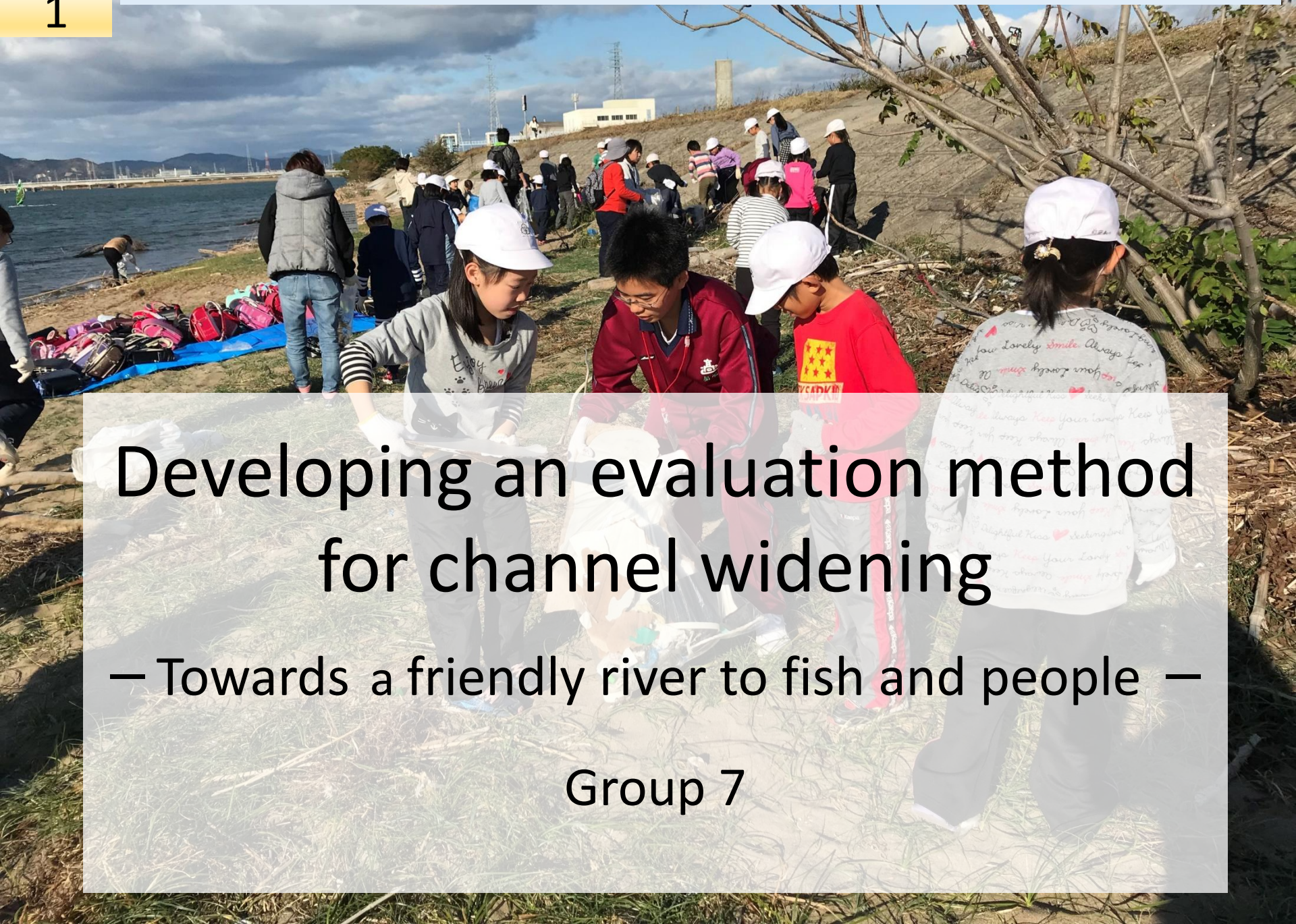
Clean up campaign in Kakogawa River with Wakamiya Elementary School students



Developing an evaluation method for channel widening

– Towards a friendly river to fish and people –

Group 7

Contents

Keyword

River channel widening

dredging a river
to prevent flooding

Channel widening

Target area

downstream area of the Kakogawa River

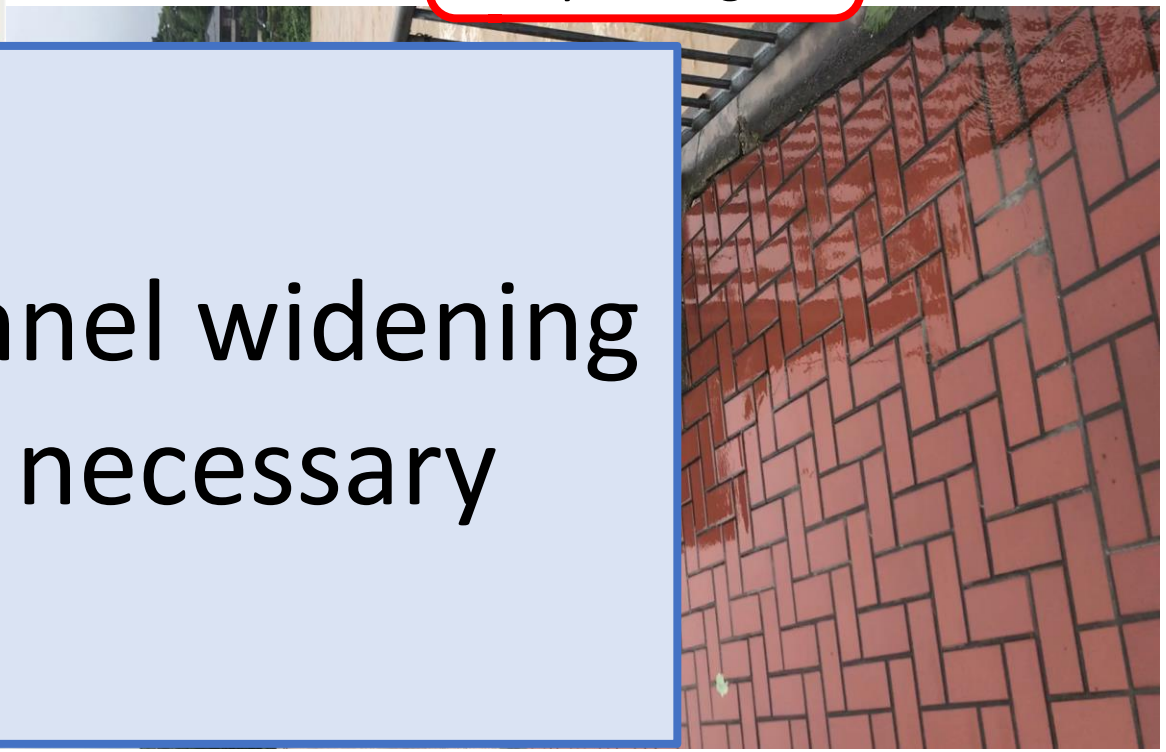
First-class river

- Especially important for our lives and economy
- National governments are tasked with the management for these rivers

Kakogawa River basin

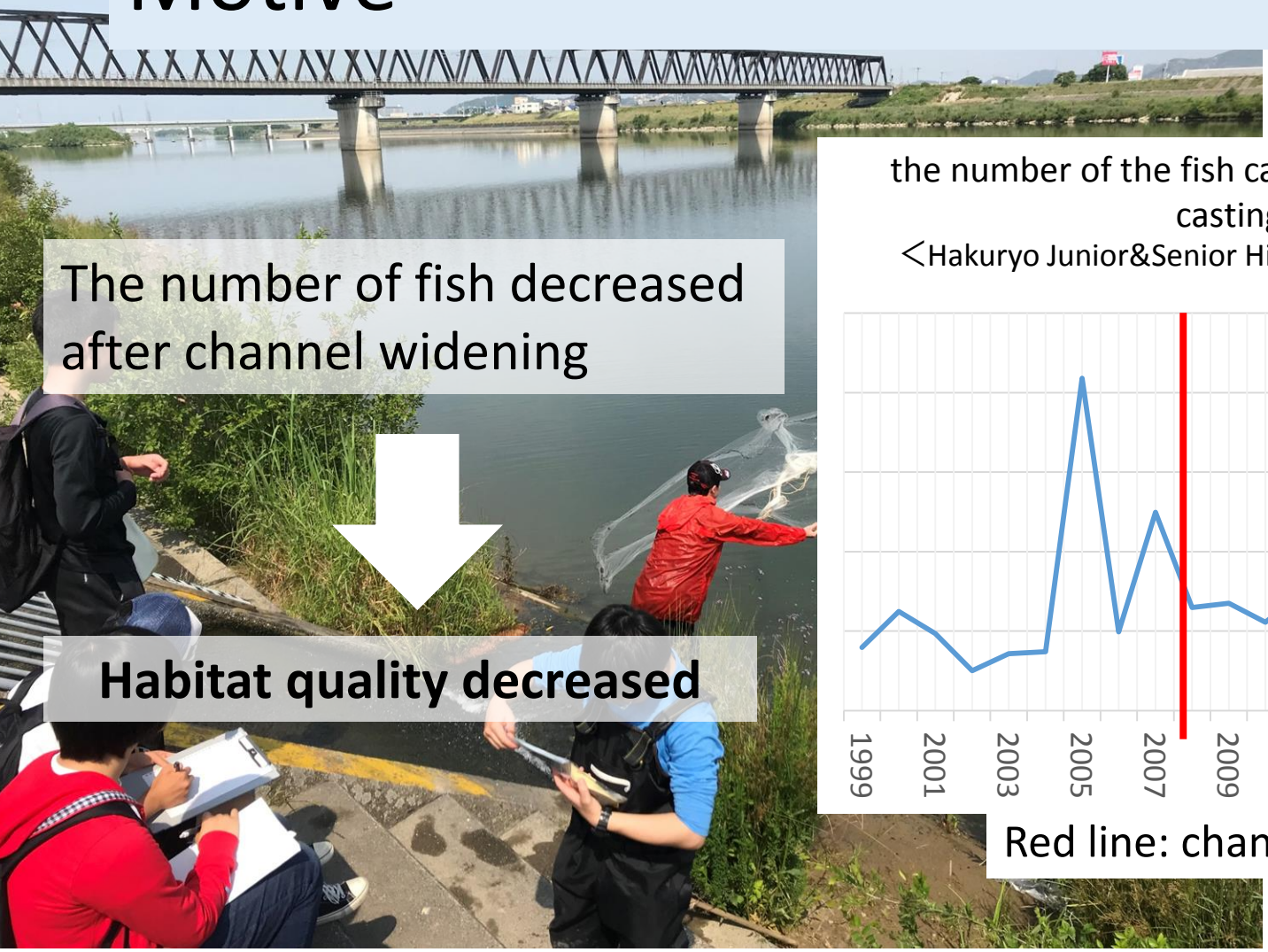
Motive | flooding

Kato city
Touryu Bridge



Channel widening is necessary

Motive



The number of fish decreased after channel widening

Habitat quality decreased

the number of the fish captured per one time of casting net
＜Hakuryo Junior&Senior High School Biology Club＞

