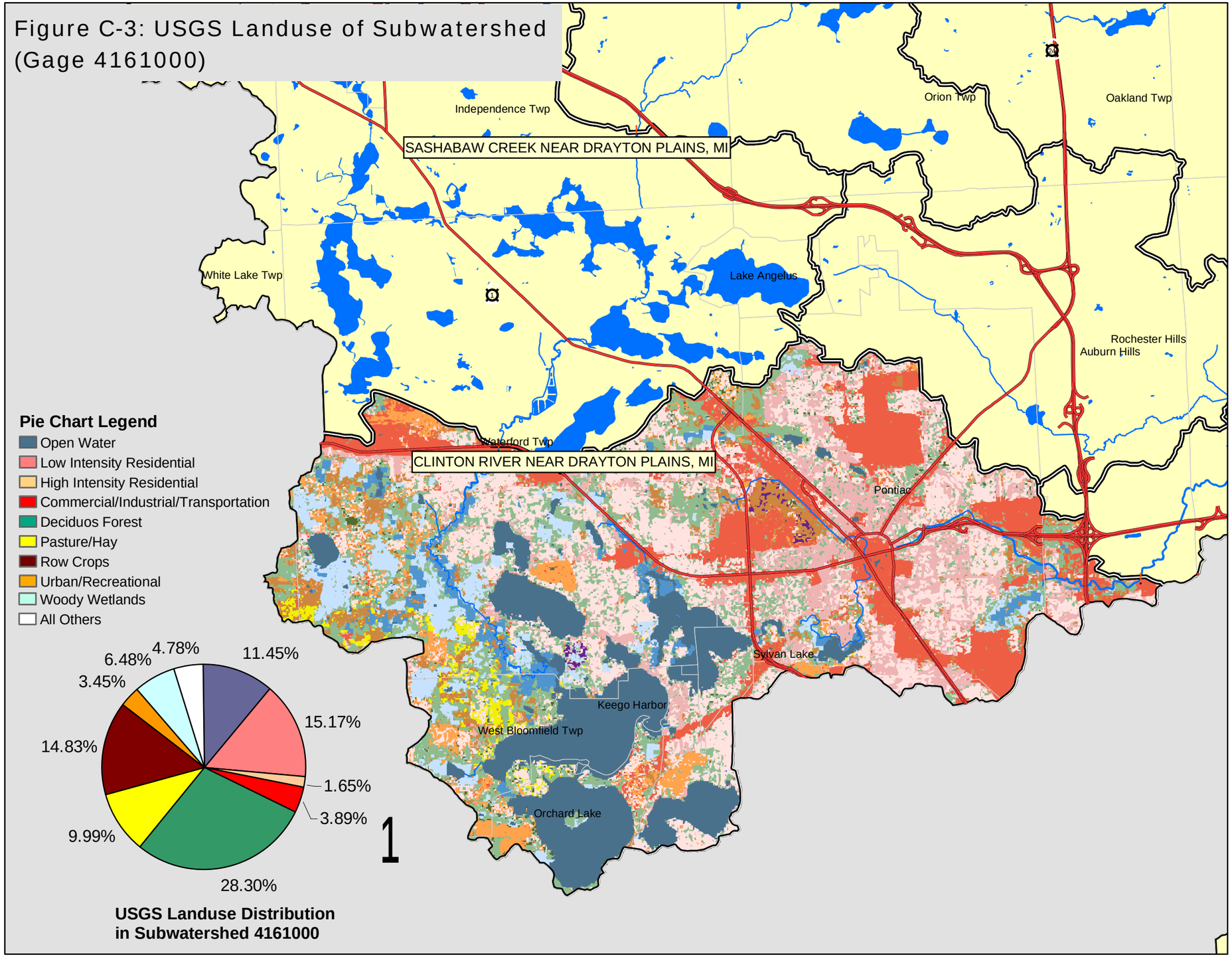
0 1 2 4 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*

# Figure C-3: USGS Landuse of Subwatershed (Gage 4161000)




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

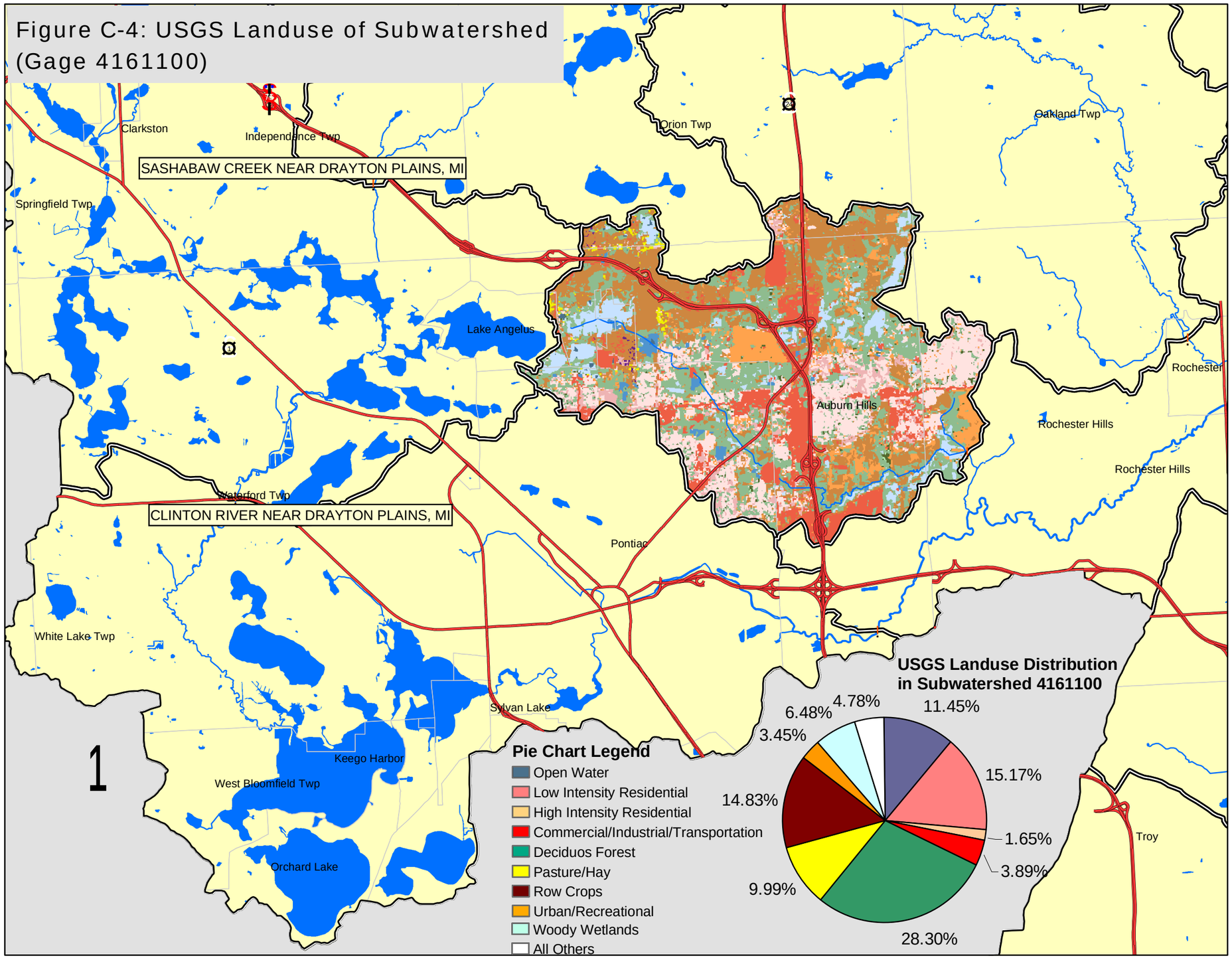
0 1 2 4 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

