Project2

February 5, 2019

1 Baseflow and Direct Runoff for a Watershed

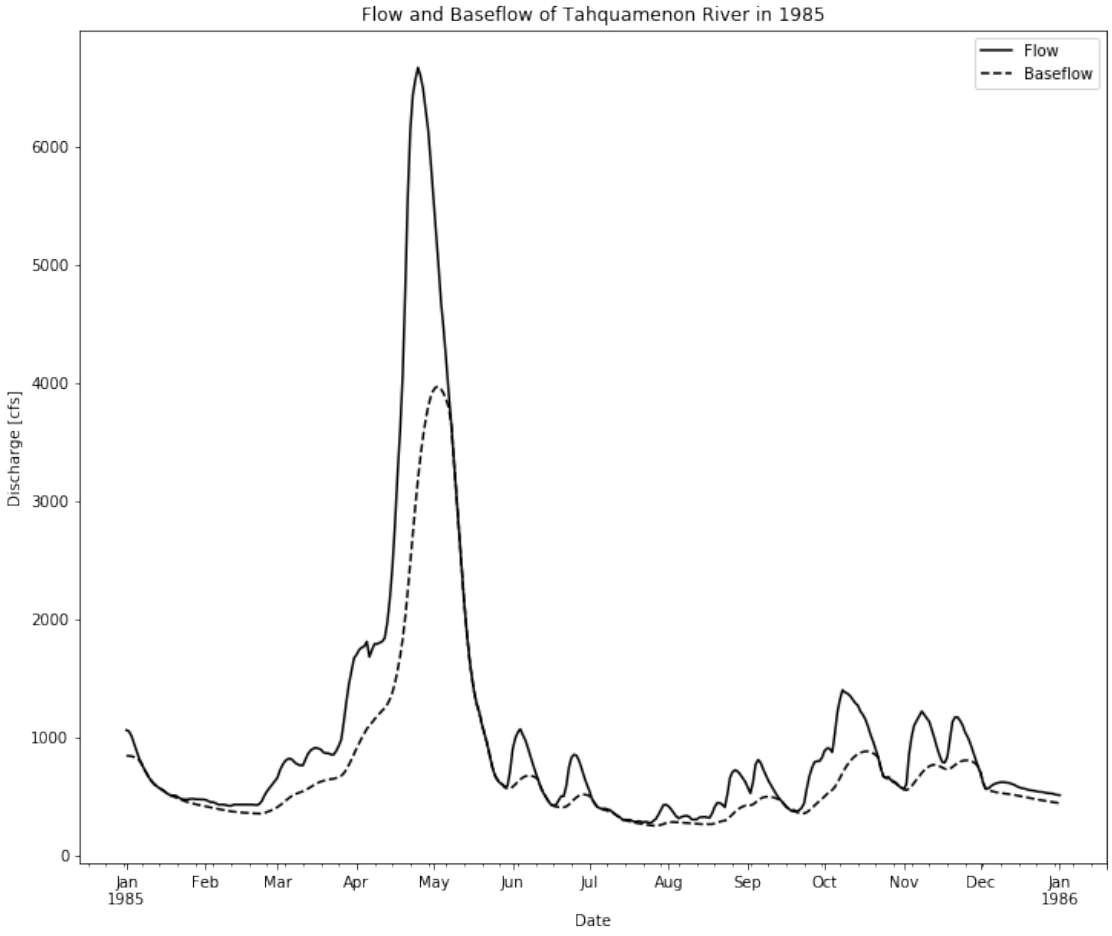
A) Report the baseflow index (BFI) for the watershed and create a graph showing the flow and baseflow hydrographs for a single year.

The BFI for the Tahquamenon River near Paradise, MI is 0.73. See below for the flow and baseflow hydrographs for 1985.