Red line: channel widening

Purpose

Existing evaluation

River flow…before channel widening
Habitat suitability, Sustainability…after channel widening

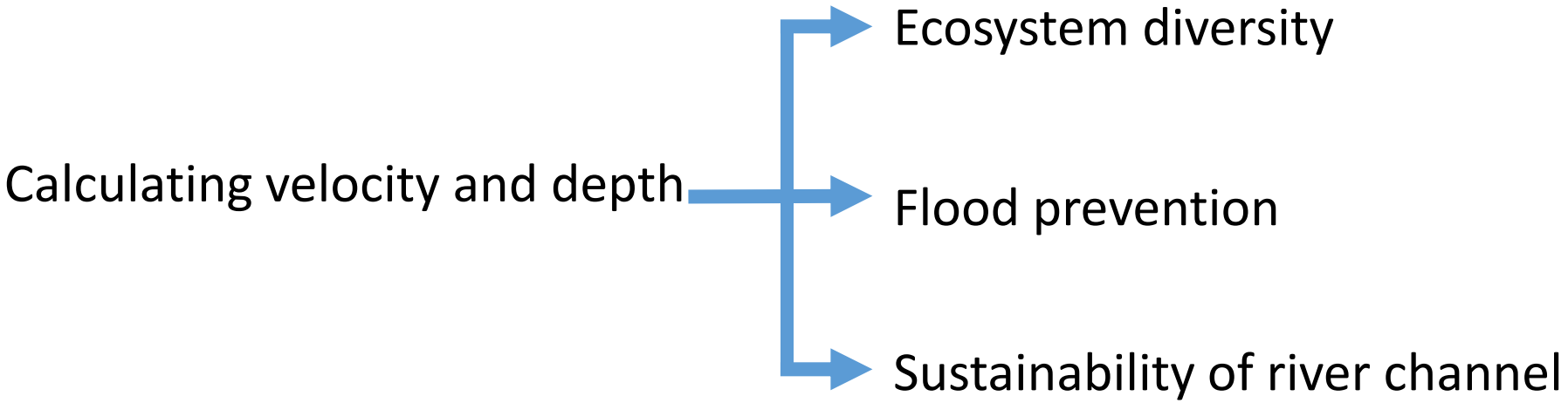
Establishing a method to evaluate channel widening plans beforehand

Let's evaluate beforehand!!

Merits of prior evaluation

Sustainability…lower the frequency of channel widening
Habitat suitability…estimate the effect on the ecosystem

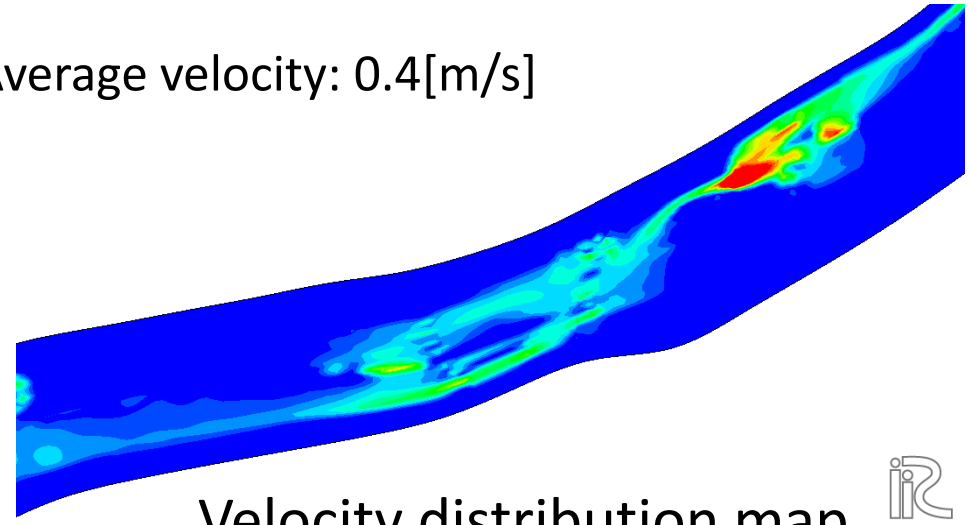
Evaluation method



Calculating velocity and depth

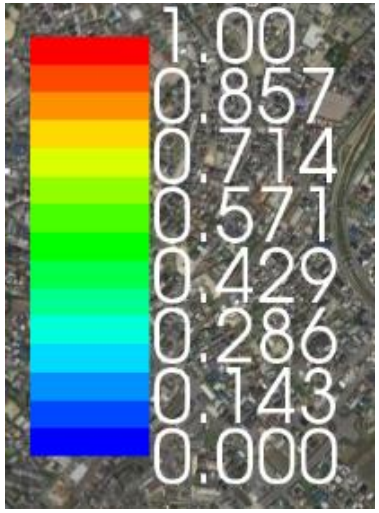
Tool:iRIC

Average velocity: 0.4[m/s]



Velocity distribution map
（4.2km～6.8km from river mouth）

Velocity(m/s)



Calculation conditions

Target area	3.8km～11.8km from river mouth
Discharge	27[m^3/s]
Time	30,000[s]

Ecosystem diversity | Evaluation method

EED[Eco-Environmental Diversity]

Index to evaluate the diversity of habitat

EED has a positive correlation with the number of species of fish

reference：Hirohumi ito ,Research on practical application of fish habitat evaluation in small-scale rivers ,2016-4

		depth(m)		
velocity(m/s)		～0.2	0.2～0.6	0.6～
	～0.2	a1	a2	a3
	0.2～0.6	a4	a5	a6
	0.6～1	a7	a8	a9

$$\mathrm{EED} = 1 - \sum_{i=1}^{9} a_i^2$$

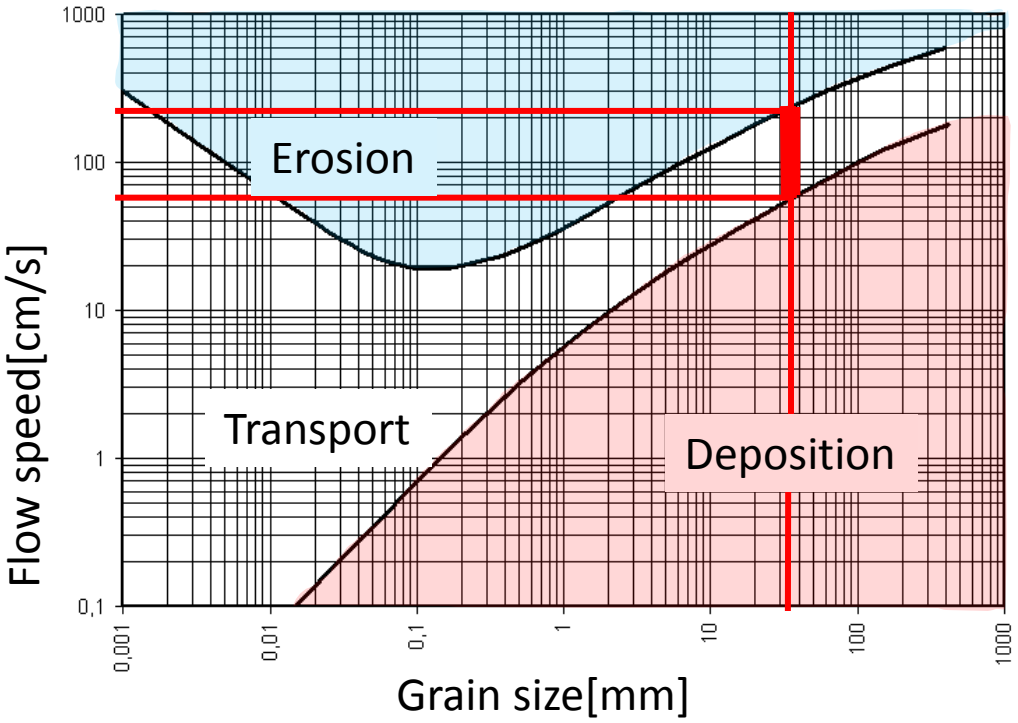
a:the relative proportion of each environment