# Figure C-4: USGS Landuse of Subwatershed (Gage 4161100)




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

0 1 2 4 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

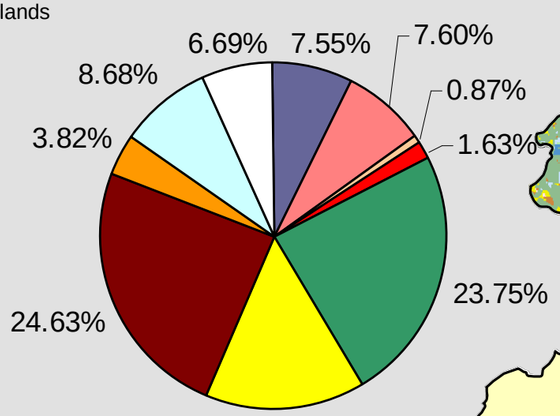
*Environmental Consulting & Technology, Inc.*

# Figure C-5: USGS Landuse of Subwatershed (Gage 4161500)

**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others

**USGS Landuse Distribution in Subwatershed 4161500**







## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

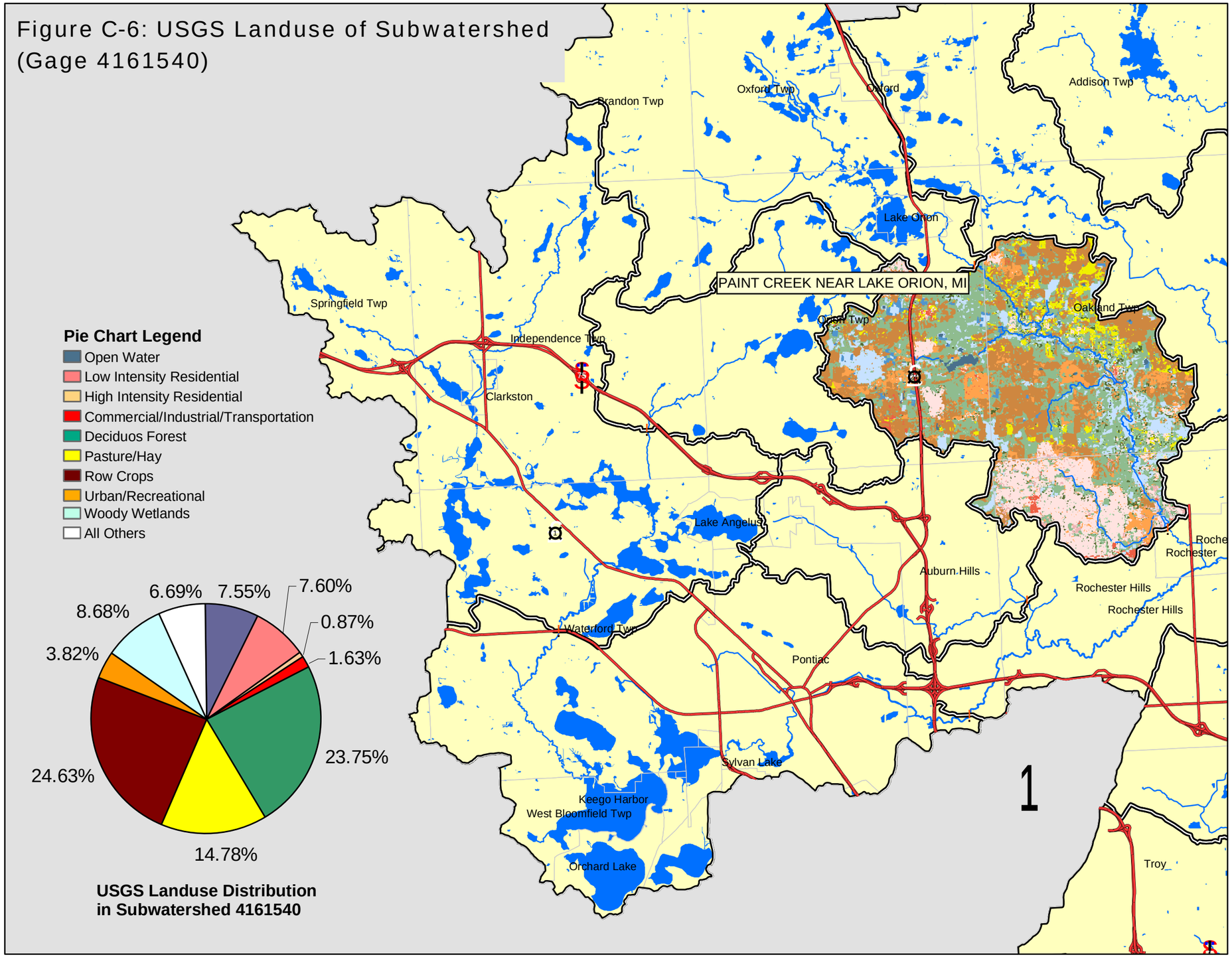
0 1 2 4 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*

