The Impact of Urban Development on Stream Macroinvertebrates is Influenced by when that Development Occurred

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Stream Macroinvertebrates: Indicators of Habitat and Water Quality

Stream Macroinvertebrate Communities:

- Diverse and complex
- Taxa vary in sensitivity
- Relatively “faithful” to their location
- Relatively long-lived

➢ Stressors reduce habitat and water quality
➢ Macroinvertebrates respond

Benthic Index of Biotic Integrity

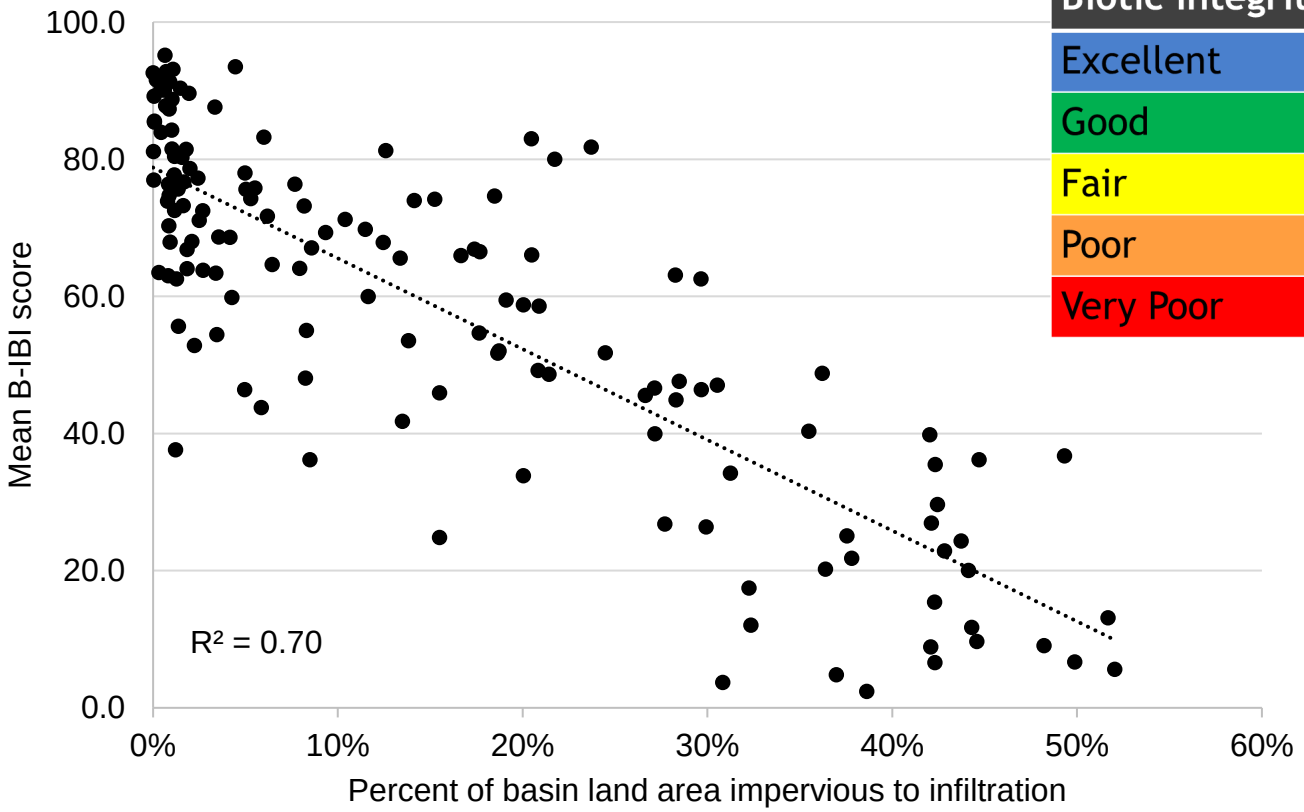
10 Metrics

Total richness score
Mayfly richness score
Stonefly richness score
Caddisfly richness score
Clinger richness score
Long-lived richness score
Intolerant richness score
Percent Dominant score
Percent Predator score
Percent Tolerant score

Condition of Biotic Integrity	B-IBI score
Excellent	80 – 100
Good	60 – 80
Fair	40 - 60
Poor	20 - 40
Very Poor	0 – 20

Urban Development vs B-IBI scores

Condition of Biotic Integrity	B-IBI score
Excellent	80 - 100
Good	60 - 80
Fair	40 - 60
Poor	20 - 40
Very Poor	0 - 20



Forest

City

Stressors associated with urban development and impervious area

- Excess fine sediment
- Altered hydrology – “flashiness”
- Contaminants
- Elevated nutrients
- Invasive species

- All associated with:
  - Loss of forest in whole basin
  - Loss of riparian vegetation
  - Increased stormwater runoff

Wait…haven't there been many actions taken to minimize the impacts of development?

