Flood Risk Mapping

Incorporating Sediment Transport

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in Malaysia….
Risk ?
Flood on 5 September 1999, Juru, Malaysia
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England....

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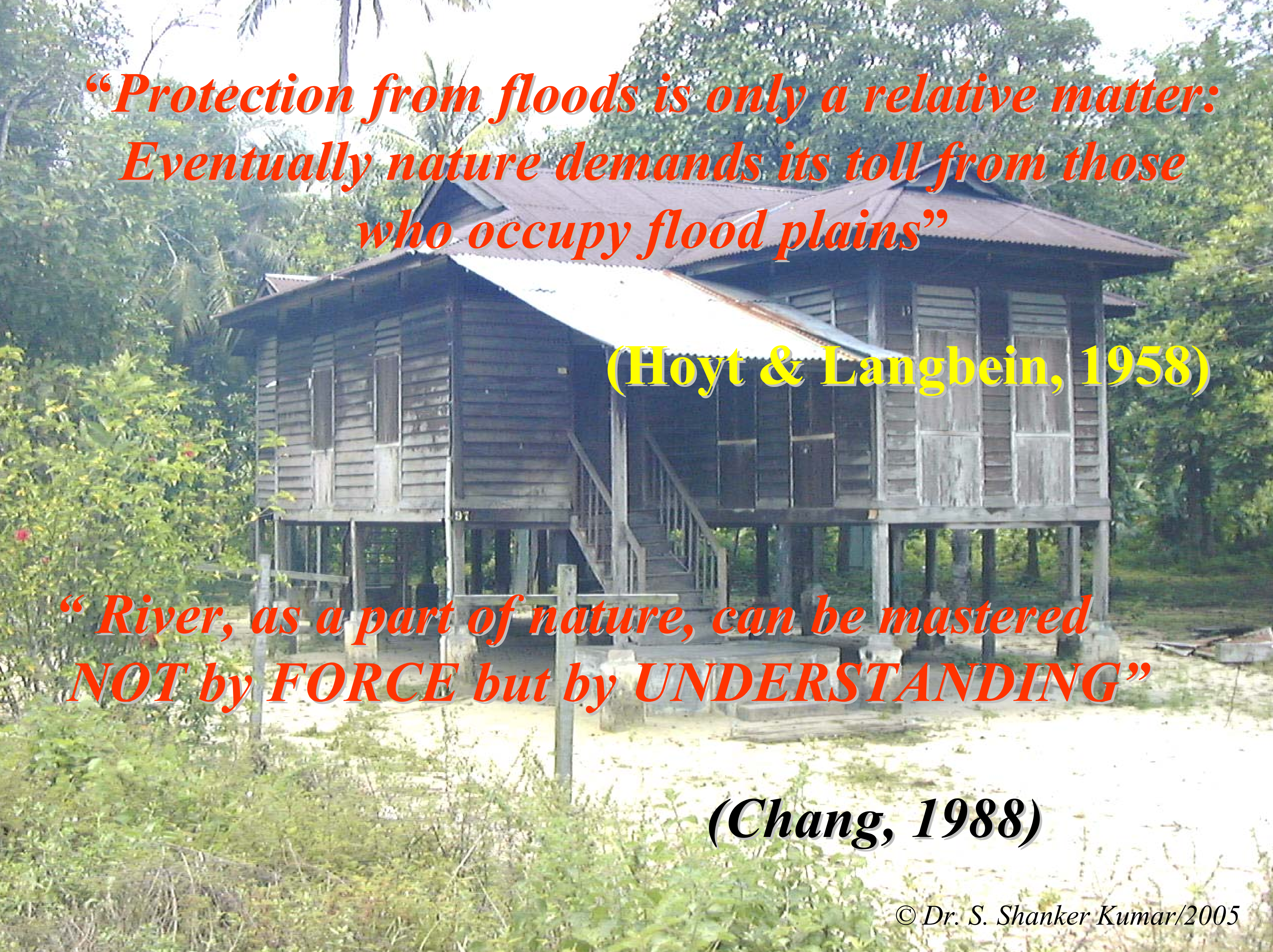