Flood prevention

Calculate water surface elevation during flood discharge

Compare with government-run widening plan

Sustainability of river channel cross section



Hjulström diagram

Grain size：35.6mm

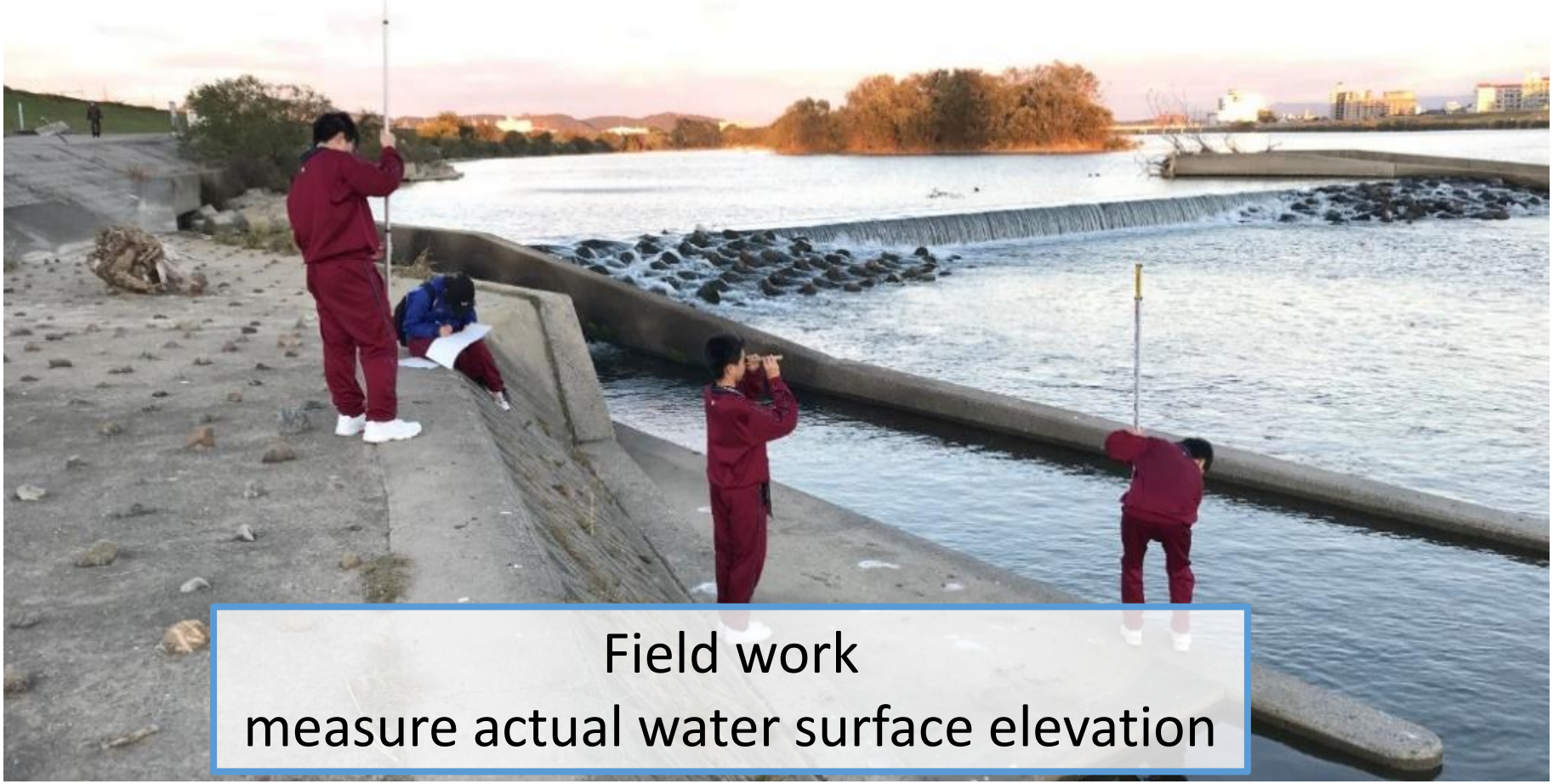
Deposition：

Under 0.55m/s

Erosion：

Over 2.3m/s

Accuracy of iRIC calculation



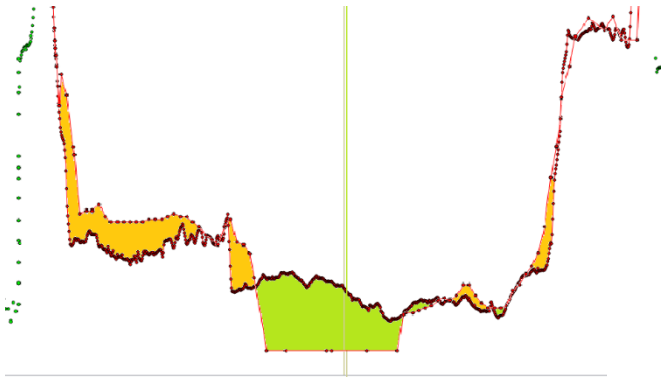
Field work
measure actual water surface elevation

Accuracy of evaluation of sustainability

The change of cross sectional shape (reality)

compare

Evaluation results (simulation)

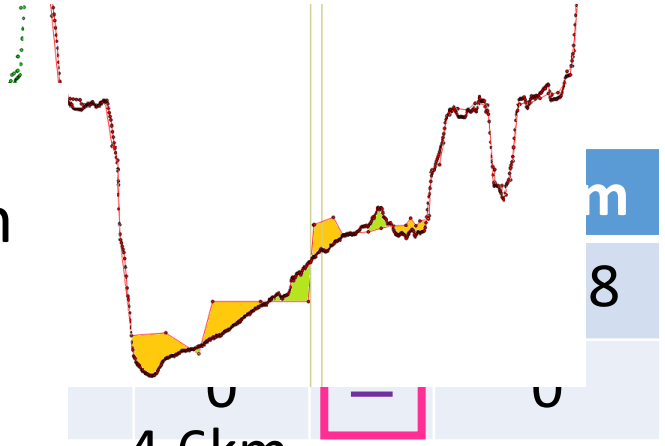


1m
25m

1km
(H27 to H29)

Deposition
1km > 4.6km

Erosion
1km ≅ 4.6km



4.6km
(H24 to H29)

: deposition
: erosion

This evaluation method is accurate.

Conclusion | Evaluation method

Velocity and depth

Calculate them using iRIC

Flood prevention

Evaluate the effectiveness of flood prevention using iRIC

Ecosystem preservation

Before : Observe it after digging

New method : **Evaluate it using EED beforehand**

Sustainability of cross sectional shape

Before : Observe it after digging

New method : **Evaluate it using Hjulström curve beforehand**

Conclusion

- Development of a method
  to evaluate channel widening plans
  easily, quantitatively, and
  before widening begins

- Confirm the accuracy of the evaluation method

Future issues

- Make a better channel widening plan
- Examine the accuracy of
  our evaluation method in greater detail
- Consider interactions among
  various kinds of fish

Acknowledgements

This study was supported by these people.

M.L.I.T Himeji Office of River and National Highways

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Mizuho Information & Research Institute, Inc

Mr. Keisuke Inoue

Civil Engineering Research Institute for Cold Region

Mr. Toshiki Iwasaki

Hakuryo Junior&Senior High School Biology Club

We’d like to acknowledge their great help.

References

・Evaluation and monitoring project commission．“Re-evaluation for the Kakogawa River improvement ”． Kinki Regional Development Bureau． 2011-12．
https://www.kkr.mlit.go.jp/plan/ippan/zigyohyoka/ol9a8v000000dn20-att/4.pdf.（referred on 2018-09-17）

・ M.L.I.T Himeji Office of River and National Highways “an outline of the Kakogawa River basin”．
2008-07-16． https://www.kkr.mlit.go.jp/himeji/iin/kako_ryuiki/pdf_files/20080716siryou7_vol01.pdf

（referred on 2018-09-17）

・Kakogawa River basin council，“The second Kakogawa River basin council, document 6（the report of the progress of the project）”.

・Hirohumi ito ,Research on practical application of fish habitat evaluation in small-scale rivers ,2016-4

（In Japanese）

・事業評価監視委員会．“加古川直轄河川改修事業再評価 近畿地方整備局． 2011-12．
https://www.kkr.mlit.go.jp/plan/ippan/zigyohyoka/ol9a8v000000dn20-att/4.pdf．

（参照日 2018-09-17）

・国土交通省姫路河川国道事務所 “加古川流域の概要”．2008-07-16．
https://www.kkr.mlit.go.jp/himeji/iin/kako_ryuiki/pdf_files/20080716siryou7_vol01.pdf

（参照日 2018-09-17）

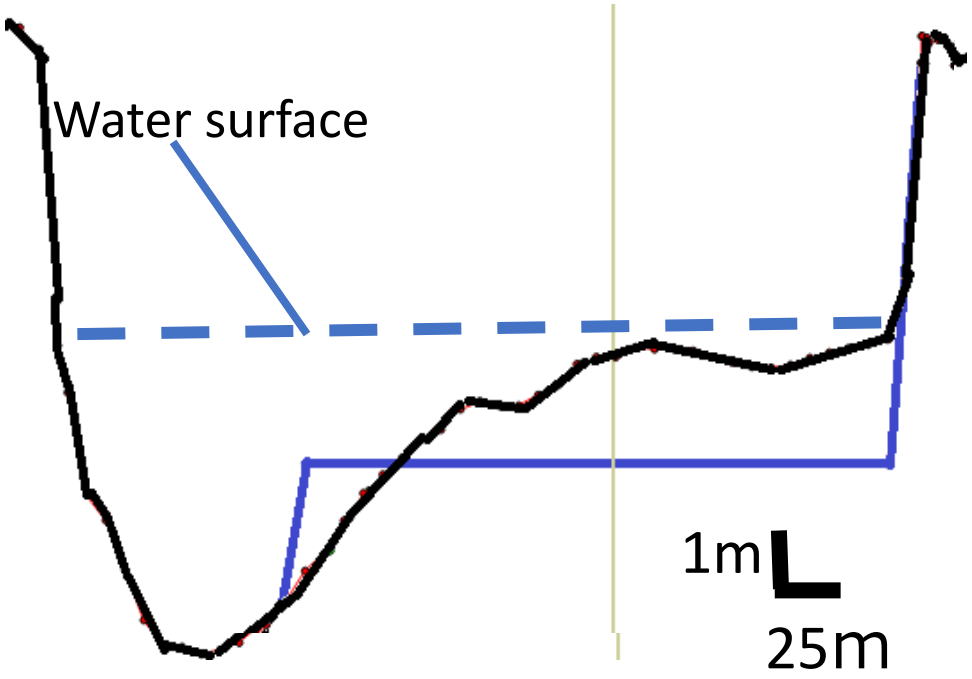
・加古川流域懇談会，“第二回加古川流域懇談会資料6 事業の進捗状況について”

Discussion with M.L.I.T Himeji Office of River and National HIghways

Thank you for listening !

Q&A

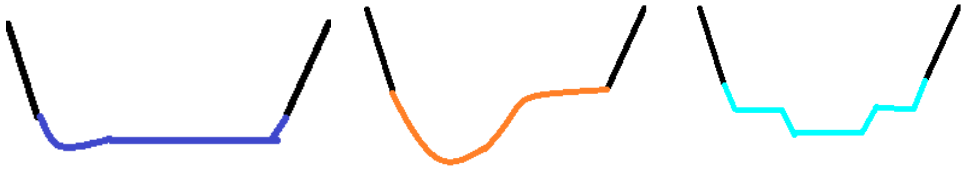
New channel widening plan



Blue : government's plan
- Flat
- Hard to inhabit for various species

Orange : cross-section A
- Various water velocities

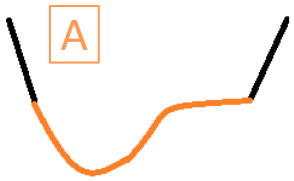
Light blue : cross section B
More differences in depth than government's plan