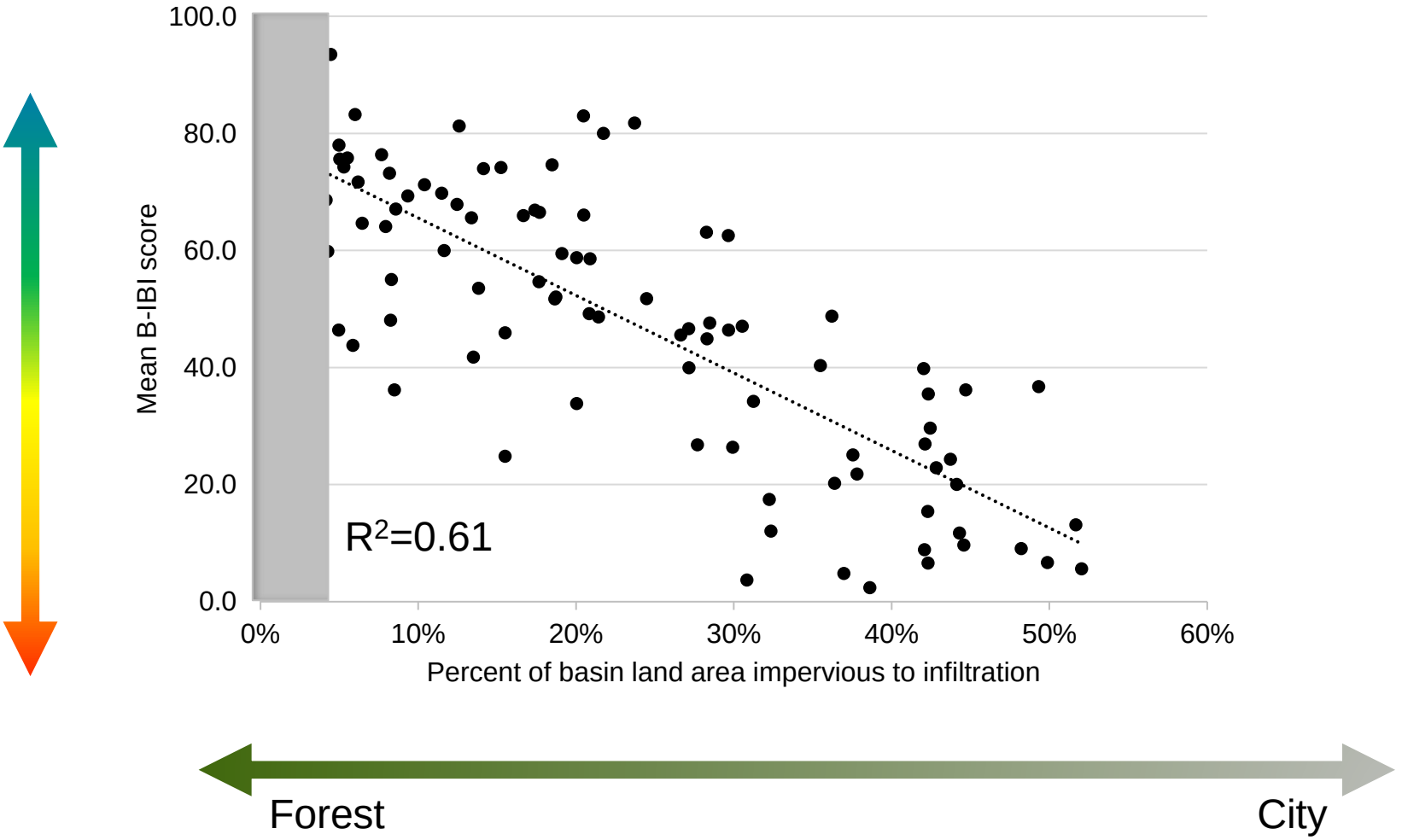
- 1964 – King County's 1st Comprehensive Plan
- 1969 – King County's 1st Surface Water Design Manual
- 1972 – Clean Water Act