"Protection from floods is only a relative matter: Eventually nature demands its toll from those who occupy flood plains"
(Hoyt & Langbein, 1958)
" River, as a part of nature, can be mastered NOT by FORCE but by UNDERSTANDING"
(Chang, 1988)
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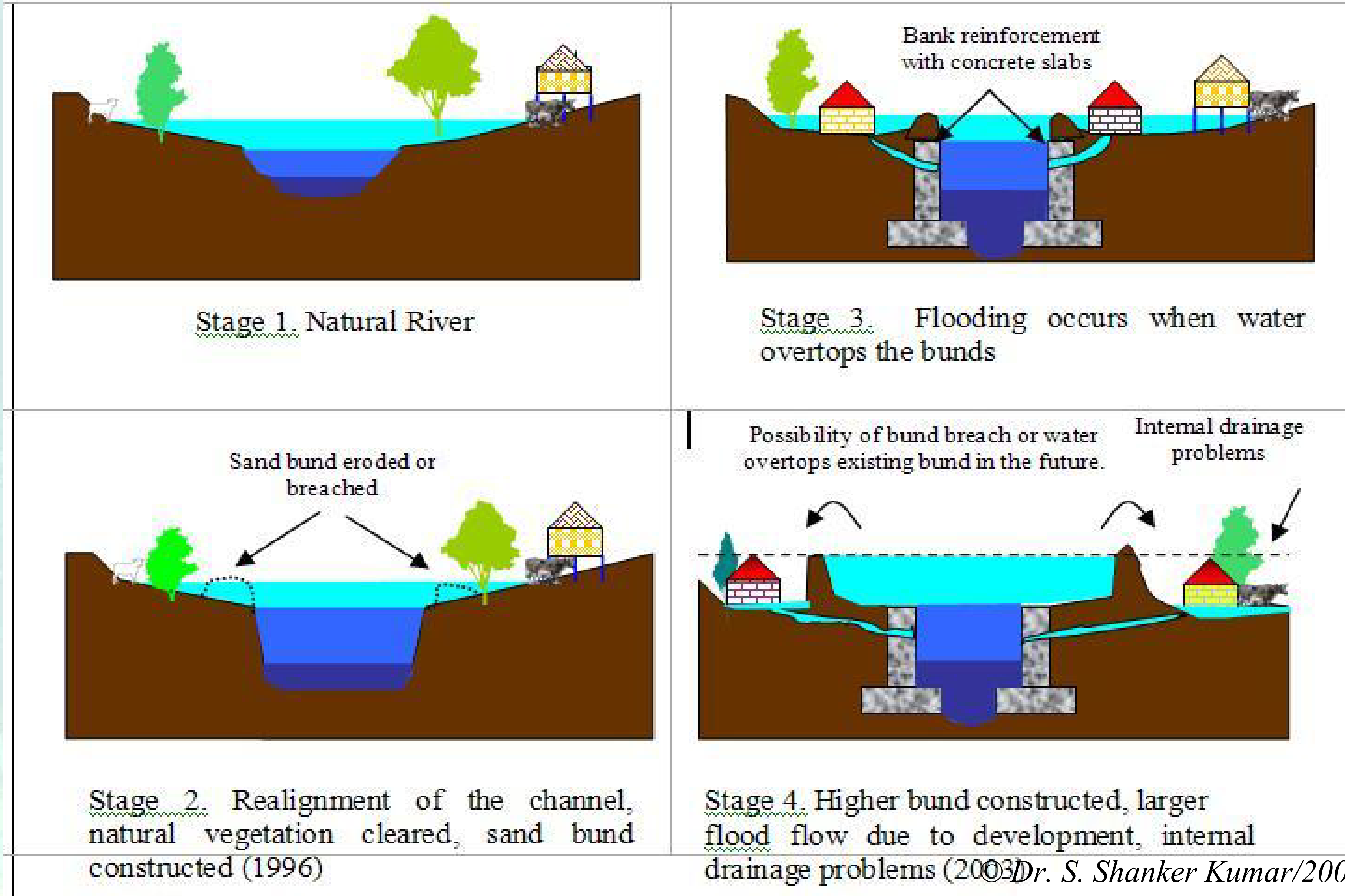
Development in a flood plain