# Figure C-6: USGS Landuse of Subwatershed (Gage 4161540)




**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others




**USGS Landuse Distribution in Subwatershed 4161540**

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 1 2 4 Miles

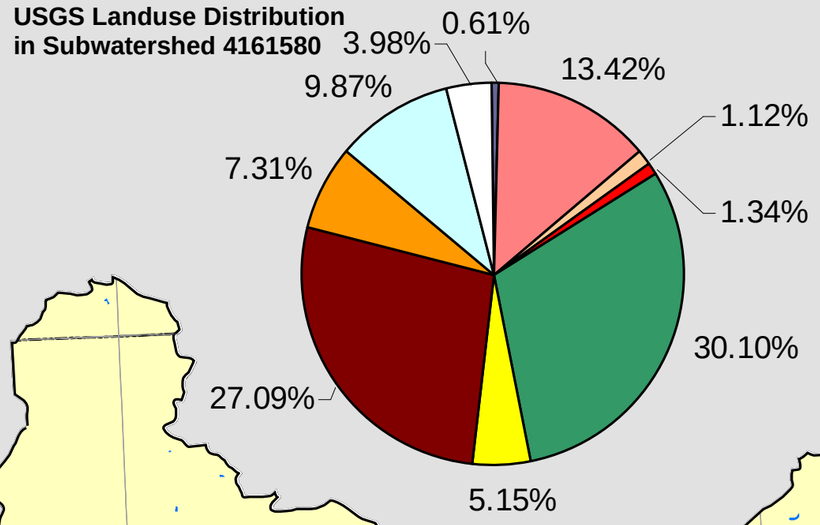
0 1.5 3 6 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

*Environmental Consulting & Technology, Inc.*

# Figure C-7: USGS Landuse of Subwatershed (Gage 4161580)




**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others

1

Almont
Almont Twp
Dryden Twp
LAPEER COUNTY
Leonard
MACOMB COUNTY
Bruce Twp
Addison Twp
Brandon Twp
Oxford Twp
Oxford
OAKLAND COUNTY
STONY CREEK NEAR ROMEO, MI
Lake Orion
Oakland Twp
Washington Twp
Independence Twp
Orion Twp
PAINT CREEK NEAR LAKE ORION, MI

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

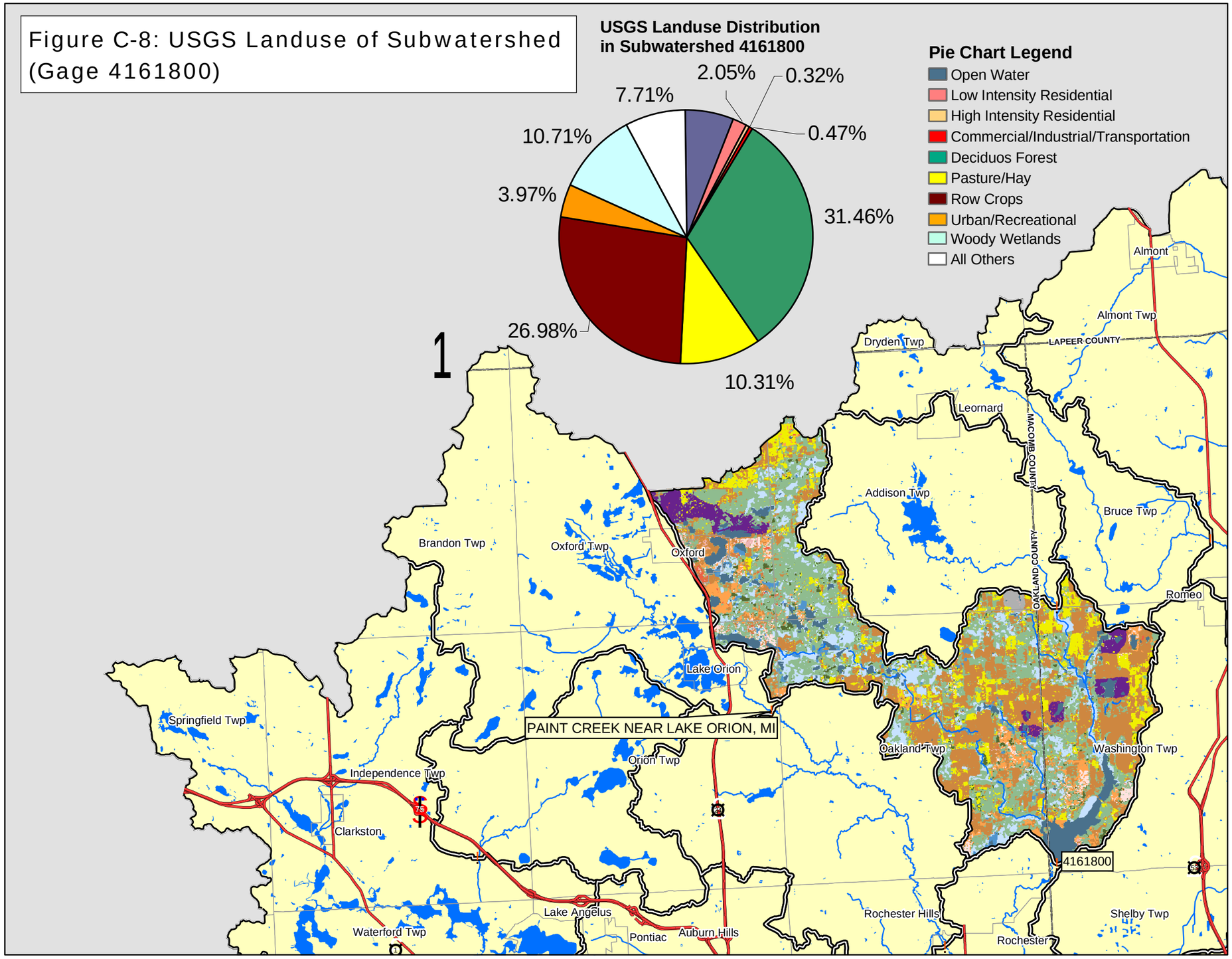
0 1 2 4 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

*Environmental Consulting & Technology, Inc.*

Figure C-8: USGS Landuse of Subwatershed (Gage 4161800)