Government's plan | A | B

Evaluation results

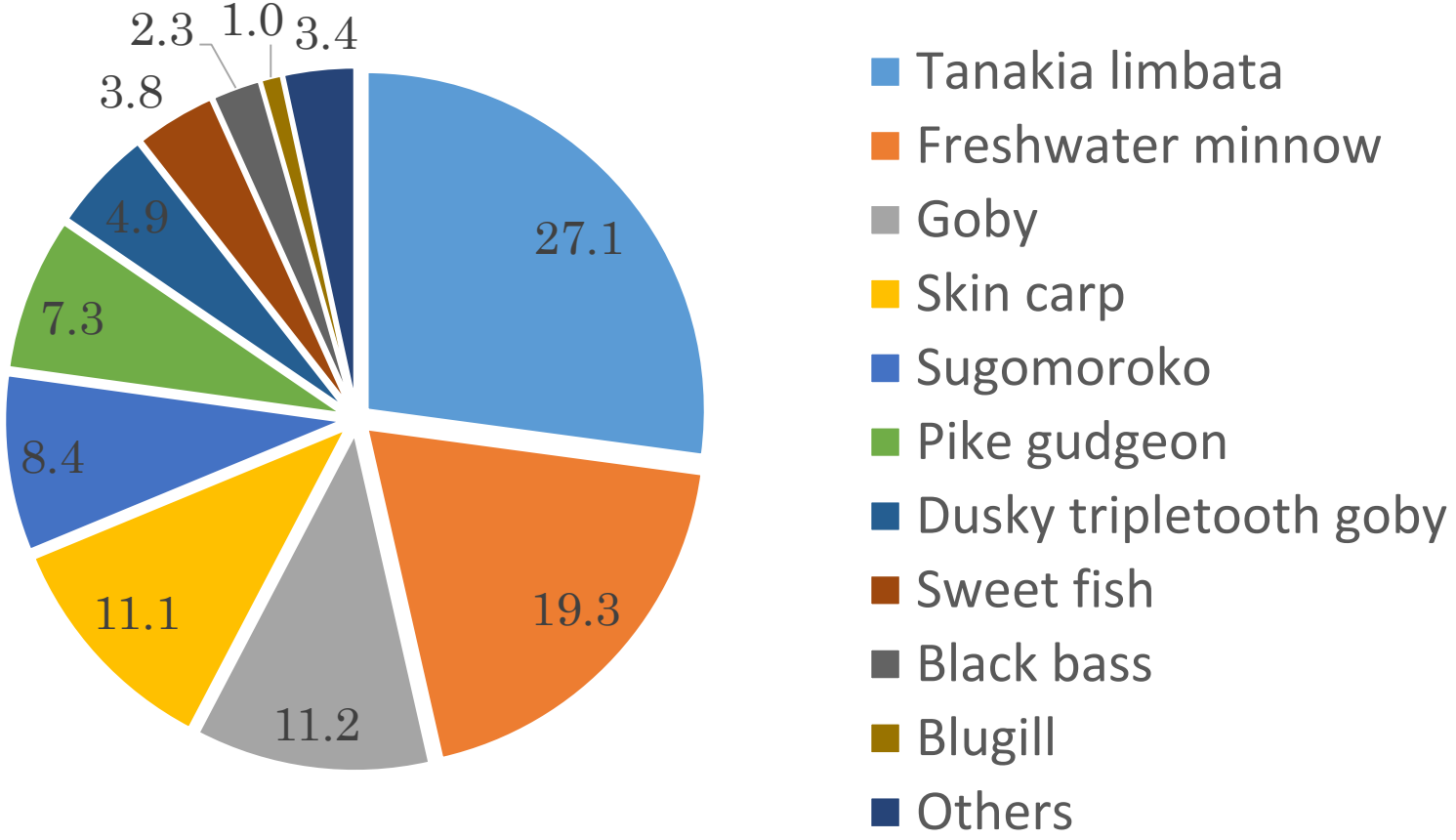
	Government's plan	New plan A	New plan B
Ecosystem diversity	0.793	0.837	0.822
Flood prevention	criterion	+0.06m	-0.06m
Sustainability	42%	34%	37%



Example Applications of iRIC

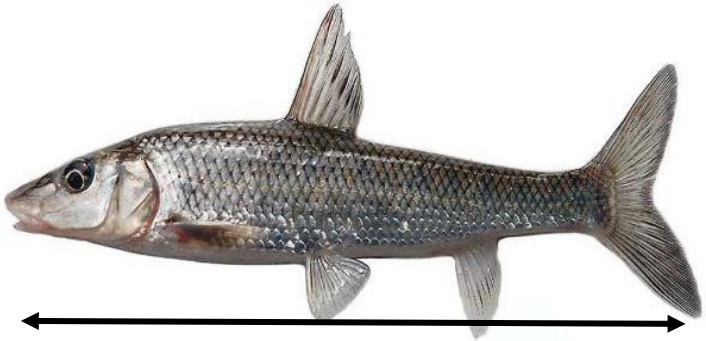
- Inundation Simulation of Oda River in 2018 West Japan Flood
- Debris flow simulation in West Japan Flood Disaster of 2018 in Kumano, Hiroshima, Japan
- Inundation Simulation of Shozu River in 2017 Flood in Kyushu, japan
- A lot of research on rivers

Reference:iRIC Website ＜http://i-ric.org/ja/＞



Proportion of the caught fish in about 5 km from the river mouth[%]

reference :
WEB fish illustrated book



50cm

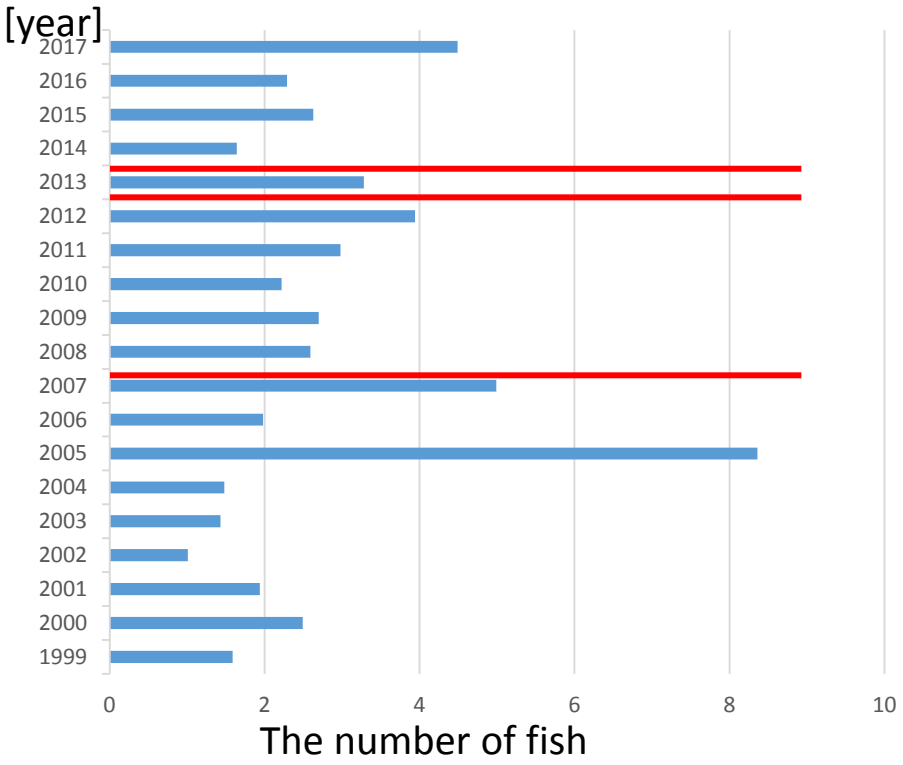
Skin carp

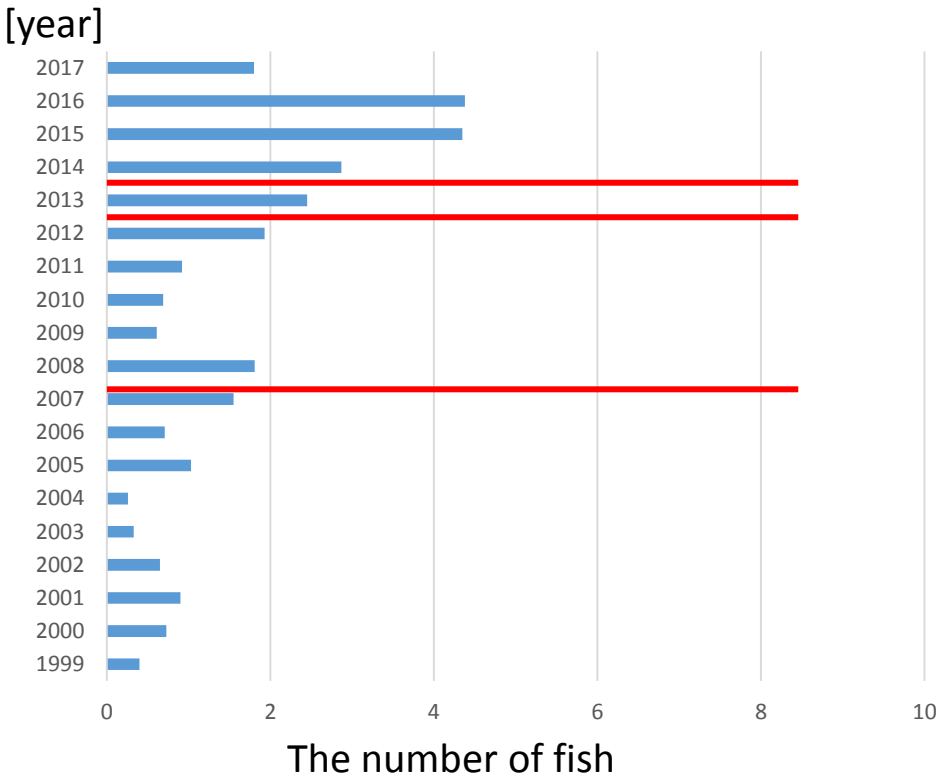
Sweet fish

Freshwater minnow

reference : M.L.I.T Himeji office of River and National Highways

the number of fish captured per one time of casting net
＜Hakuryo junior-senior high school biology club＞