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Nipah Plants

Natural protection for River Banks

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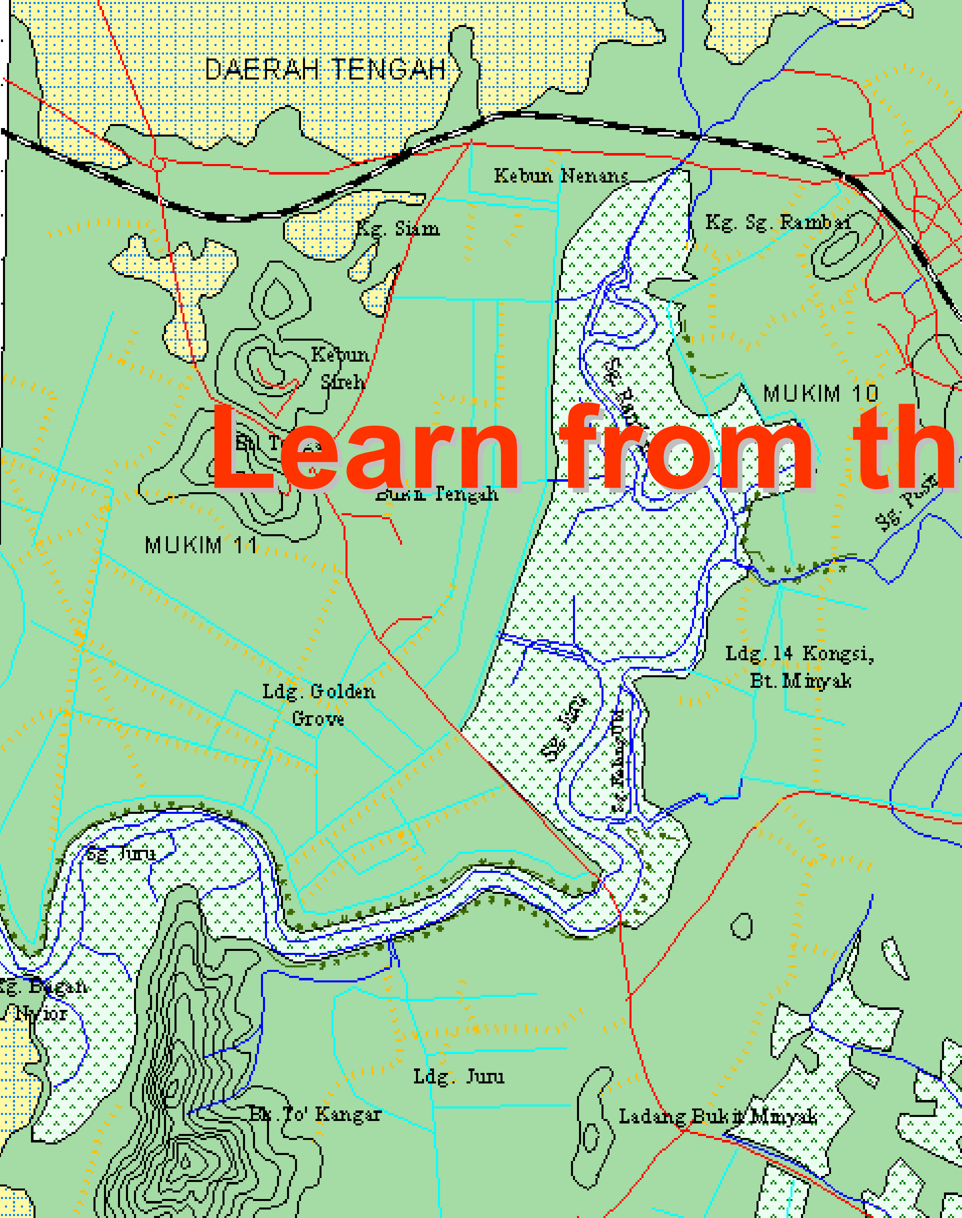
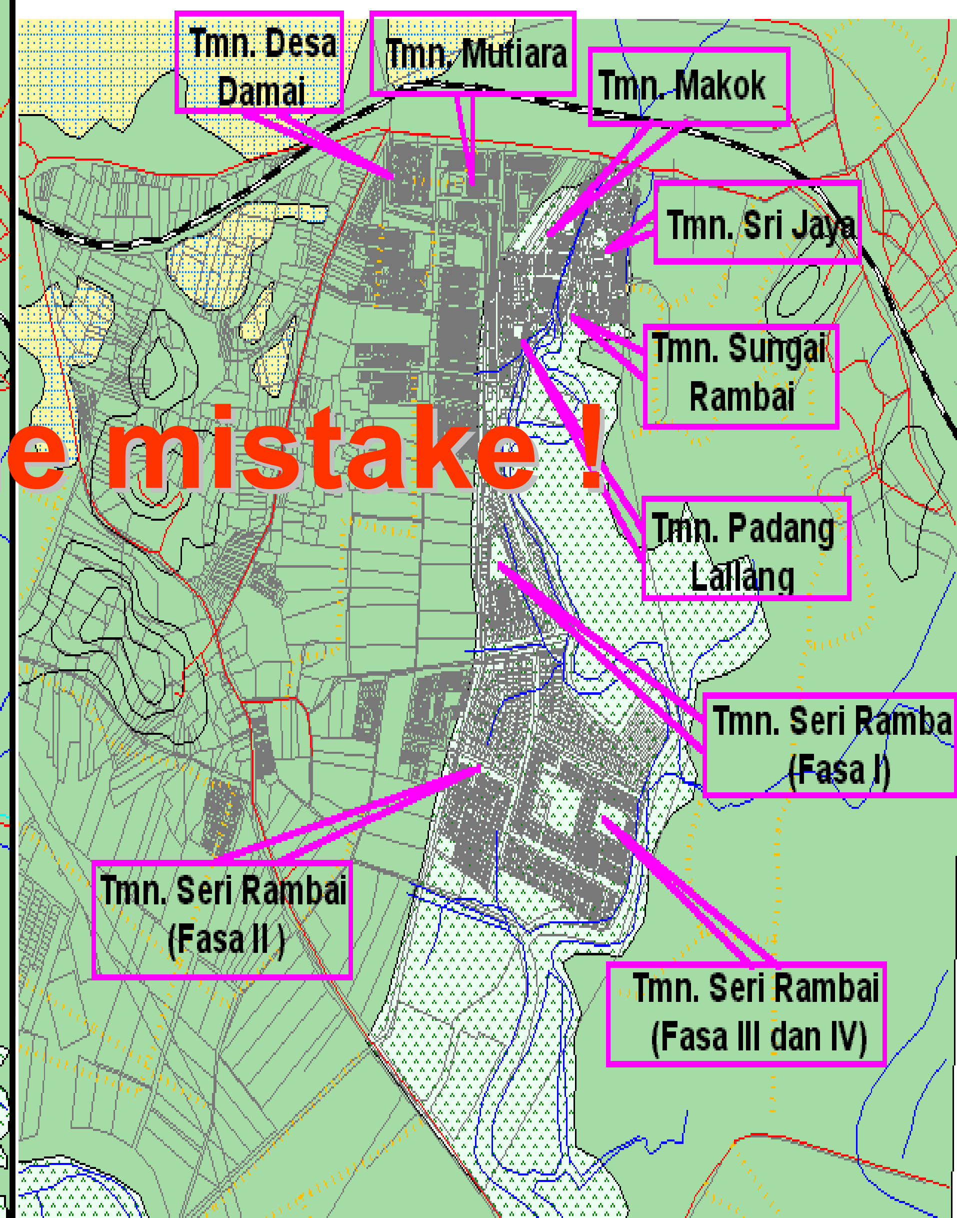
Learn from the mistake !