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 1.25 2.5 5 Miles

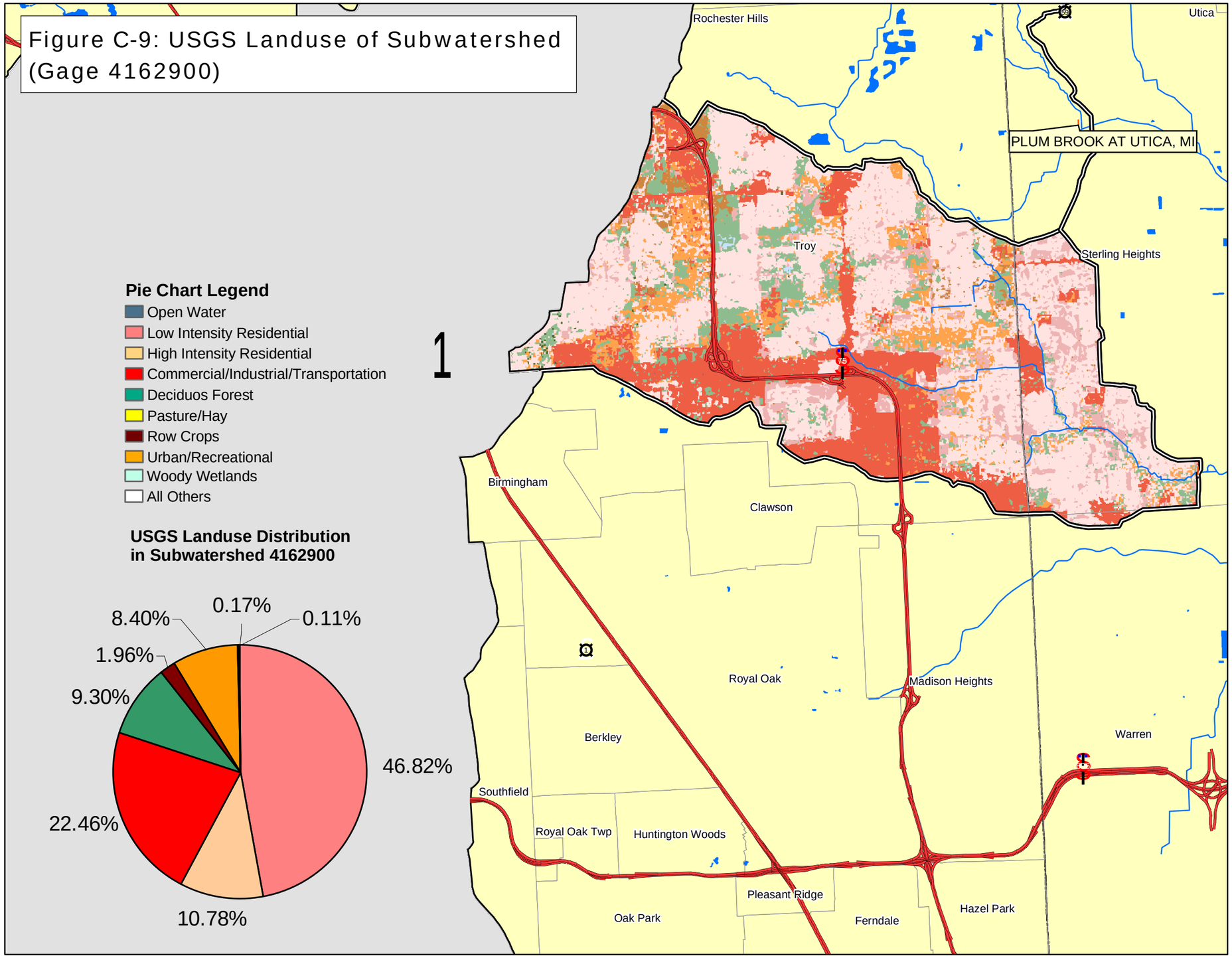
0 2 4 8 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

# Figure C-9: USGS Landuse of Subwatershed (Gage 4162900)




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

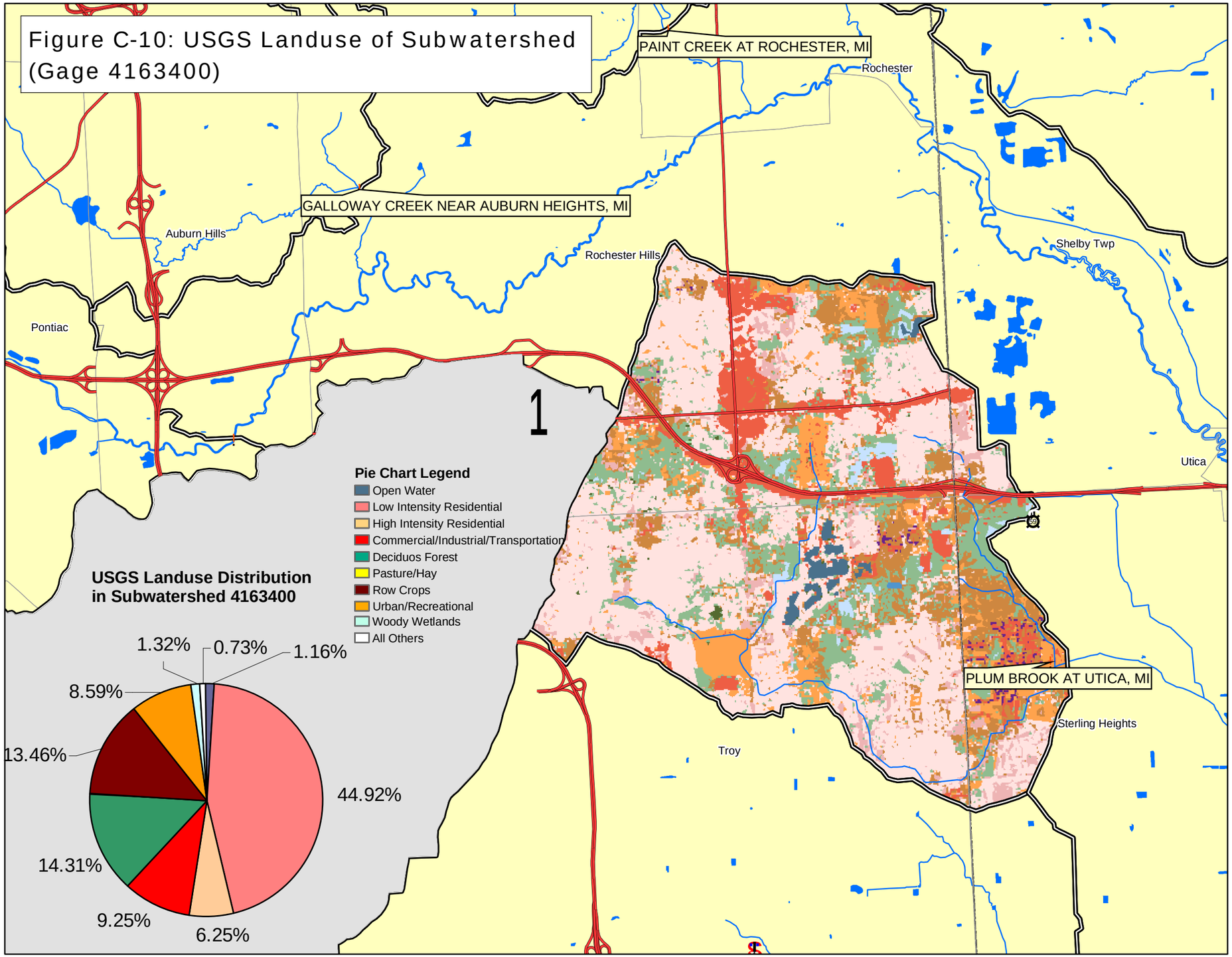
0 1 2 4 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