- 1977 - 2016 – Progressively more protective design manuals and pollution plans
- Significant changes in flow control and water quality treatment requirements in 1990 Manual

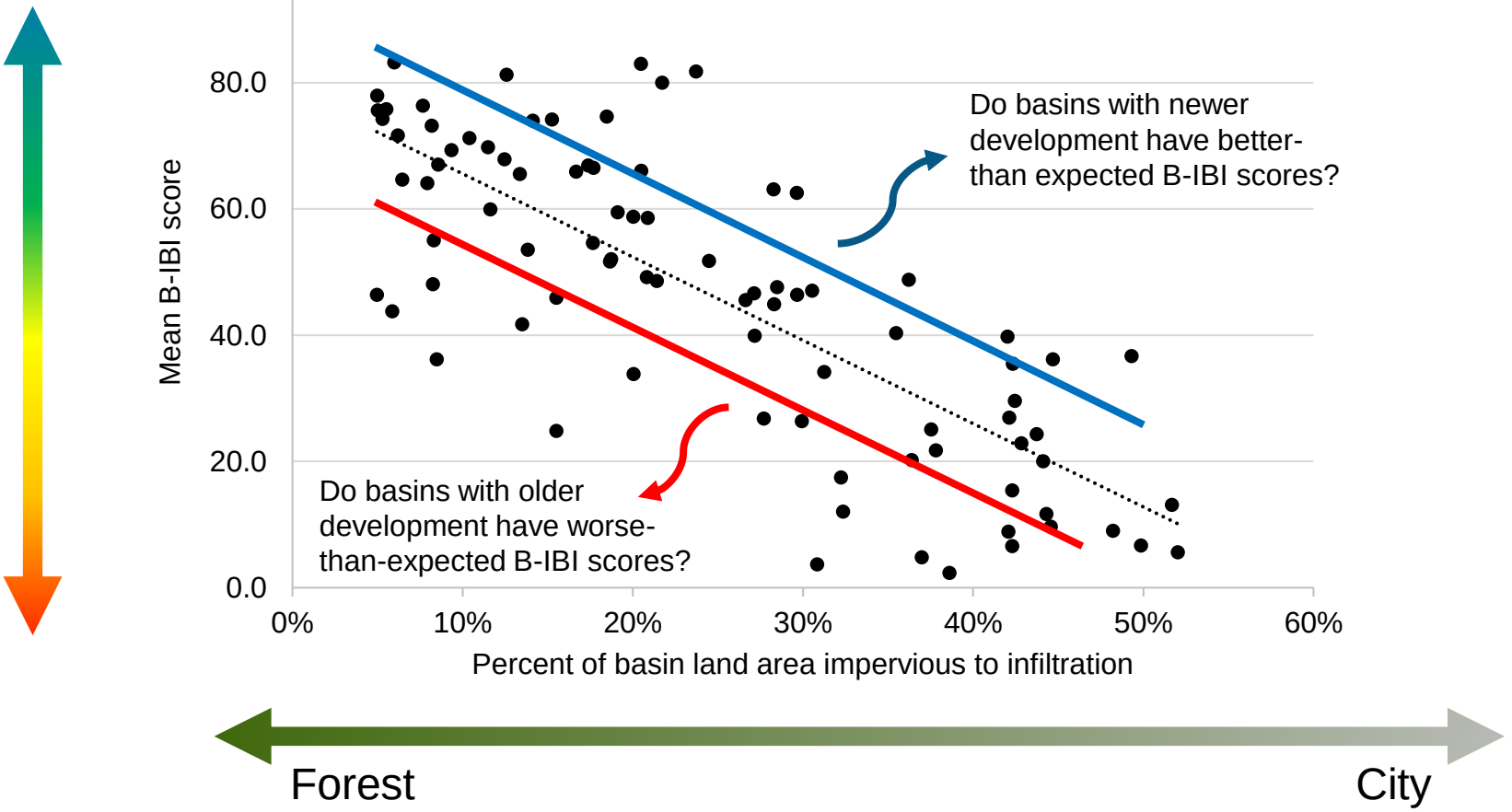
- 1990 Growth Management Act
- 1995 WA Dept of Transportation Highway Runoff Manual
- 2004 Critical Areas Ordinance
- 2005 Chinook Salmon Conservation Plan
- Citizen stewardship groups formed
- And more