Sungai Rambai / Sungai Juru, 1976 (MPSP, 2000)



Sungai Rambai / Sungai Juru 1999 (MPSP, 2000)

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Sedimentation

Sand Dredging at Pari River

Deposition in concrete monsoon drains
(a & b) Alor Setar (c) Butterworth
(d & e) Ipoh (f) Kota Bahru

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Erosion caused by flood

Sg. Keroh (1993)

During Flood

After Flood

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Hydraulic Structure Stability

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Sungai Kuala Muda Bridge, Jeniang (NST, 5/9/2000)

Sand Dredging at Kuala Pari…

..HEC2 & HEC-RAS - no sediment Transport Component !

Sand Dredging at Silibin Bridge…

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Current Practice

Historical Flood Records

a. Flood mark measurement after the flood event

b. Ground level survey

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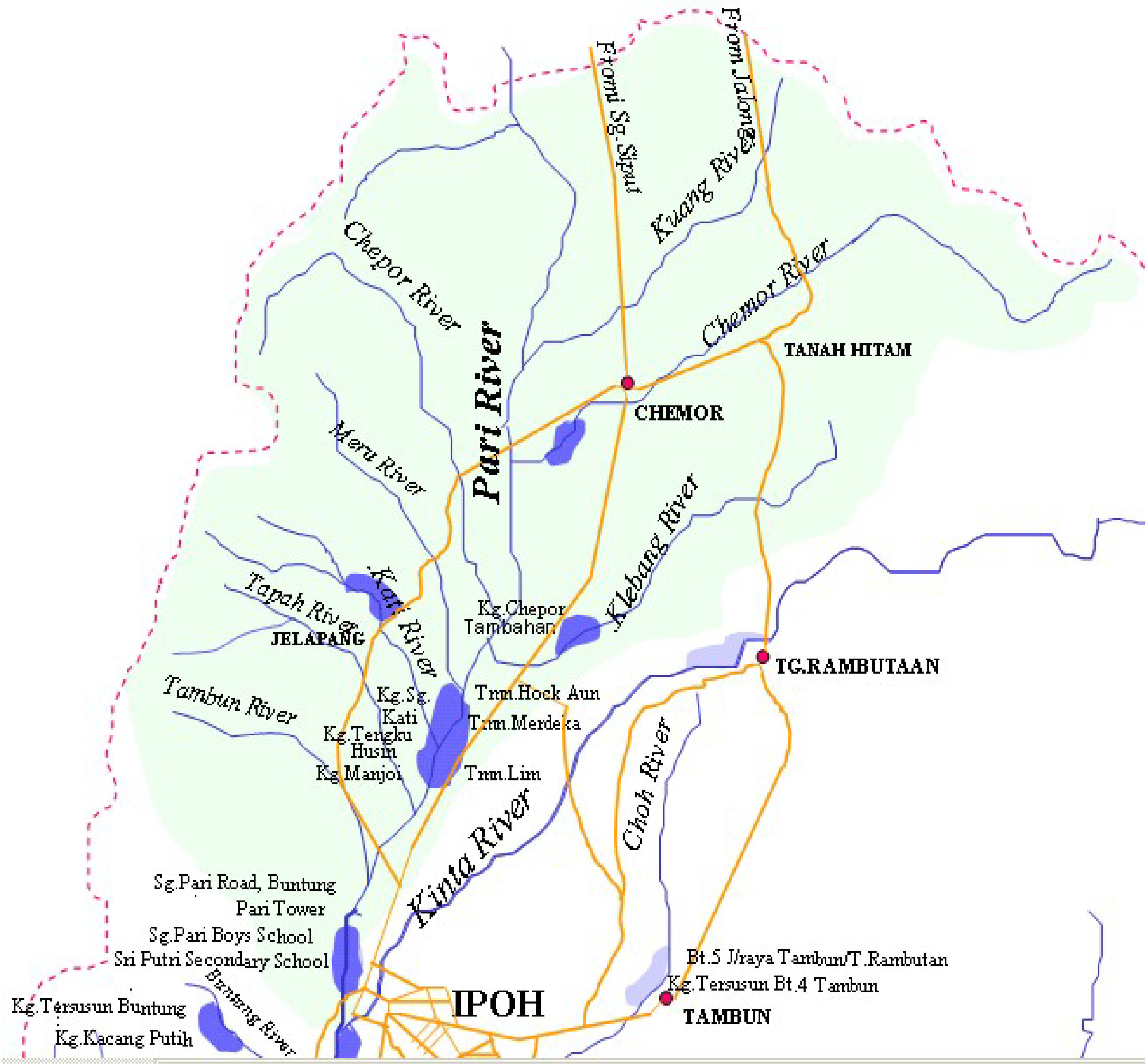

Pari Flood Map

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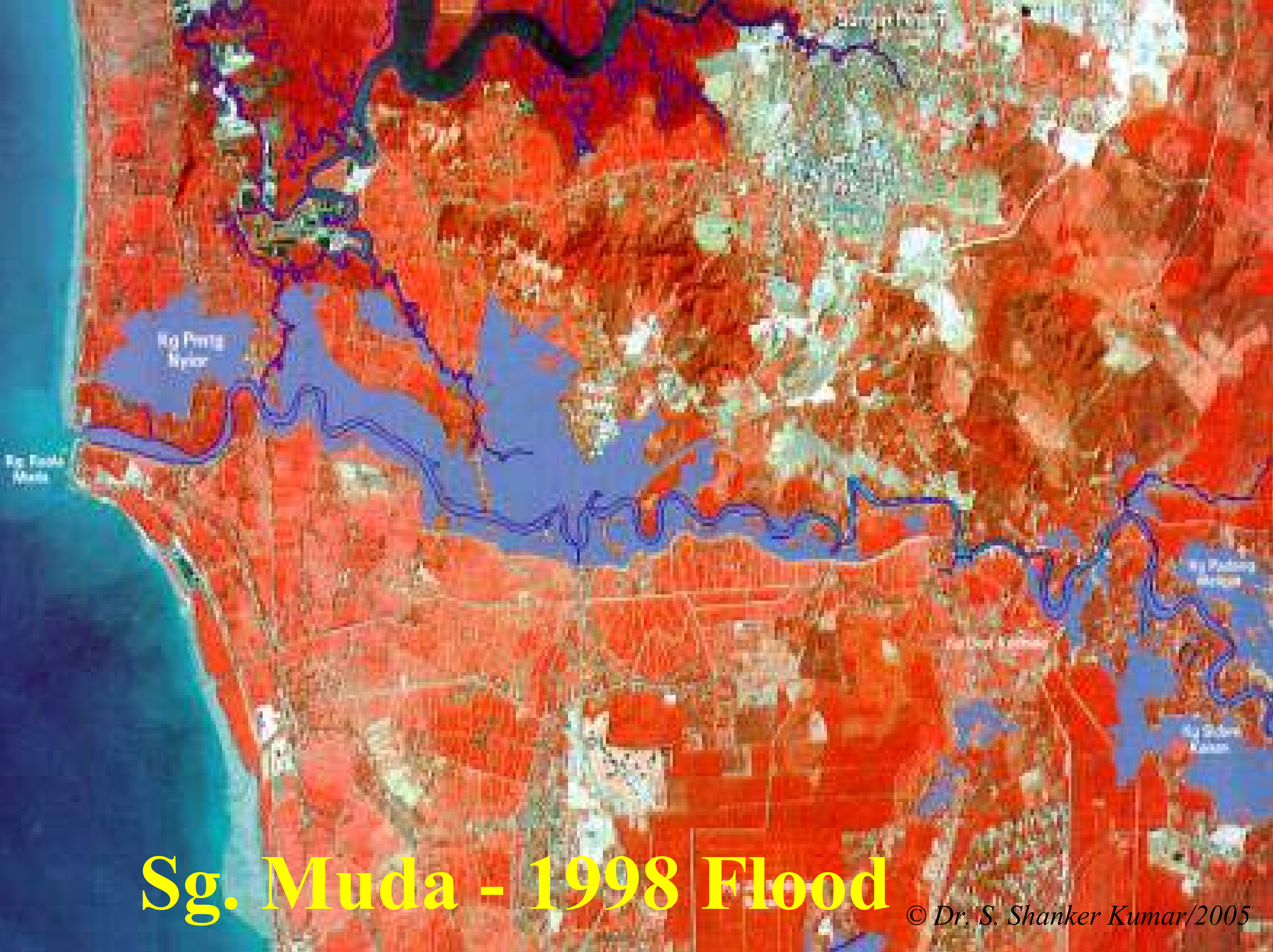