In [47]:
```
import pandas as pd
import numpy as np
import datetime as dt
import matplotlib.pyplot as plt
```

In [48]:
```
data = pd.read_csv(
    'Tue_Feb__5_21_47_27_2019__9069.csv',
    names = [
        'Day',
        'Date',
        'Flow',
        'Direct Runoff',
        'Baseflow'
    ],

    skiprows = 1,
    skipfooter = 3,
    engine='python',
    index_col = 0
)

data.Date = pd.to_datetime(data.Date)
data = data.set_index(['Date'])
```

In [56]:
```
fig,ax = plt.subplots(figsize=(12,10))
data['19850101':'19860101'].Flow.plot(ax=ax,legend=True,color='k')
data['19850101':'19860101'].Baseflow.plot(ax=ax,legend=True,color='k',linestyle='--')
ax.set_ylabel('Discharge [cfs]')
ax.set_title('Flow and Baseflow of Tahquamenon River in 1985')
plt.savefig('Hydrograph_1985.png')
plt.show()
```



B) Compute the climatology of monthly baseflow and direct runoff for the 30-year period from 1981 to 2010. Report the results as a table and in graphical form.

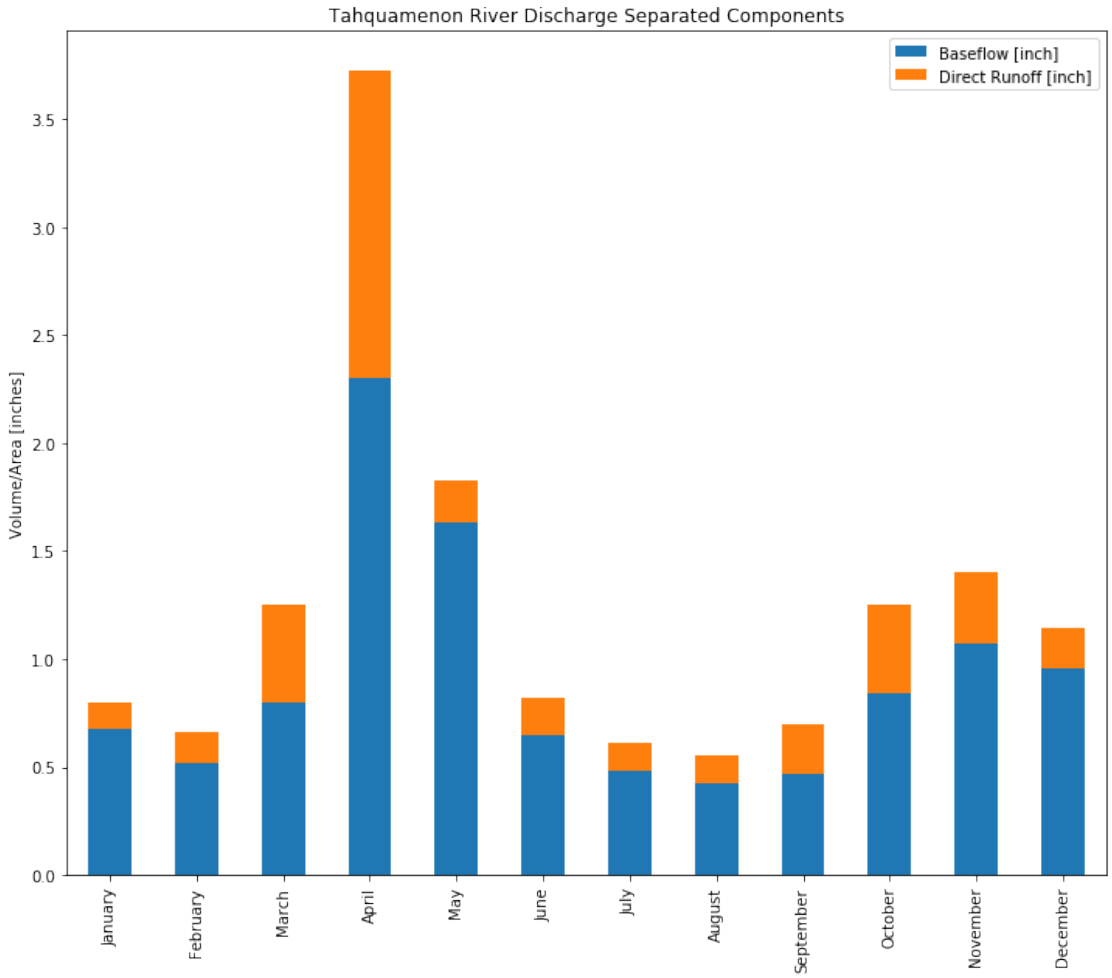
```
In [72]: baseflow_30 = pd.read_csv(
             'Tue_Feb__5_21_47_27_2019__9069_monthly-baseflow.csv',
             engine='python',
             index_col = 0
         )

         runoff_30 = pd.read_csv(
             'Tue_Feb__5_21_47_27_2019__9069_monthly-directrunoff.csv',
             engine='python',
             index_col = 0
         )

         baseflow_30 = baseflow_30.drop(columns=['Average'])
         runoff_30 = runoff_30.drop(columns=['Average'])
```

```
In [127]: TableCombined = pd.concat([baseflow_30.mean(),runoff_30.mean()],axis=1)
           TableCombined.columns = ['Baseflow [cfs]','Direct Runoff [cfs]']
```

```
TableCombined['DaysInMonth'] = pd.Series(
    [31,28,31,30,31,30,31,31,30,31,30,31],
    index=TableCombined.index)

# Watershed Area
Area_mi2 = 790
Area_ft2 = Area_mi2 * 27878000

TableCombined['Total [cfs]'] = \
    TableCombined['Baseflow [cfs]'] + TableCombined['Direct Runoff [cfs]']

TableCombined['Baseflow_V'] = \
    TableCombined['Baseflow [cfs]']*60*60*24*TableCombined['DaysInMonth']

TableCombined['Direct Runoff_V'] = \
    TableCombined['Direct Runoff [cfs]']*60*60*24*TableCombined['DaysInMonth']

TableCombined['Baseflow [inch]'] = \
    TableCombined['Baseflow_V'] * 12 / Area_ft2

TableCombined['Direct Runoff [inch]'] = \
    TableCombined['Direct Runoff_V'] * 12 / Area_ft2

TableCombined['Total [inch]'] = \
    TableCombined['Baseflow [inch]'] + TableCombined['Direct Runoff [inch]']


TableCombined = TableCombined.drop(
    columns=[
        'DaysInMonth',
        'Baseflow_V',
        'Direct Runoff_V',
        'Total [cfs]',
        'Total [inch]'
    ]
)

TableCombined.round(decimals=2)
```