# Figure C-10: USGS Landuse of Subwatershed (Gage 4163400)




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

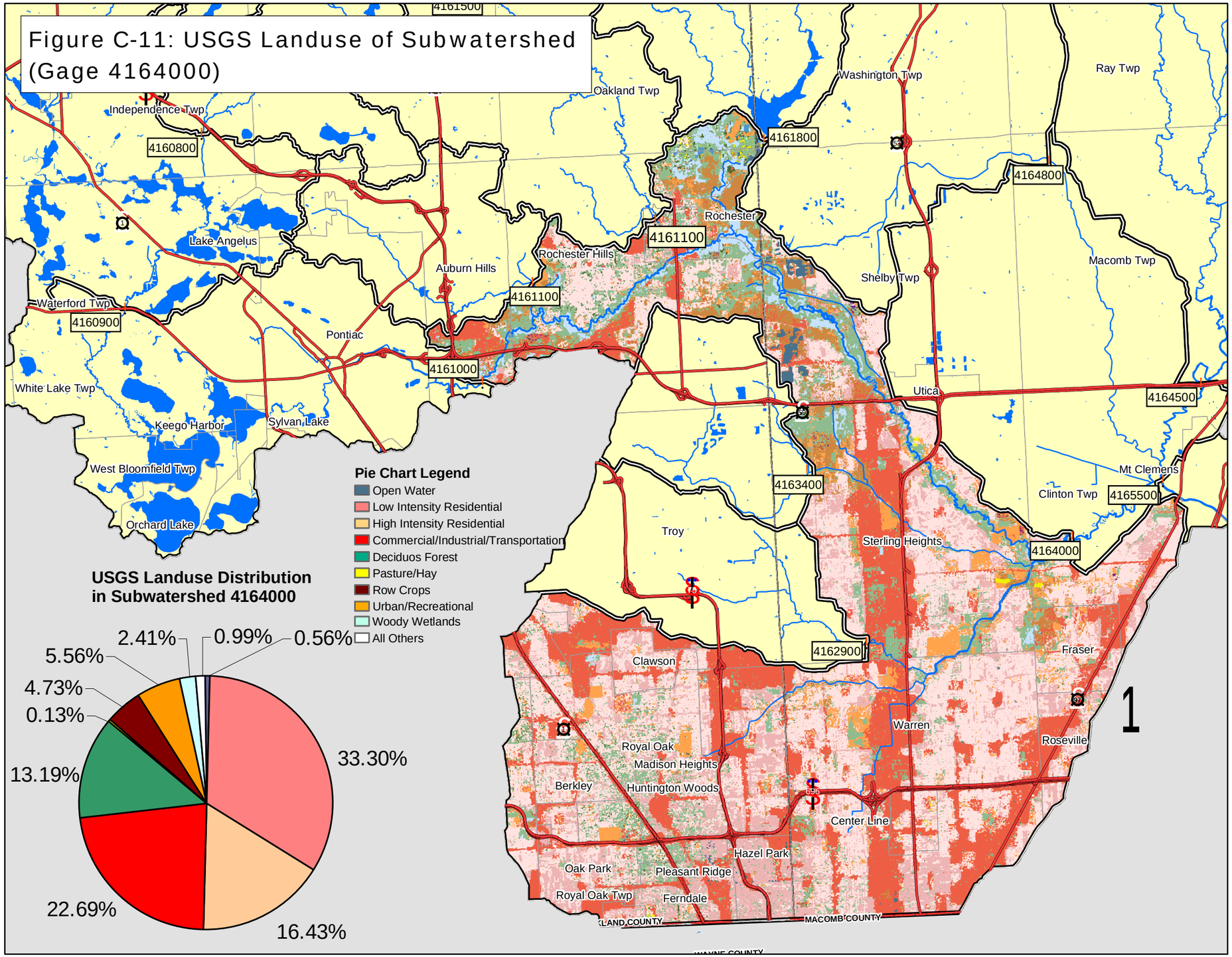
0 0.5 1 2 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

Environmental Consulting & Technology, Inc.

# Figure C-11: USGS Landuse of Subwatershed (Gage 4164000)




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

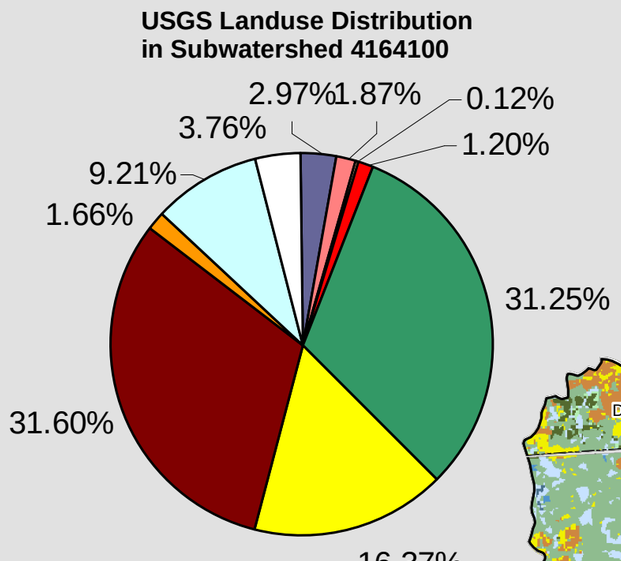
March 2004

0 1.25 2.5 5 Miles

0 2 4 8 Kilometers

Environmental Consulting & Technology, Inc.