Sg. Muda - 1998 Flood

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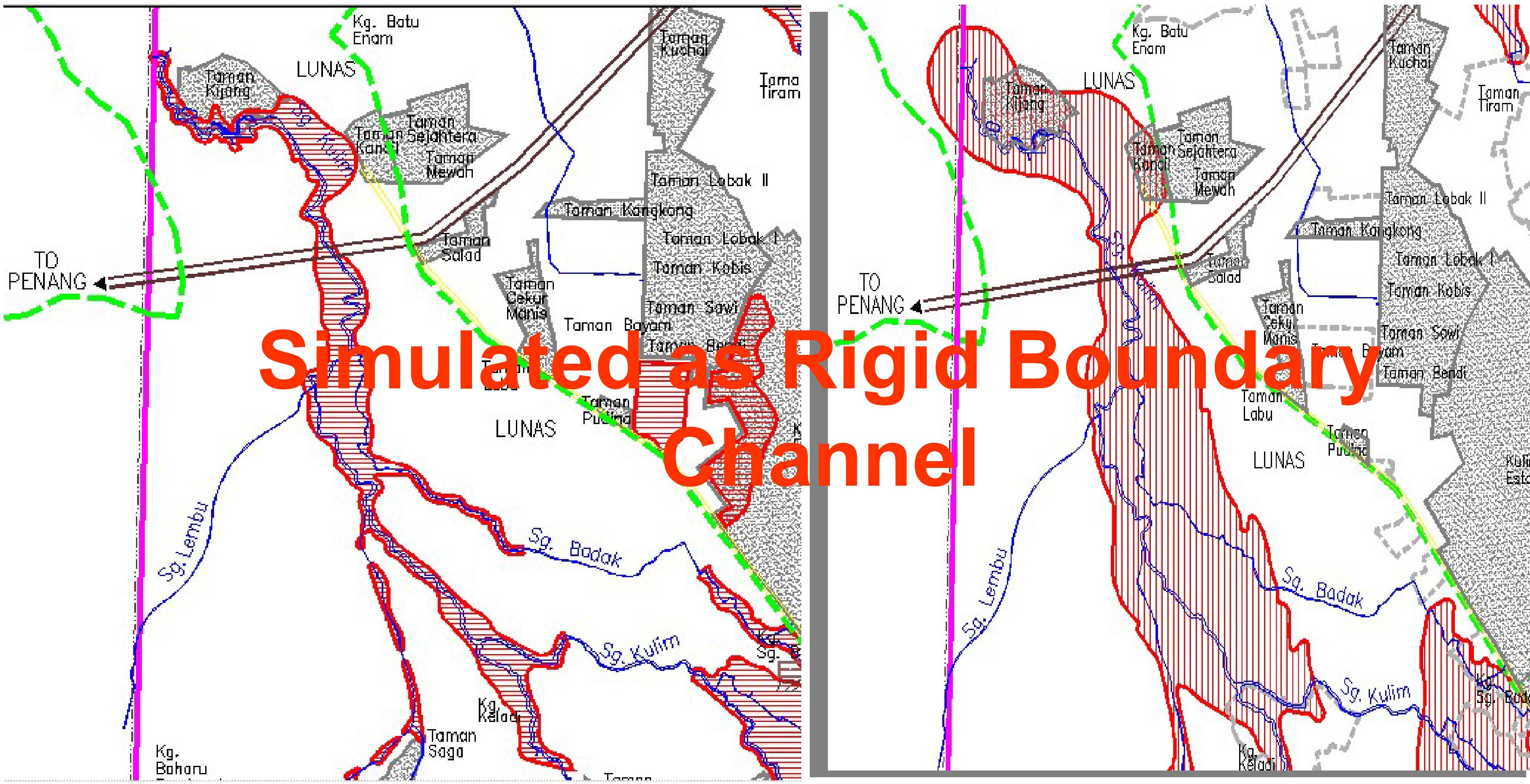
Inundation Mapping for Kulim River