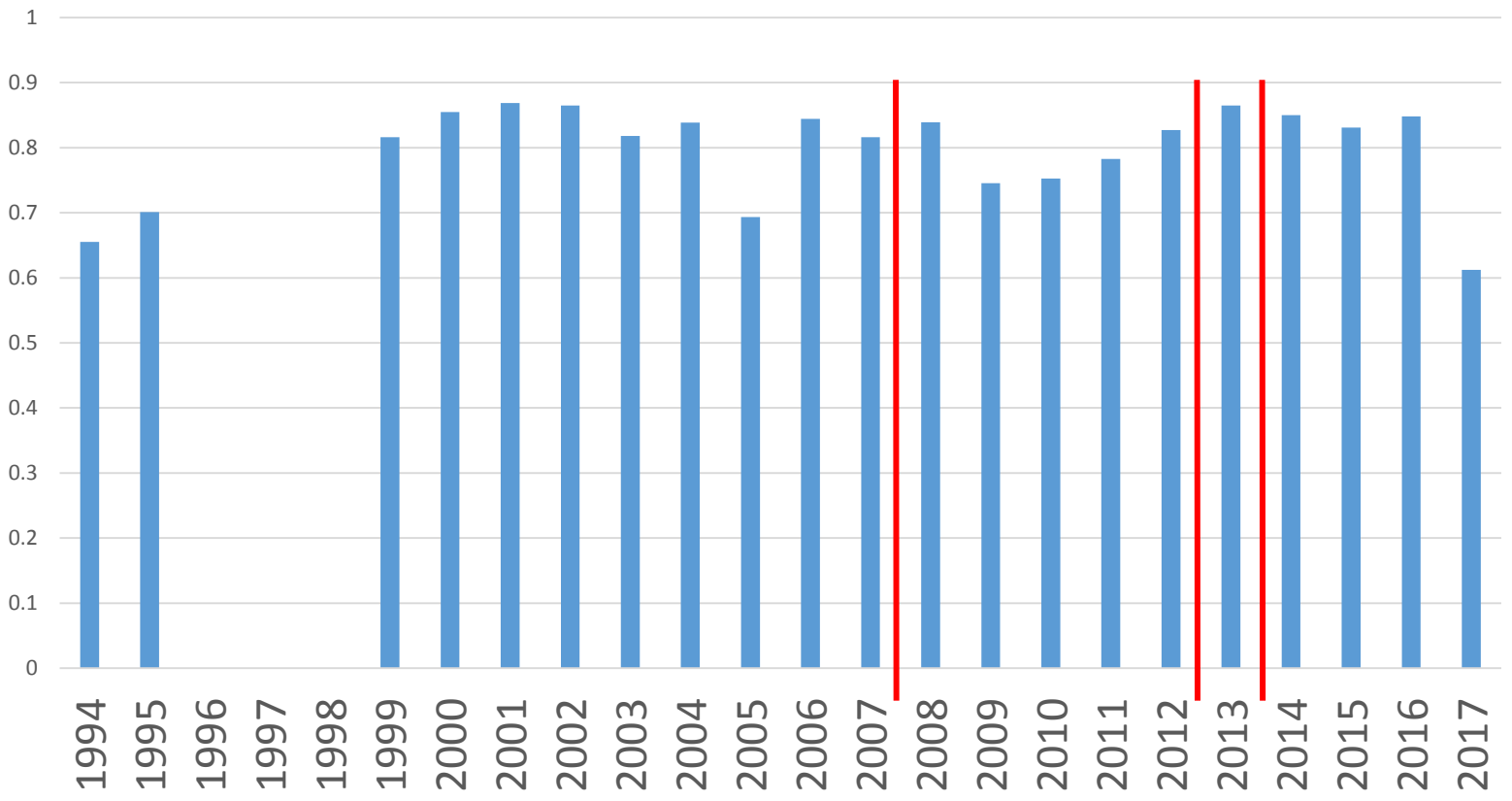




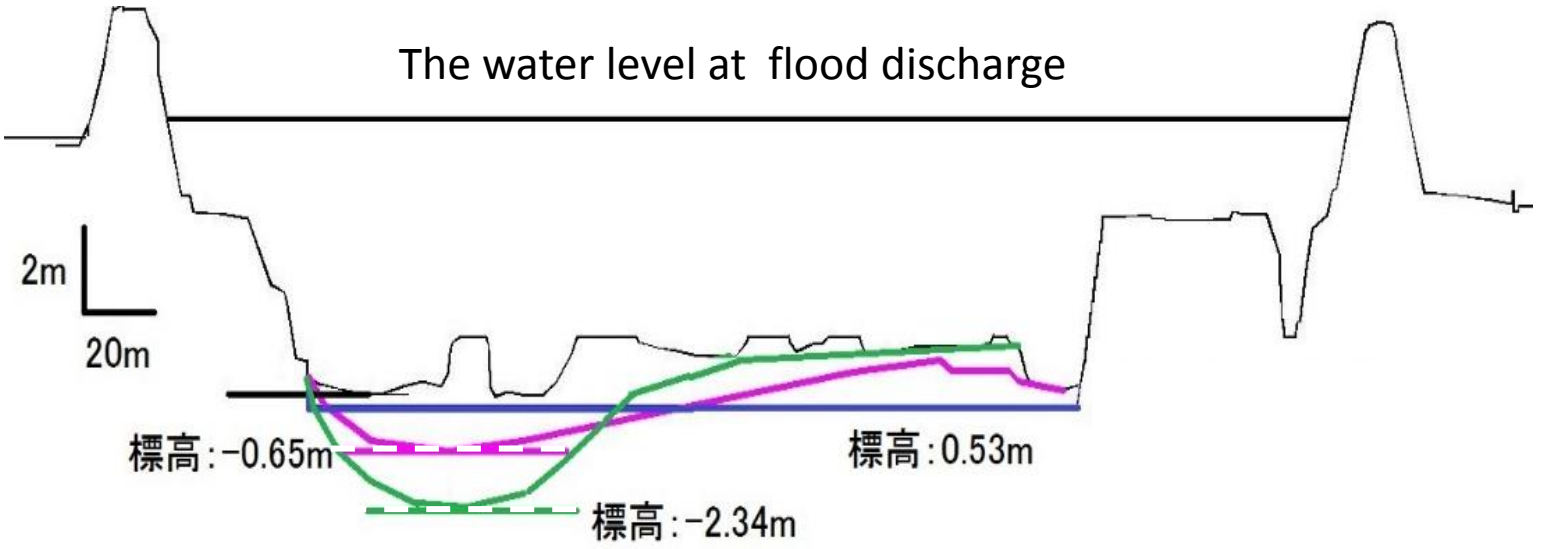
Lower stream

Midstream

Simpson's Diversity Index

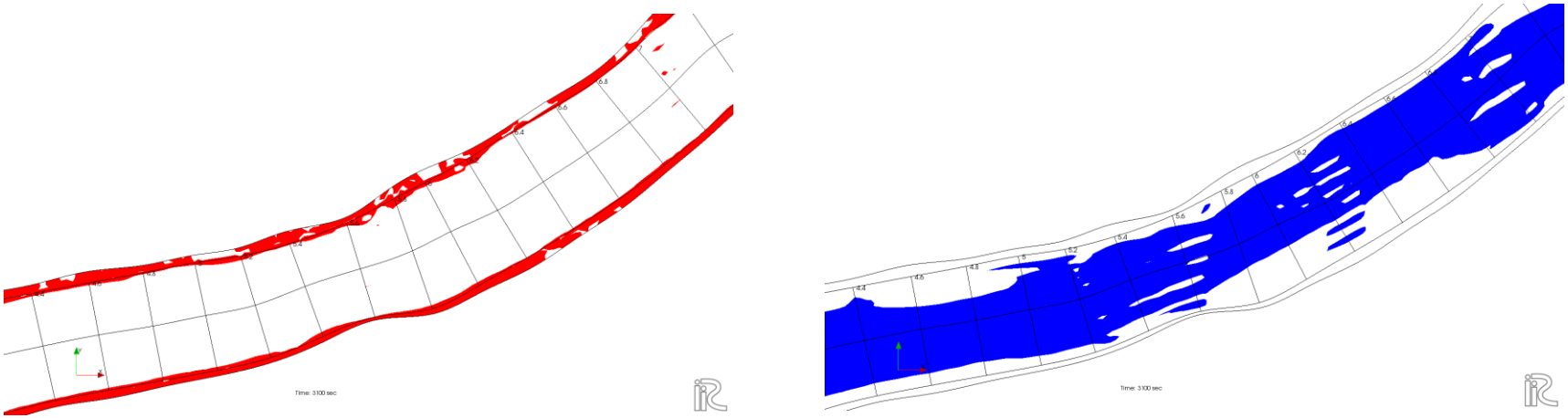


Cross sectional shape



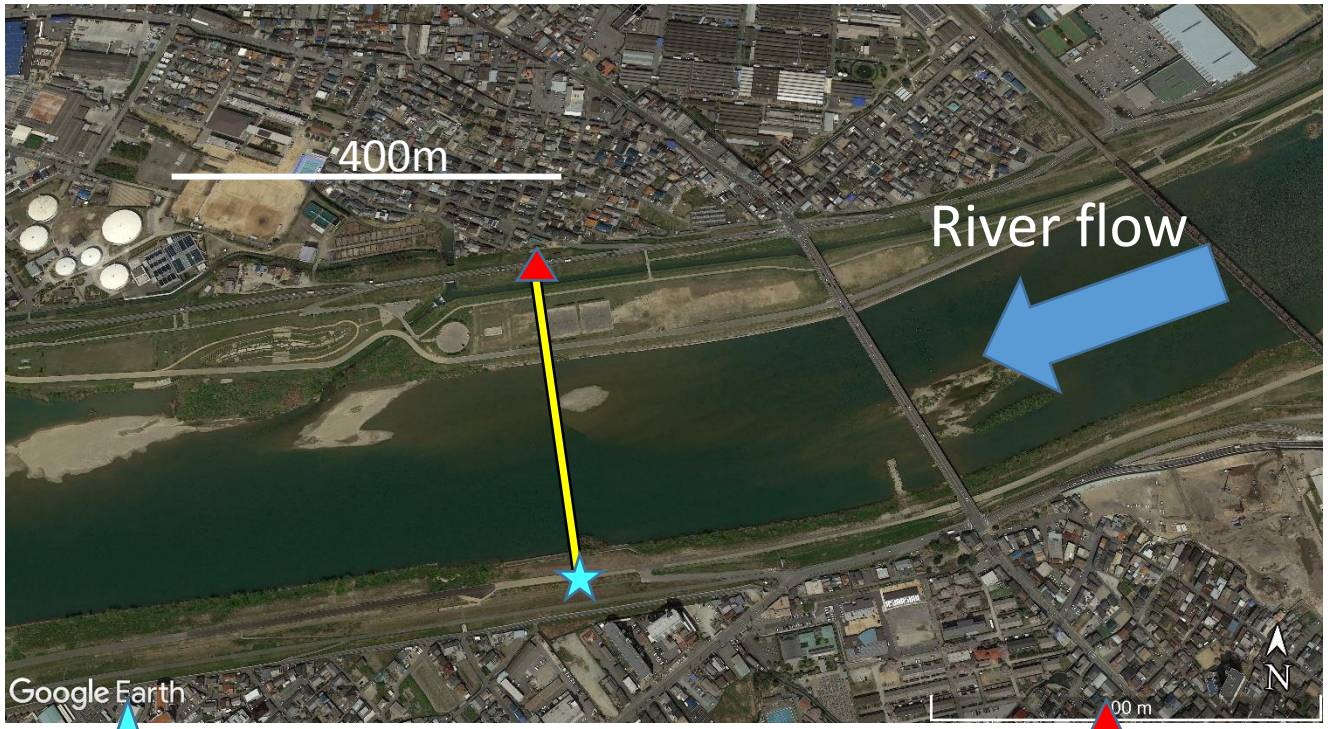
Erosion at flood discharge

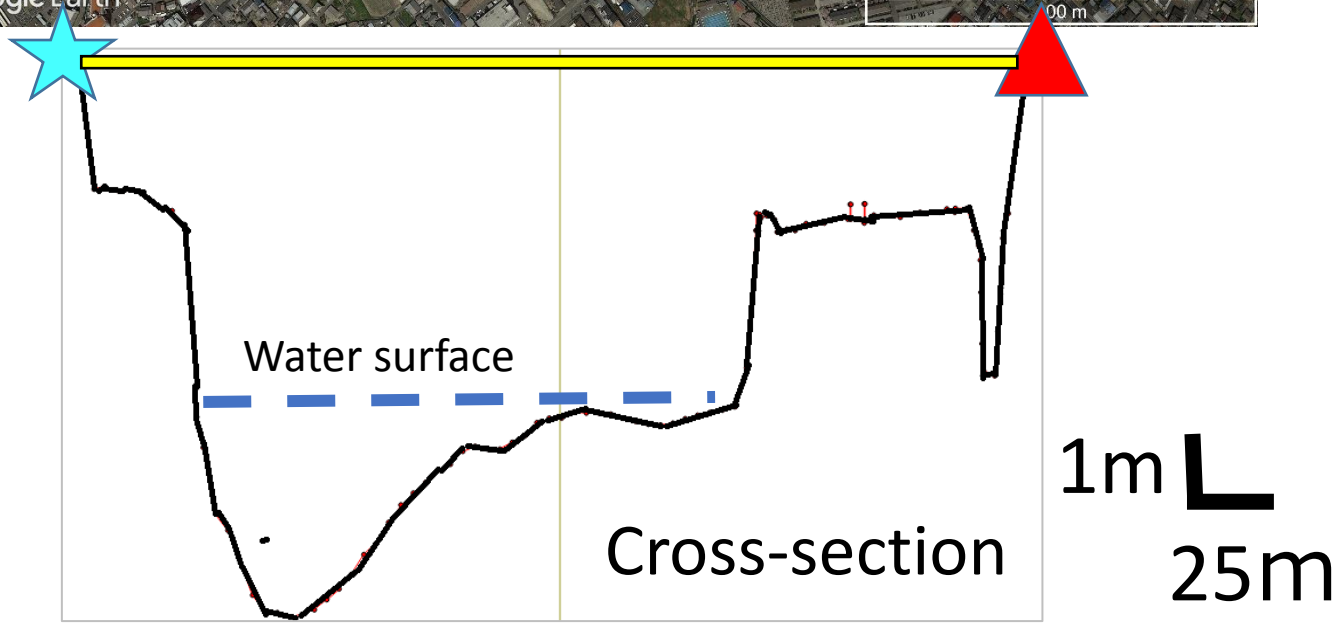
	Government's plan	1	2	3	4
Erosion(%)	66	69	69	67	67



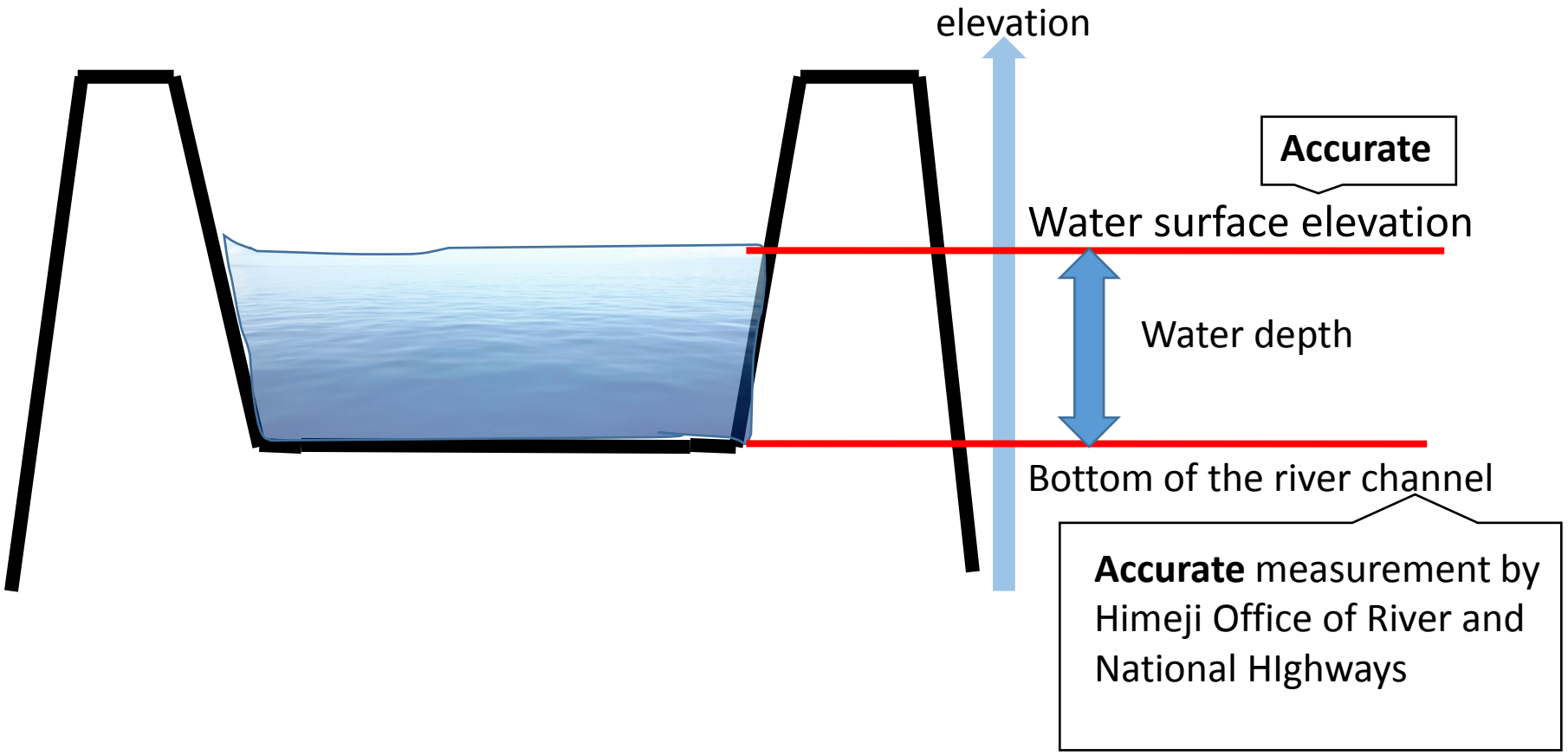
deposition（left） erosion（right） distribution map