	Baseflow [cfs]	Direct Runoff [cfs]	Baseflow [inch]	Direct Runoff [inch]
January	461.11	87.34	0.67	0.13
February	394.99	105.01	0.52	0.14
March	546.77	308.70	0.80	0.45
April	1631.47	1004.95	2.30	1.42
May	1116.82	134.32	1.63	0.20
June	459.02	120.48	0.65	0.17
July	330.63	89.37	0.48	0.13
August	291.17	86.11	0.42	0.13
September	331.48	162.93	0.47	0.23
October	575.05	284.05	0.84	0.41
November	759.58	233.21	1.07	0.33
December	653.86	129.97	0.95	0.19

In [123]:
```
fig,ax = plt.subplots(figsize=(12,10))
BarGraph = pd.concat(
    [
        TableCombined['Baseflow [inch]'],
        TableCombined['Direct Runoff [inch]']
    ],
    axis=1)

BarGraph.plot.bar(stacked=True,ax=ax)
ax.set_ylabel('Volume/Area [inches]')
ax.set_title('Tahquamenon River Discharge Separated Components')

plt.savefig('TahquamenonSeparatedComponents.png')
plt.show()
```


Tahquamenon River Discharge Separated Components
Baseflow [inch]
Direct Runoff [inch]
Volume/Area [inches]
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
January
February
March
April
May
June
July
August
September
October
November
December