HEC – 2 + Manual AutoCad plot



Simulated as Rigid Boundary Channel

Existing — Future Development

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God can't solve flood problems

The Sun 28/4

Only affirmative action can prevent flooding in the city

Citizen Nades

Voice of the people

-nades@thesundaily.com

TWO months ago, Kuala Lumpur Mayor Tan Sri Kamaruzaman Shariff shared his dreams for the city with a motley crowd which comprised some of the top decision makers.

"It is our vision for Kuala Lumpur to be world class city for all. It will strive to provide a good quality living, working and business environment benchmarked against the best in the world," he had said.

A few days earlier, while being interviewed by my colleague Arion Yeow while on a trip to flood-prone areas in the city, he said: "God put the city in a valley. That is why there are flood problems in Kuala Lumpur and it cannot be totally eliminated."

These contrasting views draw a broad line between vision and implementation; between fact and fiction and

houses cannot accommodate additional water from nearby high-rise condominiums which were subsequently built. This being the case, why weren't the drains widened before approvals were given?

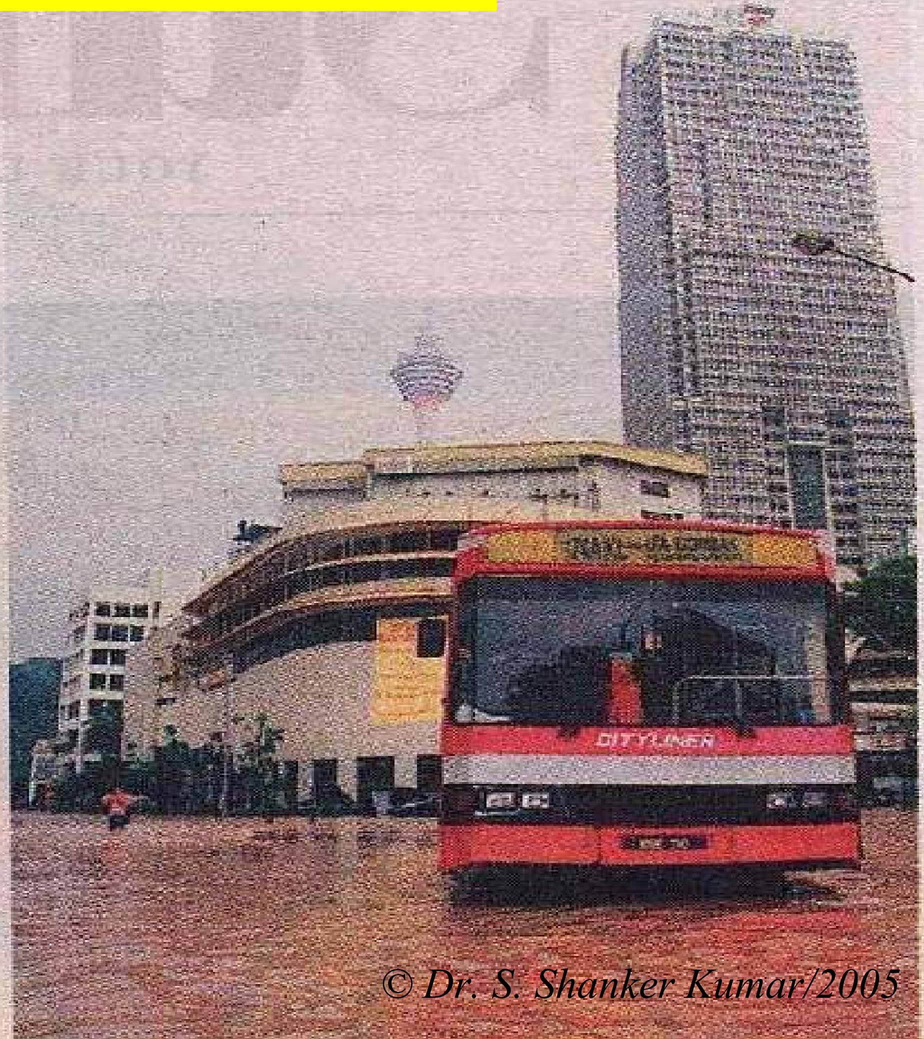
Aren't silt traps compulsory at construction sites? Who checks if these are in place?