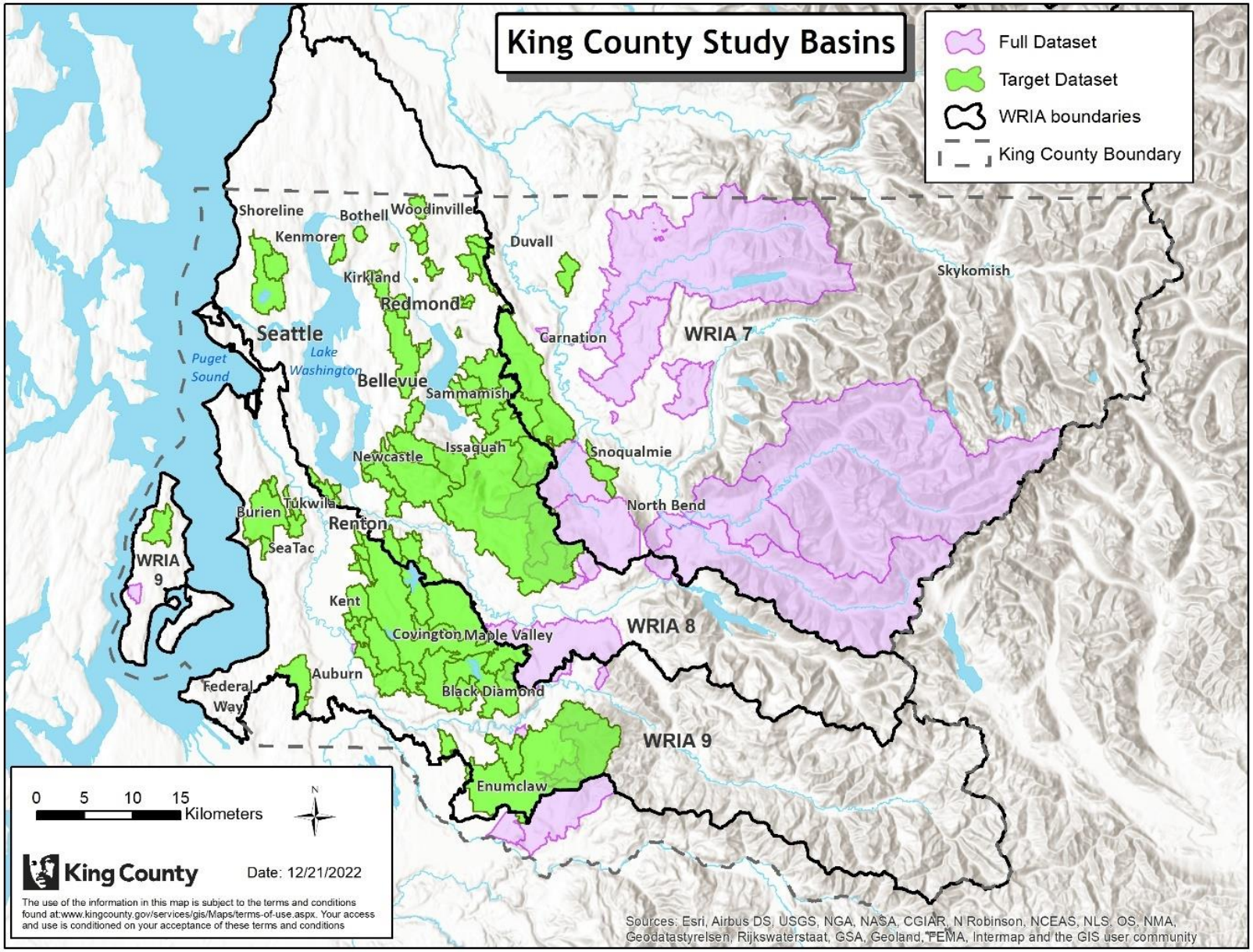
Have these actions have helped?