Figure C-12: USGS Landuse of Subwatershed (Gage 4164100)




**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others




## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

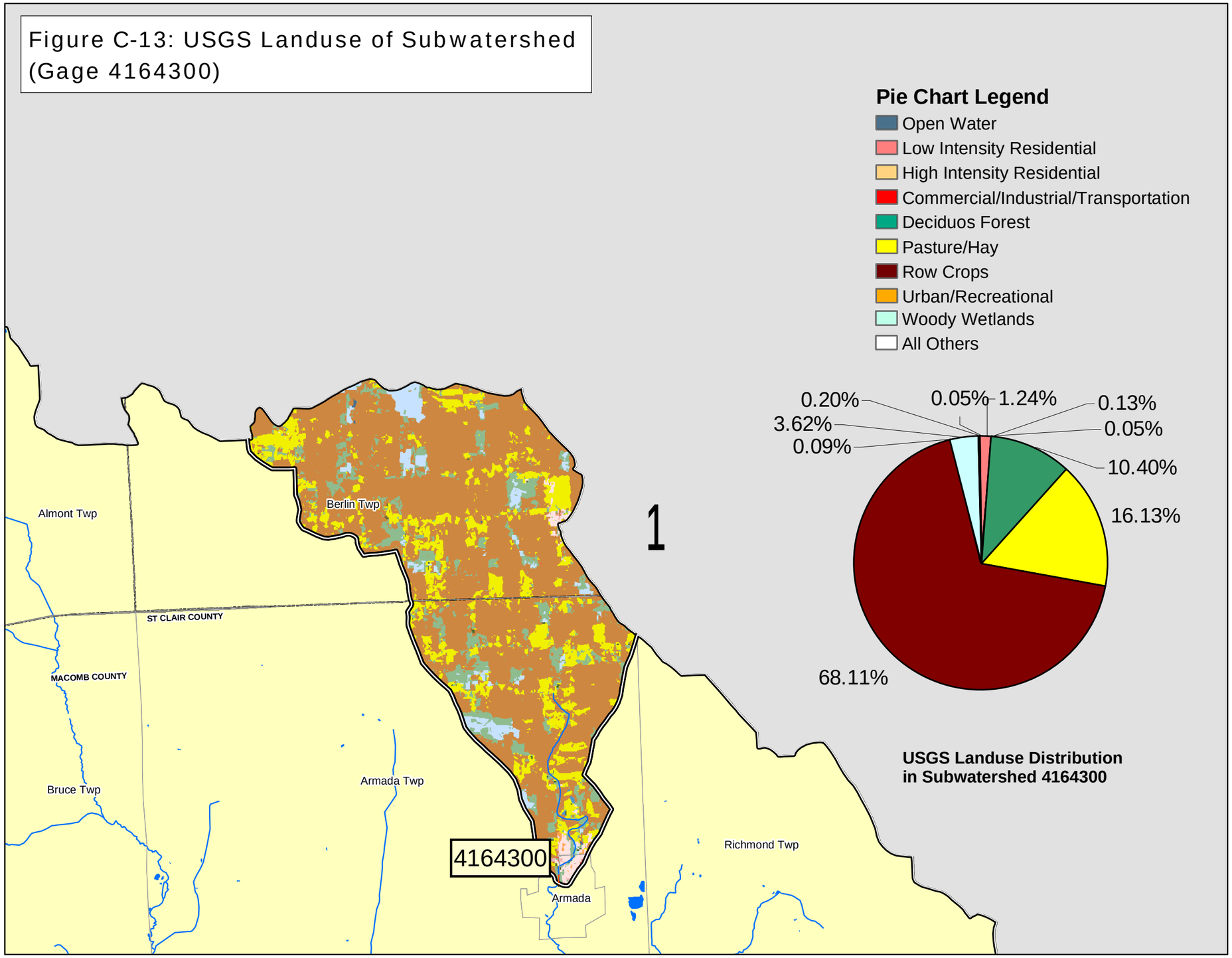
0 1 2 4 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

Environmental Consulting & Technology, Inc.

Figure C-13: USGS Landuse of Subwatershed (Gage 4164300)