Satellite photo downstream of the Kakogawa River


400m
River flow
Google Earth
N

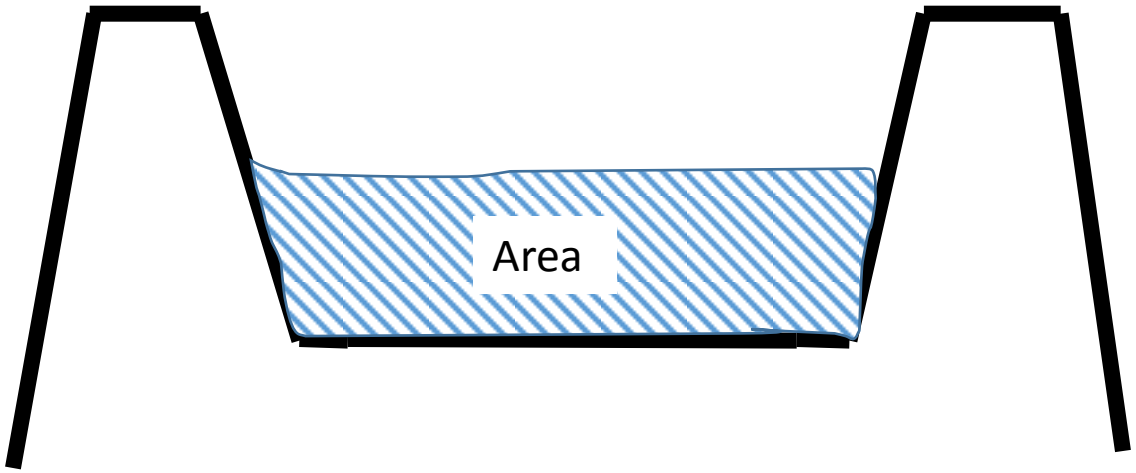

Water surface
Cross-section
1m
25m

Relationship between flow velocity, water depth, and water surface elevation



Water surface elevation is accurate → Water depth is accurate

Relationship between flow velocity, water depth, and water surface elevation



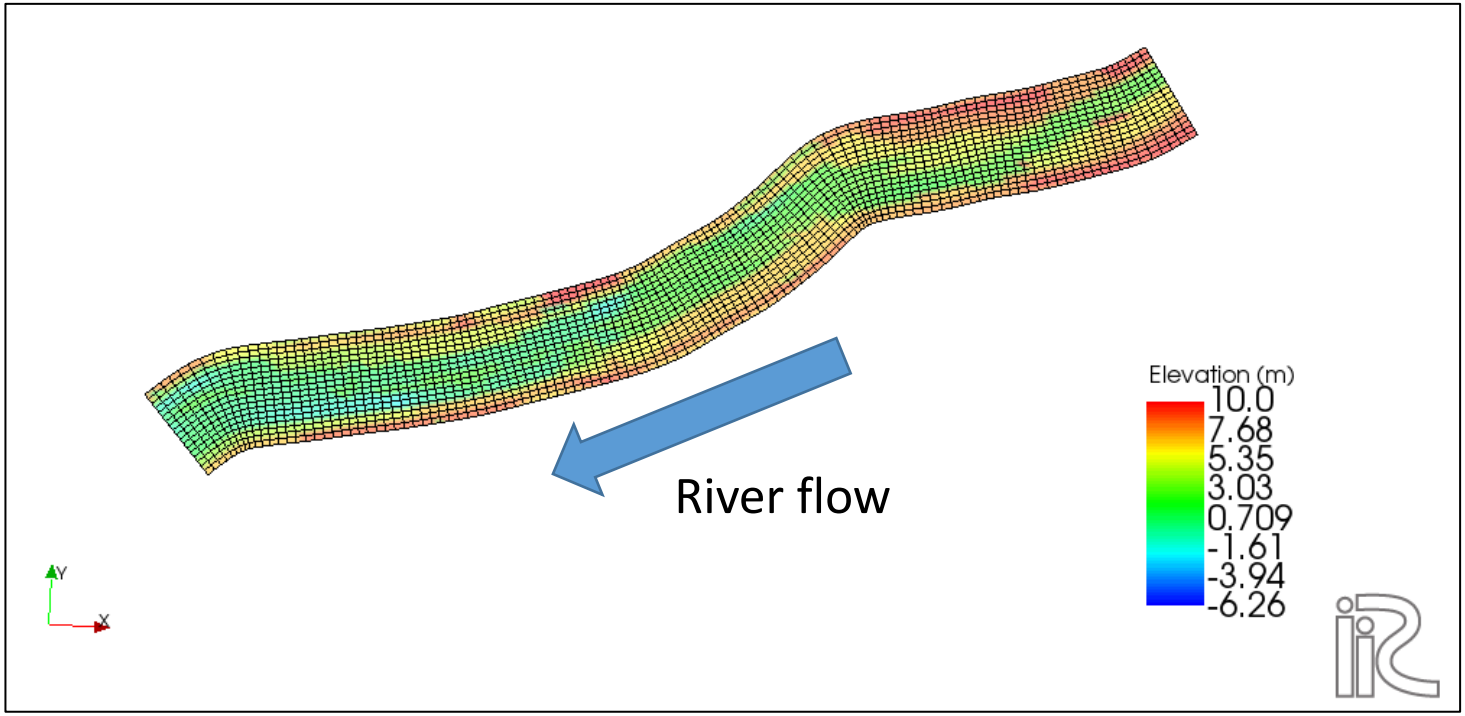
$$\text{Discharge}[m^3/s] = \text{Area}[m^2] \times \text{Flow velocity}[m/s]$$