Urban Development vs B-IBI scores



Urban Development vs B-IBI scores




King County Study Basins
Full Dataset
Target Dataset
WRIA boundaries
King County Boundary
Shoreline
Bothell
Woodinville
Kenmore
Duvall
Kirkland
Redmond
Seattle
Lake Washington
Puget Sound
Carnation
WRIA 7
Skykomish
Bellevue
Sammamish
Issaquah
Newcastle
Snoqualmie
North Bend
Burien
Tukwila
Renton
SeaTac
WRIA 9
Kent
Covington
Maple Valley
WRIA 8
Auburn
Federal Way
Black Diamond
WRIA 9
Enumclaw
0 5 10 15
Kilometers
N
King County
Date: 12/21/2022
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Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Impervious area

Ecopia landcover data,
6-inch resolution

Landcover Data Example with Original Categories

Parcel boundaries

Land cover (Ecopia 2019)

Impervious	Pervious
building	grass
road	shrub
pavement	forest
driveway	bareland
sidewalk	

N

0 50 100 200 Feet

Photo Year: 2019

Date: 12/15/2022

Landcover Data Source:
Ecopia Vector Maps © [2021] Ecopia Tech Corporation

King County

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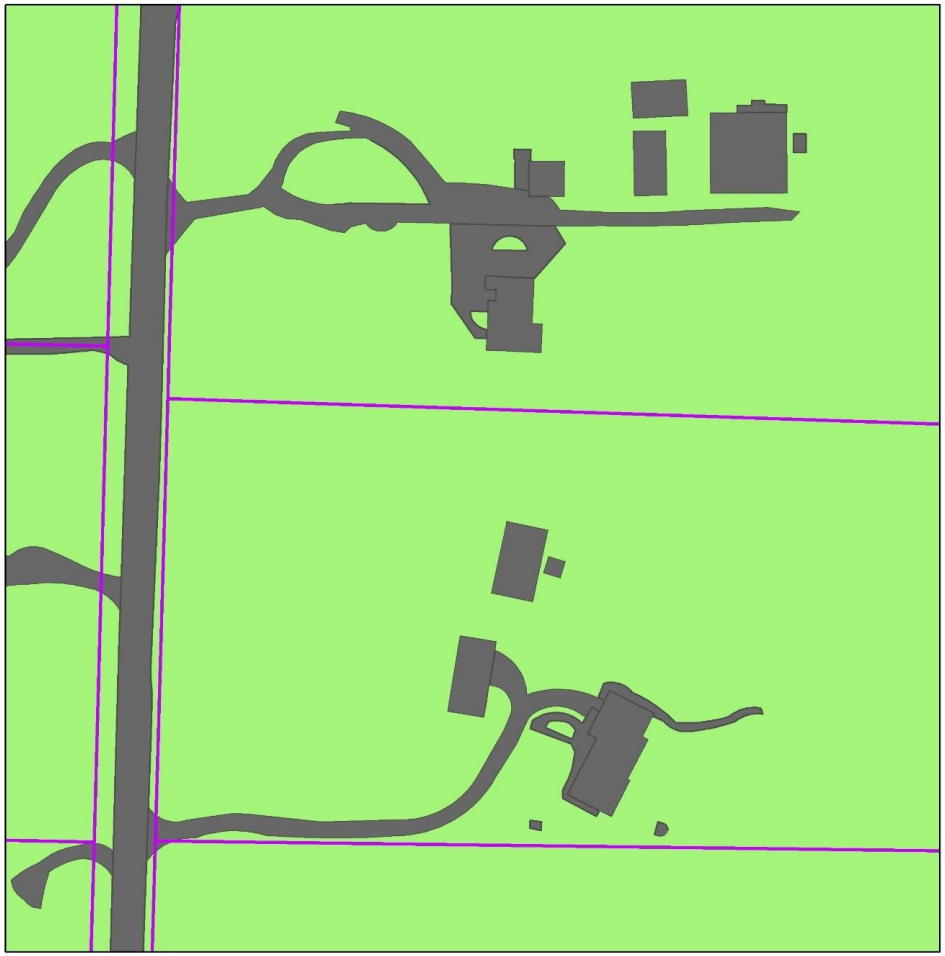
Impervious area

For each parcel:

- Impervious area
- Date parcel was developed

For each B-IBI basin:

- Total % impervious area
- % impervious area in place by certain dates (1993, 2001, 2008)
- By what year 75% of impervious area in place



Landcover Data Example with Impervious and Pervious Categories

Parcel boundaries

Land cover (Ecopia 2019)