**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others




**USGS Landuse Distribution in Subwatershed 4164300**

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 0.5 1 2 Miles

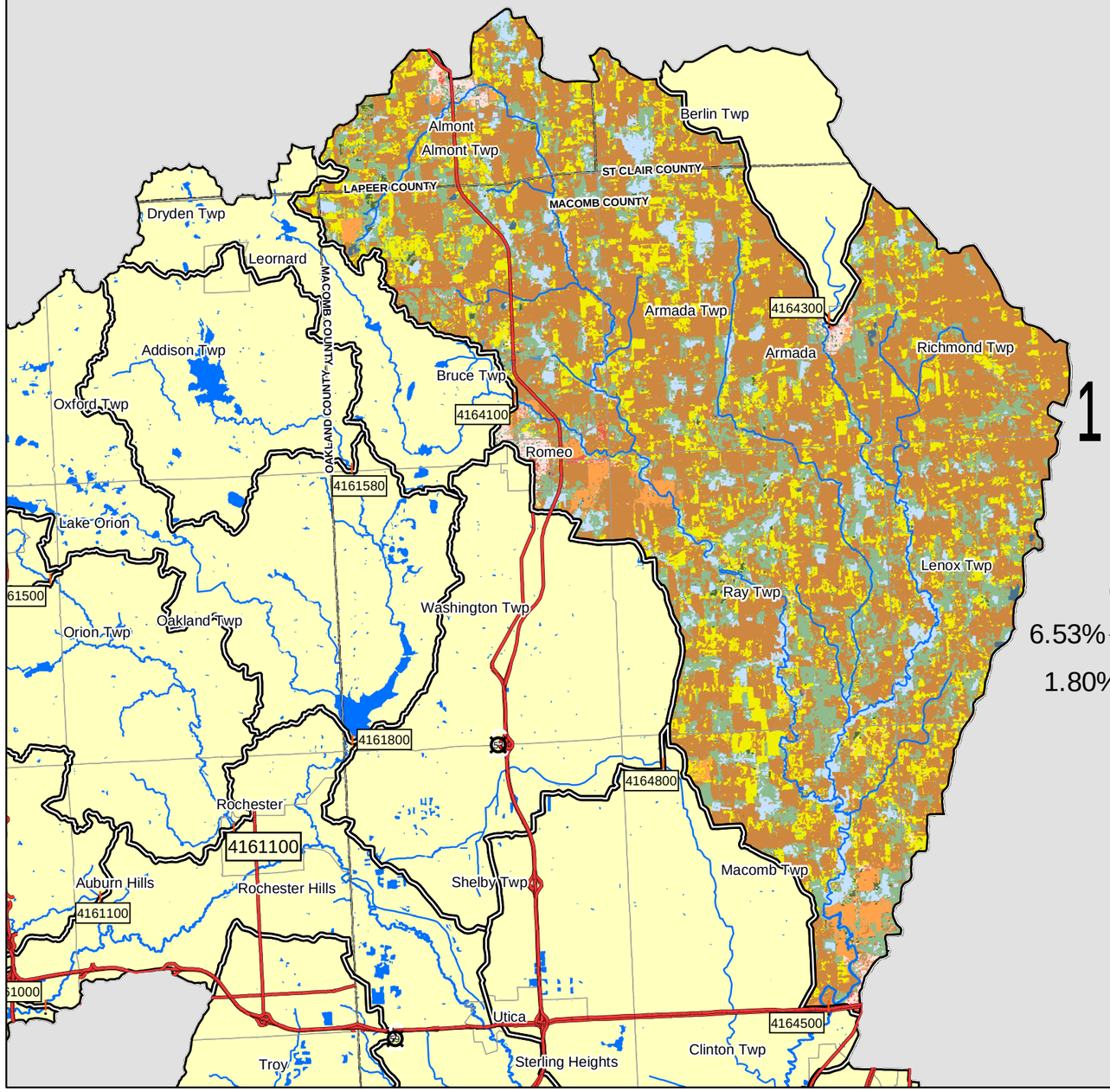
0 1 2 4 Kilometers

MACOMB COUNTY MICHIGAN 1818

ECT

Environmental Consulting & Technology, Inc.

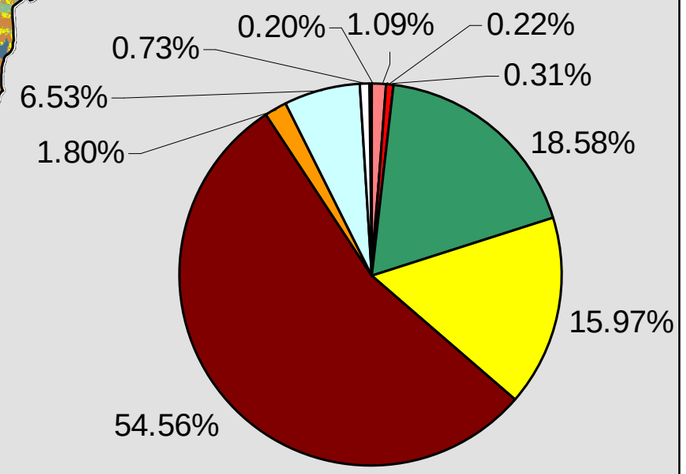
# Figure C-14: USGS Landuse of Subwatershed (Gage 4164500)




1

**Pie Chart Legend**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Deciduos Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- All Others




**USGS Landuse Distribution in Subwatershed 4164500**

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 1.5 3 6 Miles

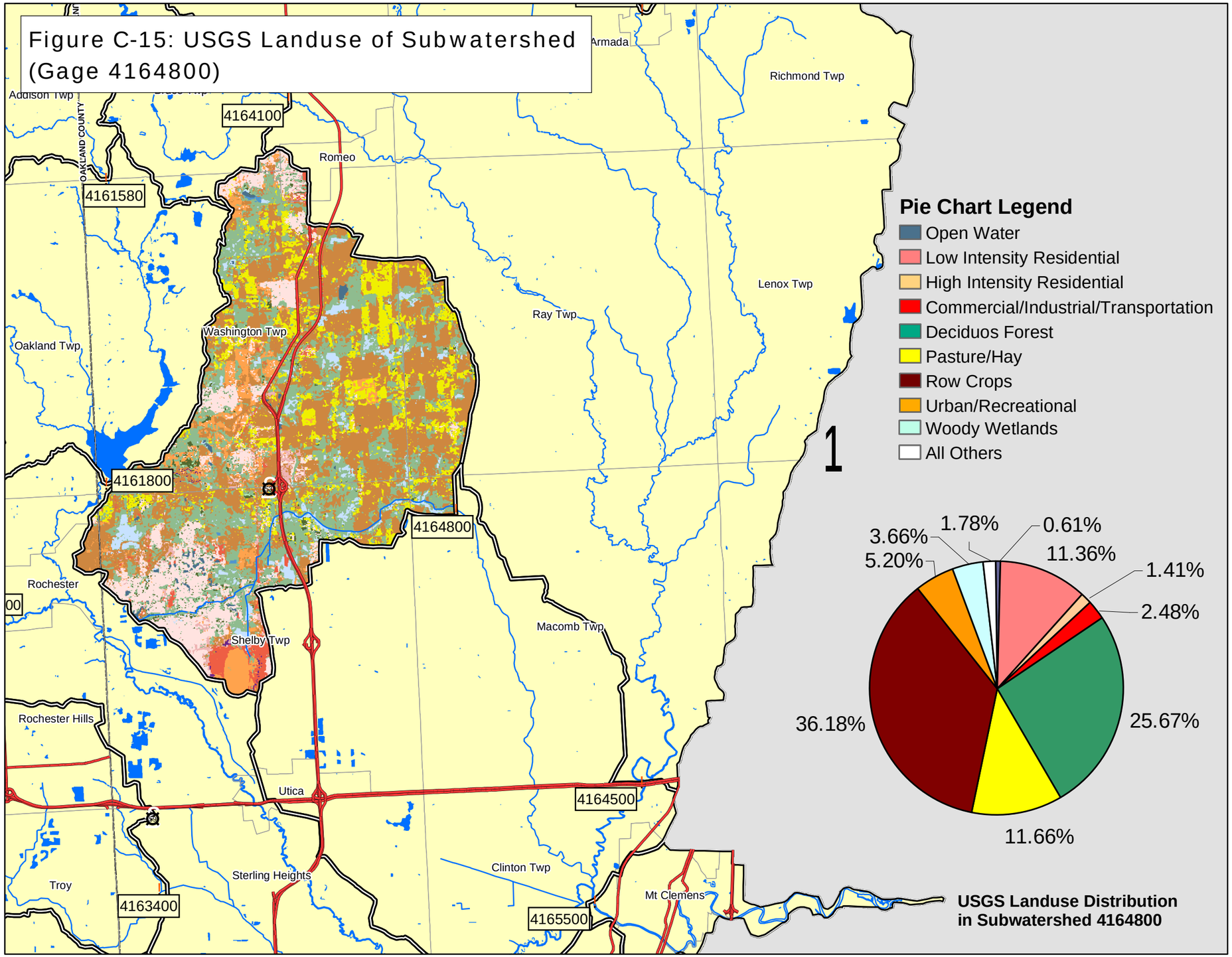
0 2.5 5 10 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*

Figure C-15: USGS Landuse of Subwatershed (Gage 4164800)