Water surface elevation is accurate → Water depth is accurate

Water depth is accurate → Flow velocity is accurate

How to calculate flow velocity and water depth

Import the elevation data and make a grid

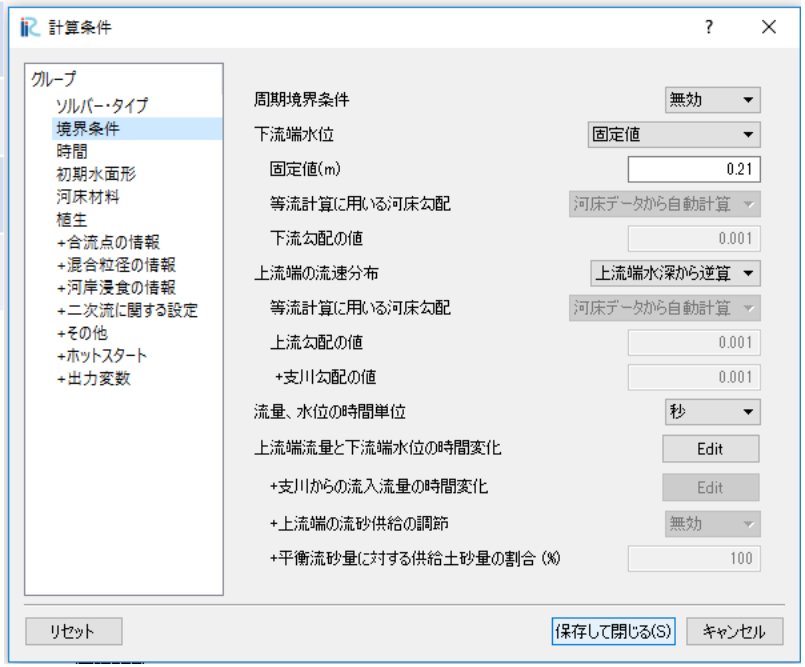


River bottom elevation

How to calculate flow velocity and water depth

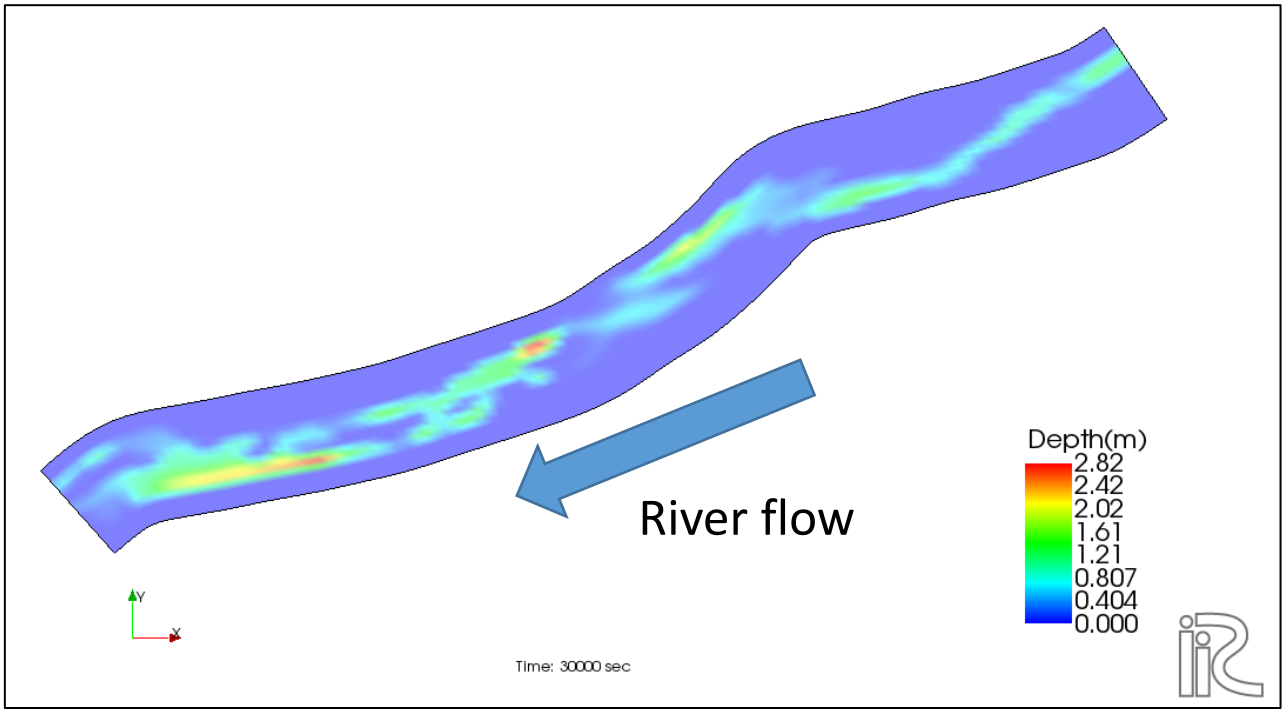
Set calculation conditions

Target area	3.8km～11.8km from river mouth
Discharge	27[m^3/s]
Time	30,000[s]
…	…



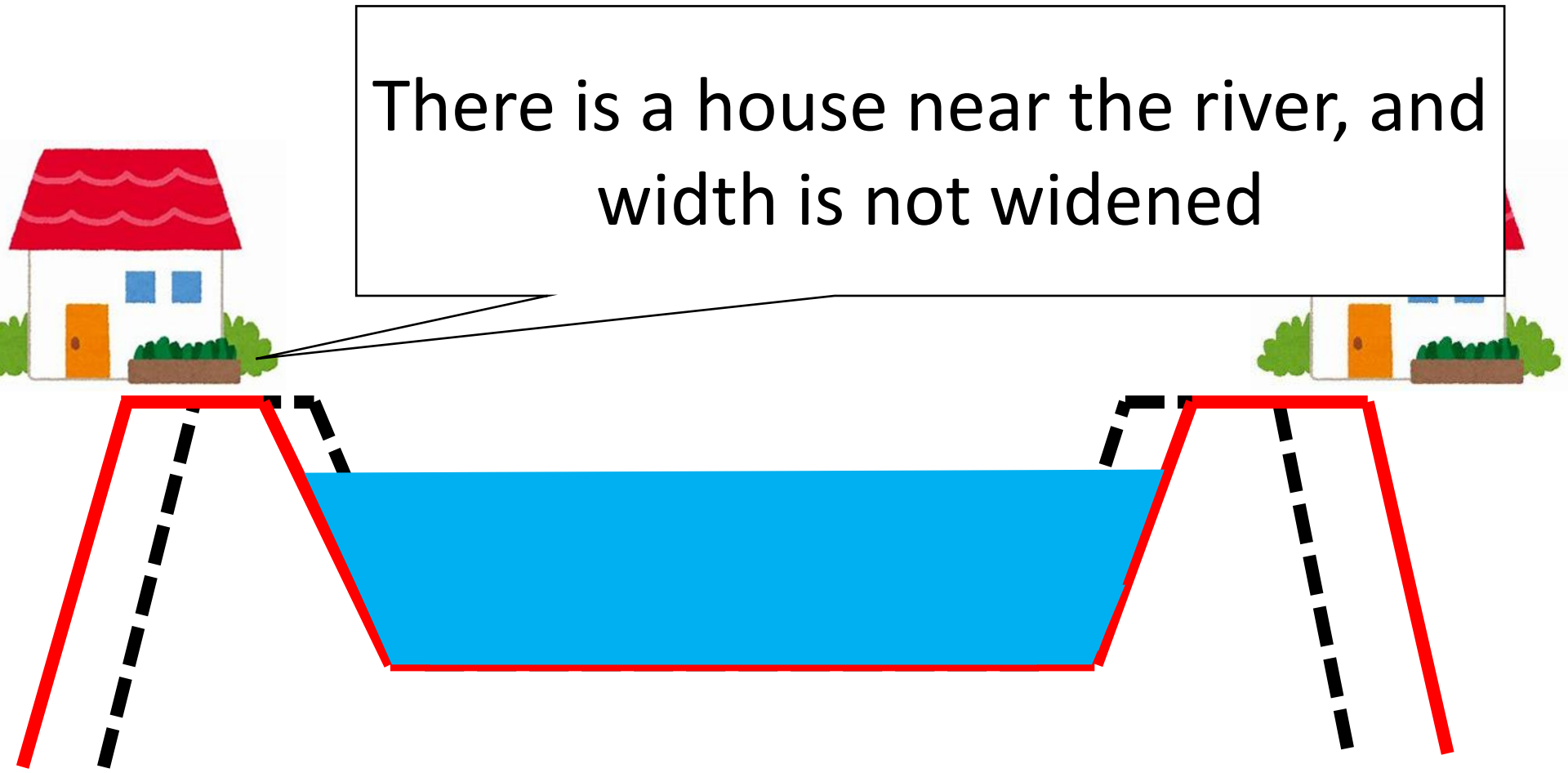
How to calculate flow velocity and water depth