Pervious

Impervious

N

0 50 100 200 Feet

Landcover Data Source:
Ecopia Vector Maps © [2021] Ecopia Tech Corporation

King County

Photo Year: 2019

Date: 12/15/2022

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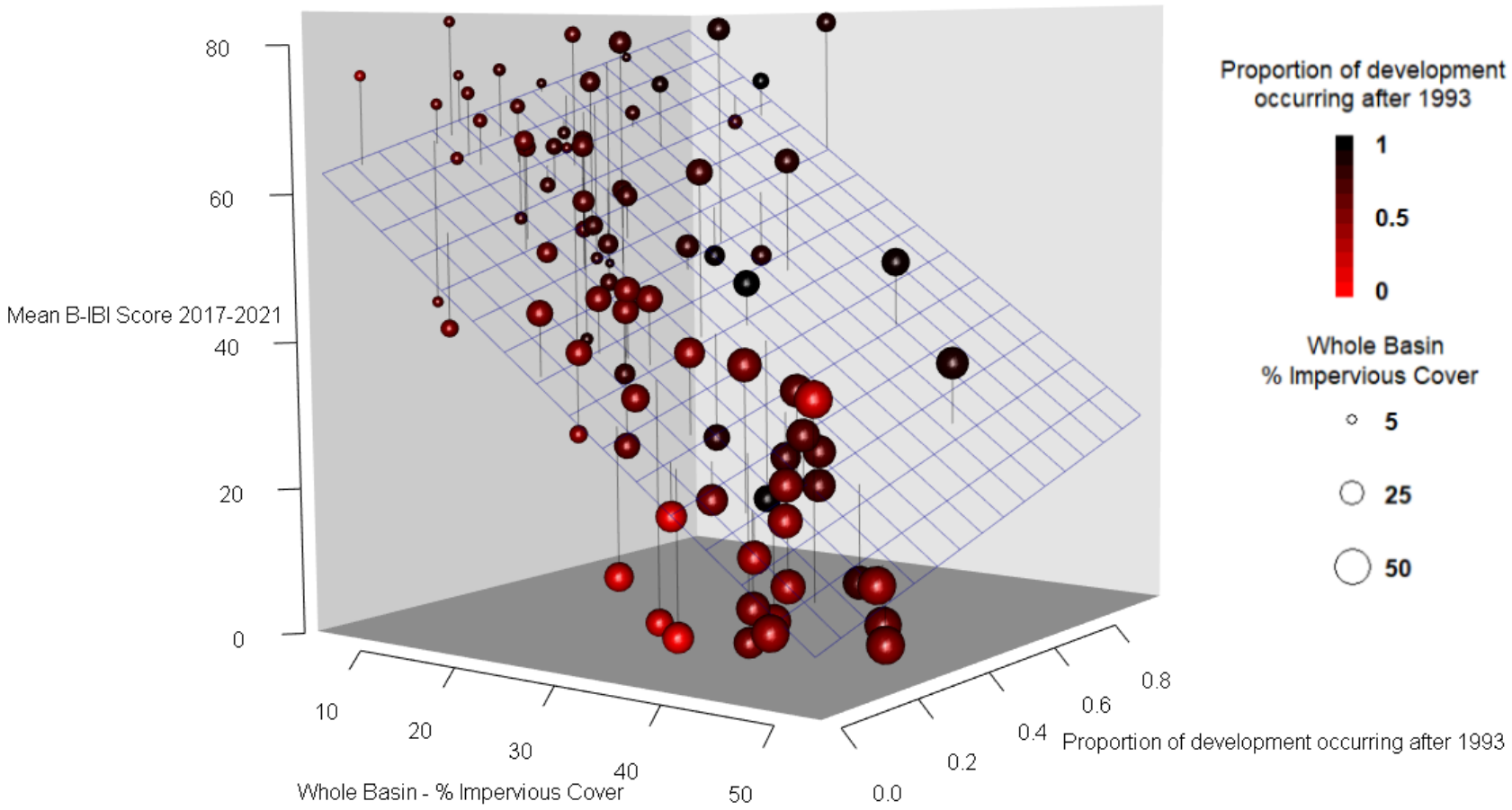
Does when a basin was developed help explain B-IBI scores?