**USGS Landuse Distribution in Subwatershed 4164800**

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 1 2 4 Miles

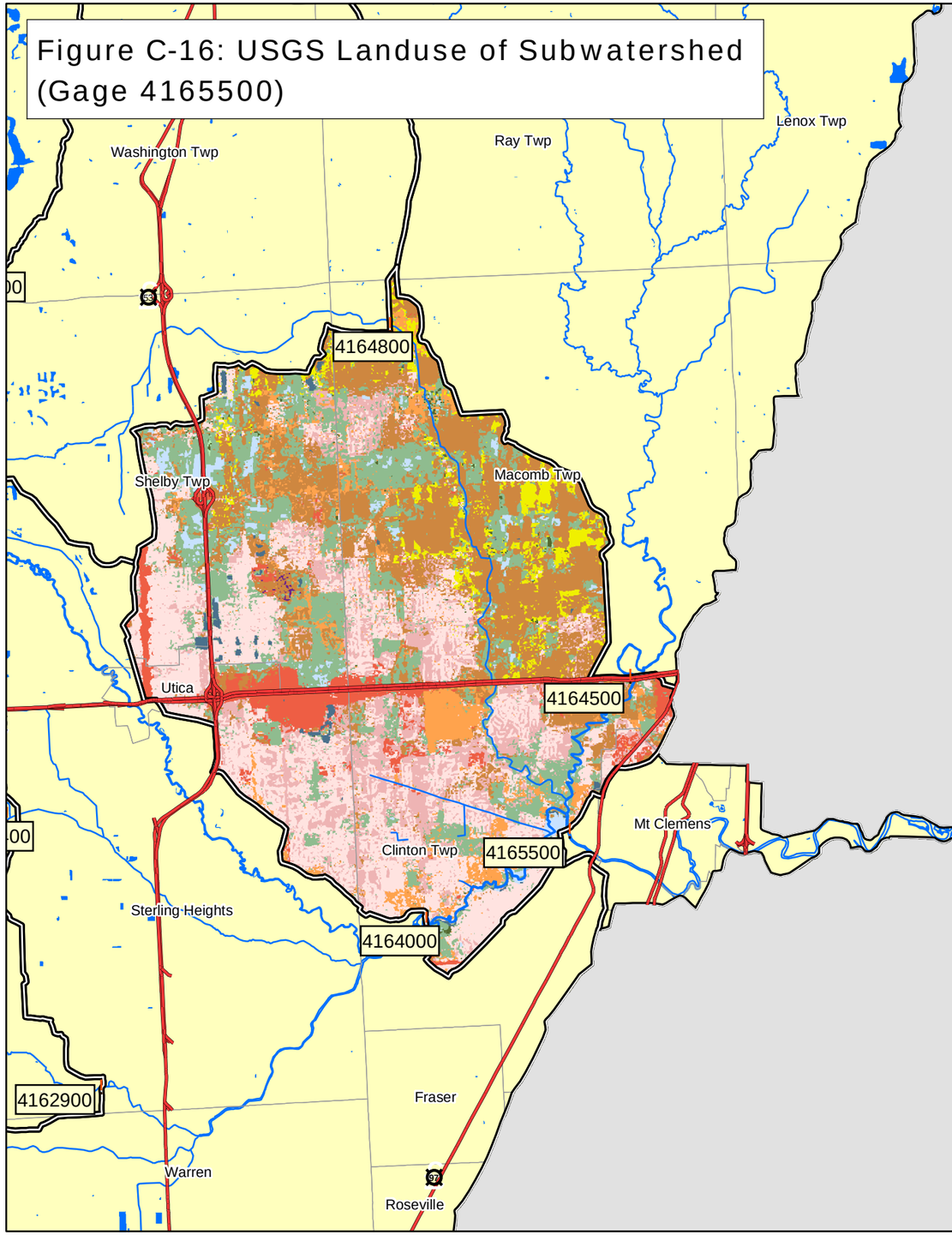
0 1.5 3 6 Kilometers

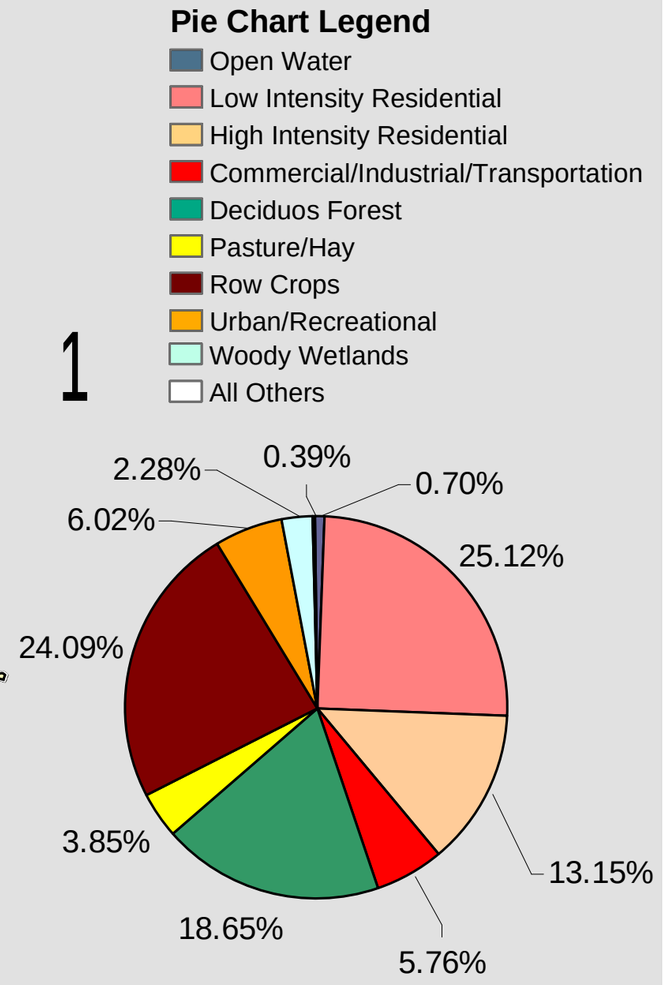
MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*

# Figure C-16: USGS Landuse of Subwatershed (Gage 4165500)




**USGS Landuse Distribution in Subwatershed 4165500**

## LEGEND

- River
- Major Road
- Subwatershed Boundary

**USGS LANDUSE**

- Open Water
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture/Hay
- Row Crops
- Urban/Recreational
- Woody Wetlands
- Emergent Herbaceous Wetlands

Source: Basemap files obtained from the Michigan Geographical Framework Website, File for USGS stations obtained from MDEQ

Software: ArcGIS 8.3

State Plane NAD 83 Michigan South

March 2004

0 1 2 4 Miles

0 1.5 3 6 Kilometers

MACOMB COUNTY 1818 MICHIGAN

ECT

*Environmental Consulting & Technology, Inc.*