Run the simulation



Calculation result of water depth

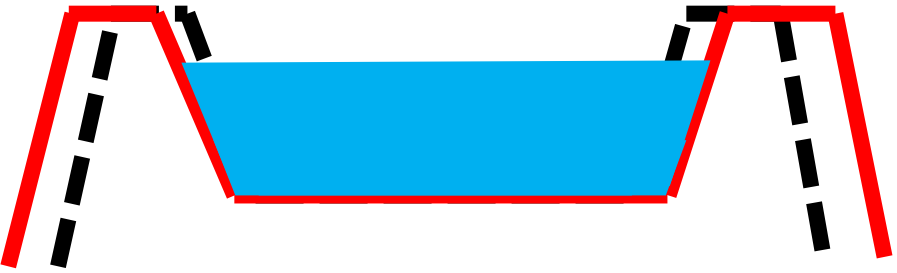
Widening of the width of a river



Raising a dike

The top of the dike becomes the way, and construction is difficult

Widening of the width of a river

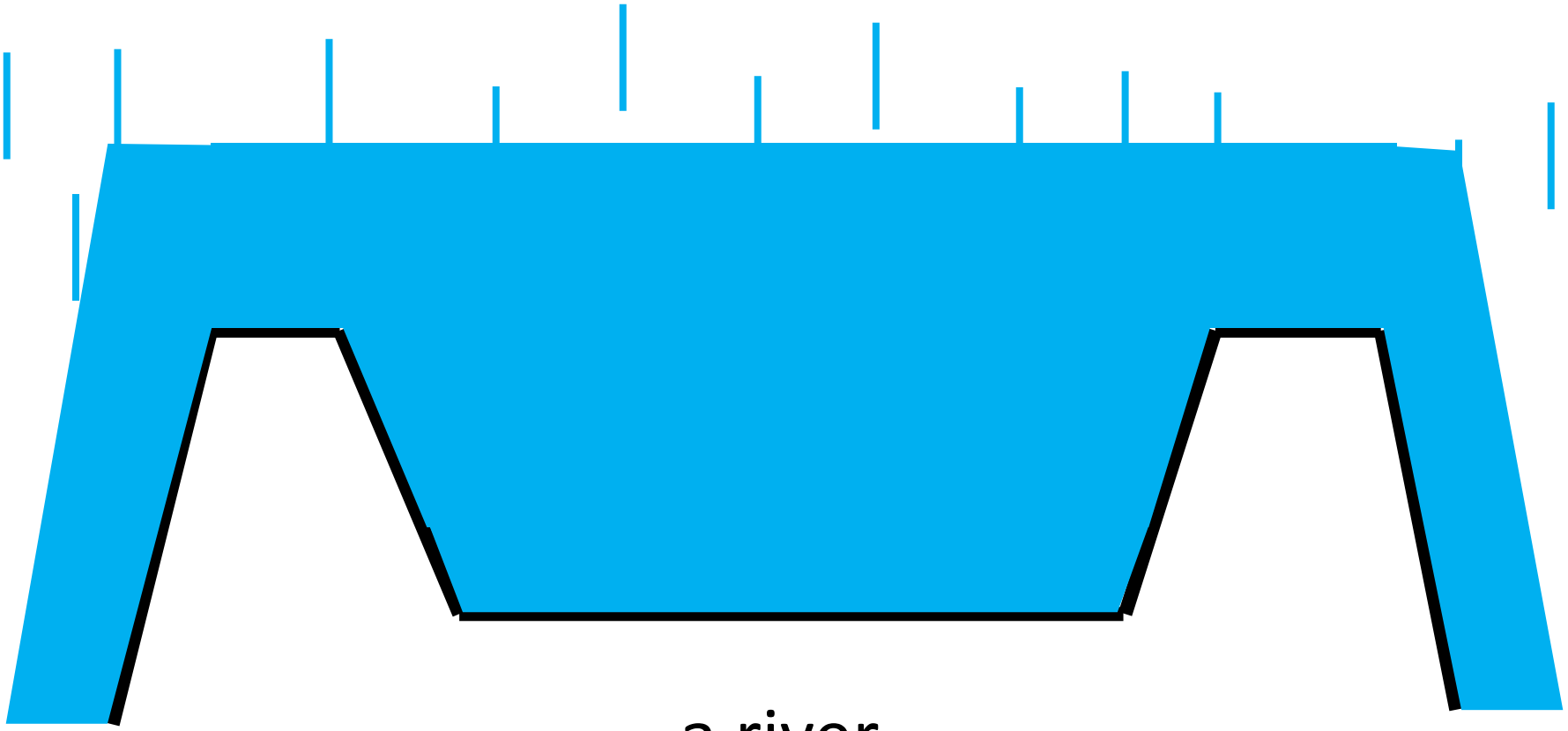


Raising a dike

Dredging the bottom of a river, widening of the width of a river and raising a dike would affect the river ecosystem.

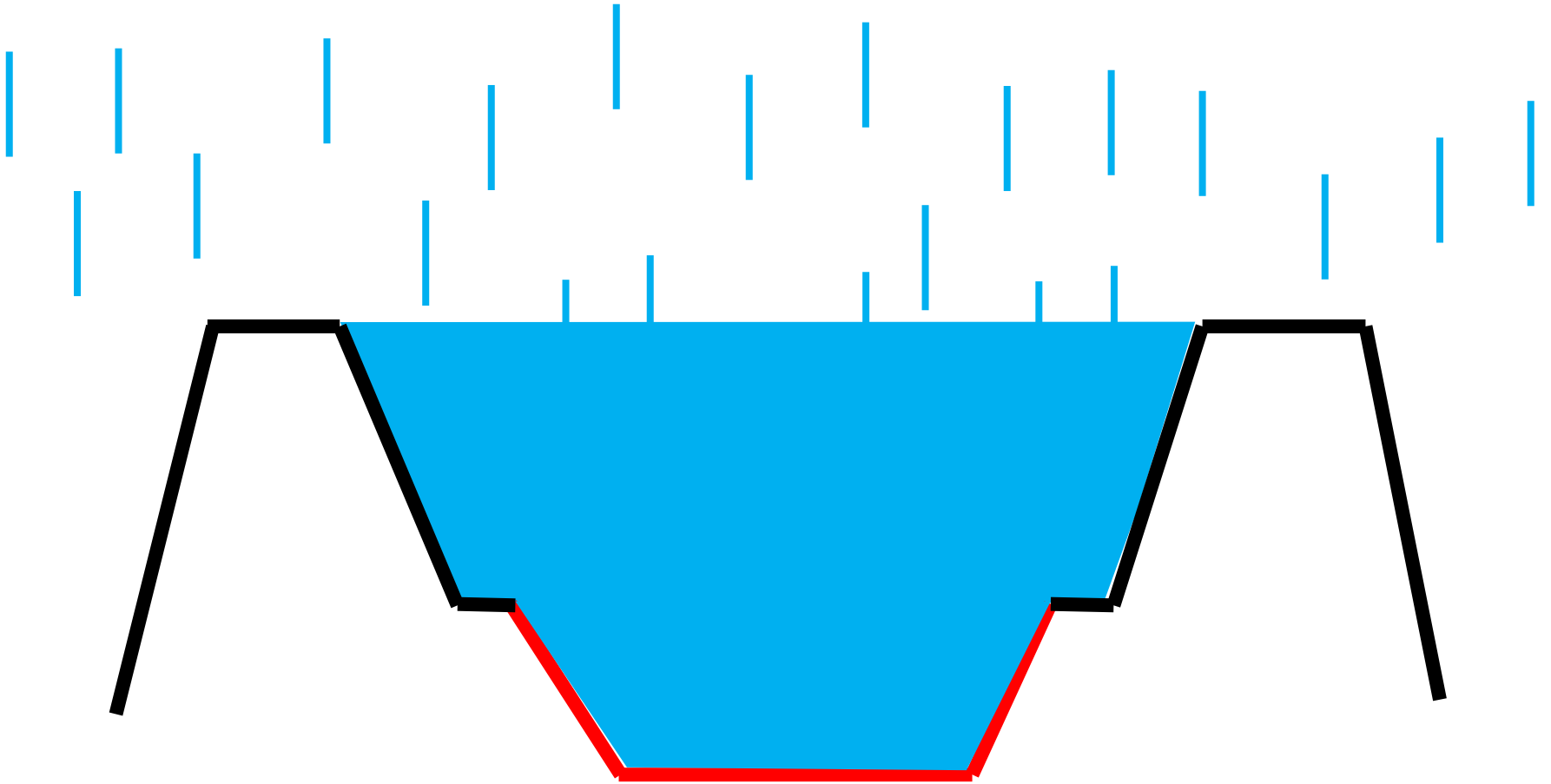
Heavy rain falls, and a river rises.

The flooding is generated.



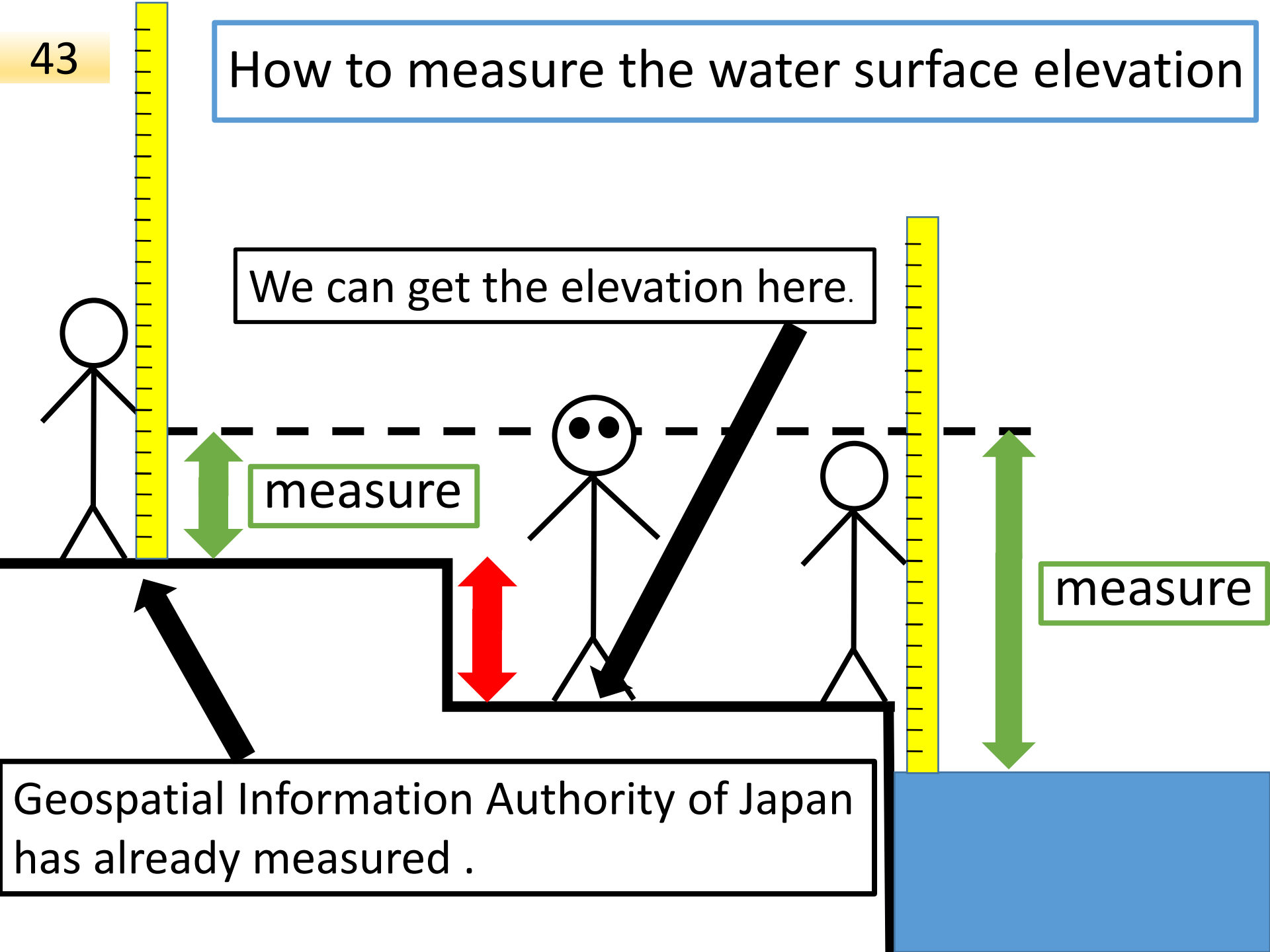
a river

Heavy rain falls, and a river rises.
But much water can discharge and are hard to occur a flooding.



a river(conducted channel widening)

How to measure the water surface elevation



the number of the fish captured per one time of casting net
＜Hakuryo Junior&Senior High School Biology Club ＞