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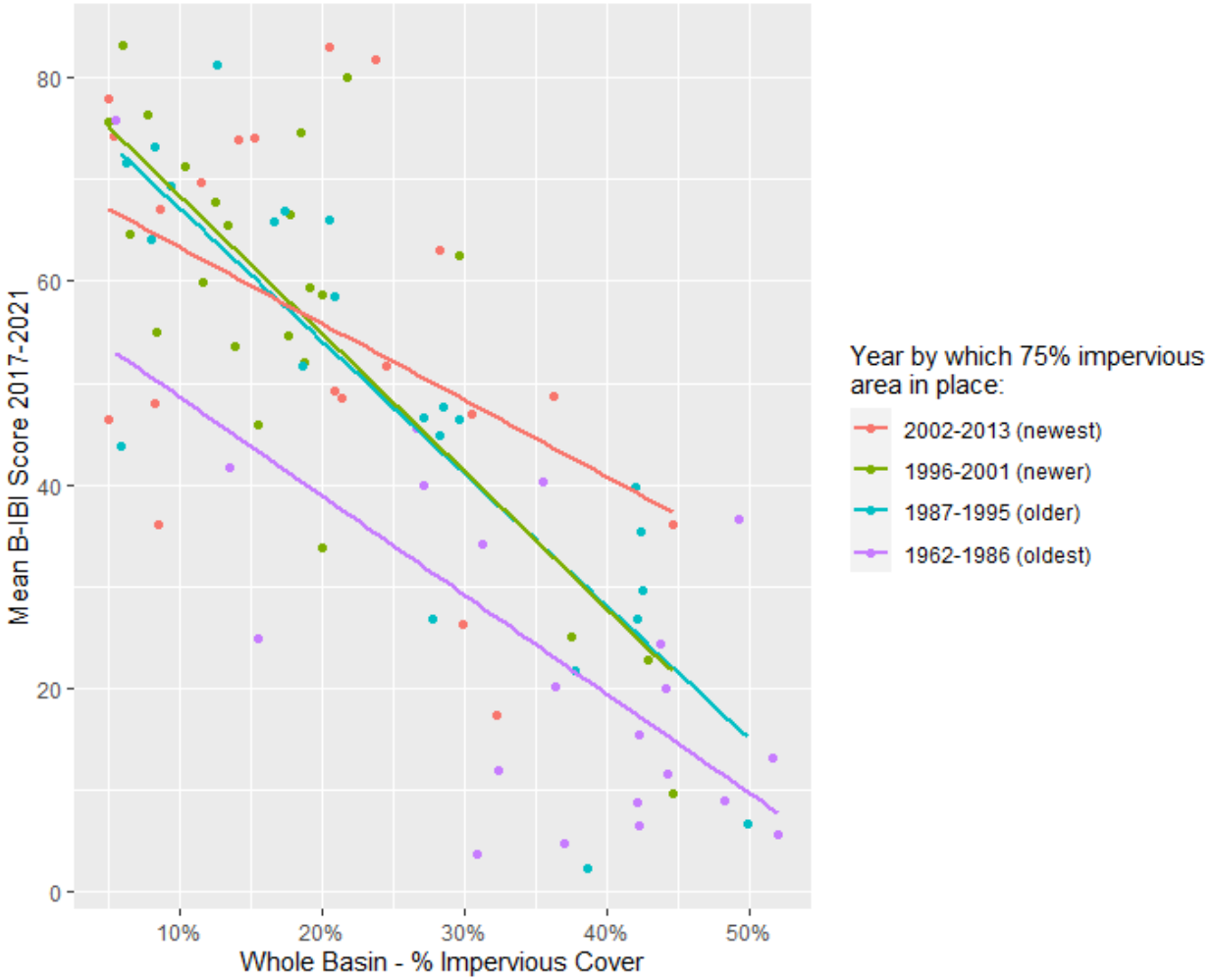

Conclusions

- Most development before significant regulations were implemented (on average 75% in place by 1995)
- Basins with the oldest development have lower B-IBI scores than basins with newer development
    - Ecologically relevant: 10- to 20-point difference
- Development date explains ~ 5% of variation in B-IBI scores
- Cannot say which regulations or changes have made the difference, but results are encouraging

Challenges

- Need more info to understand mechanism(s)
- What, where, and when have actions been implemented
  - Stormwater control measures
  - Riparian vegetation management
  - In-stream restoration (e.g., large wood placement)
  - Other actions (e.g., culvert replacements, street sweeping)

Thank you!

For more information, please contact me at kate.macneale@kingcounty.gov