In Happy Gardens off Old Klang Road, a hill is being levelled. And yesterday, the drains were fille7d with silt.

If this is not enough evidence that no silt traps have been in place, what else is?

Along Lorong Maarof in Bangsar, piles of earth dug up to put underground petrol tanks were washed into the narrow drains. What is more ironic is that City Hall approved the construction of a petrol kiosk on a plot of land between two houses.

Never mind that. But



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Solution ??

Flood Risk analysis and modeling

How ???

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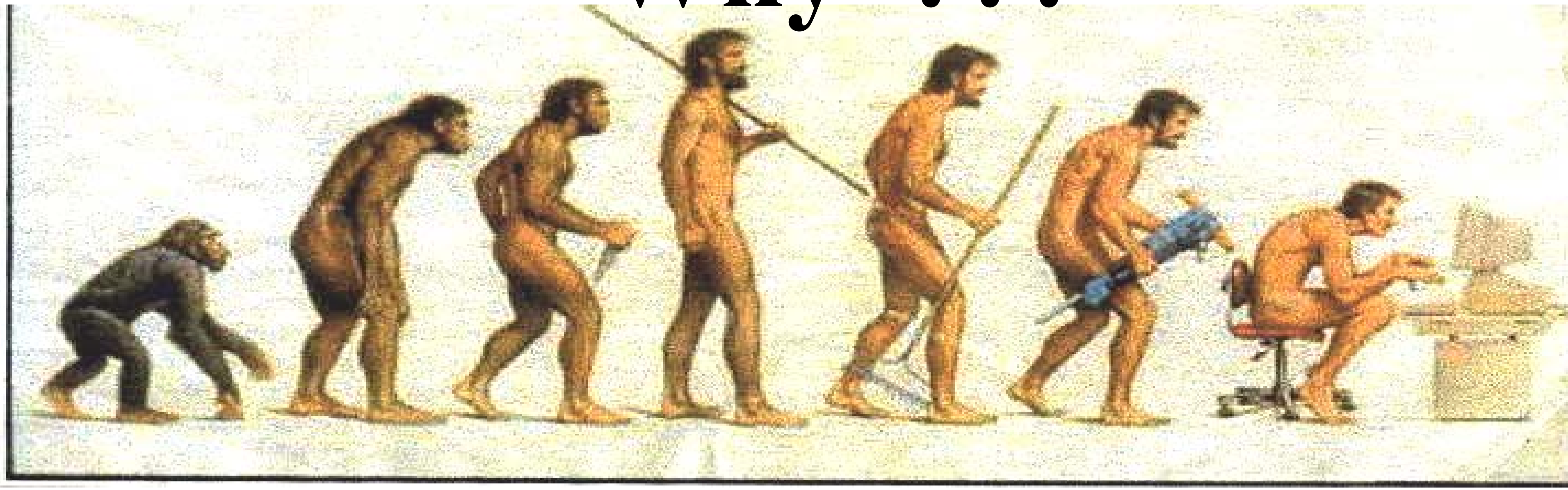
Computer Modeling…

Why ???



The computer is incredibly **Fast**, **Accurate**, and **Stupid**. Man is unbelievably **Slow**, **Inaccurate**, and **Brilliant**. The marriage of the two is a challenge and opportunity beyond imagination

(Wallesh, 1989)

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Sediment Transport

HEC-6 Existing sediment transport functions

- Toffaleti's (1966) transport function
- User specified Transport Function
- Madden's (1963) modification of Laursen's (1958) relationship
- **Yang's (1973) stream power for sands**
- DuBoys' transport function (Vanoni 1975)
- **Ackers-White (1973) transport function**
- Colby (1964) transport function
- Toffaleti (1966) and Schoklitsch (1930) combination
- Meyer-Peter and Müller (1948)
- Toffaleti and Meyer-Peter and Müller combination
- Madden's (1985, unpublished) modification of Laursen's (1958) relationship
- Copeland's (1990) modification of Laursen's relationship (Copeland and Thomas 1989)

- Other Total Load Equations
- Inglis (1947)
- Einstein (1950)
- Einstein modified by Colby & Hembree
- Egiazaroff (1957)
- Bogardi (1958)
- Laursen (1958)
- Garde & Albertson (1958)
- Bishop, Simons & Richardson (1965)
- Chang, Simons & Richardson (1967)
- Graf (1968)
- Karim (1998) ....and .... more...

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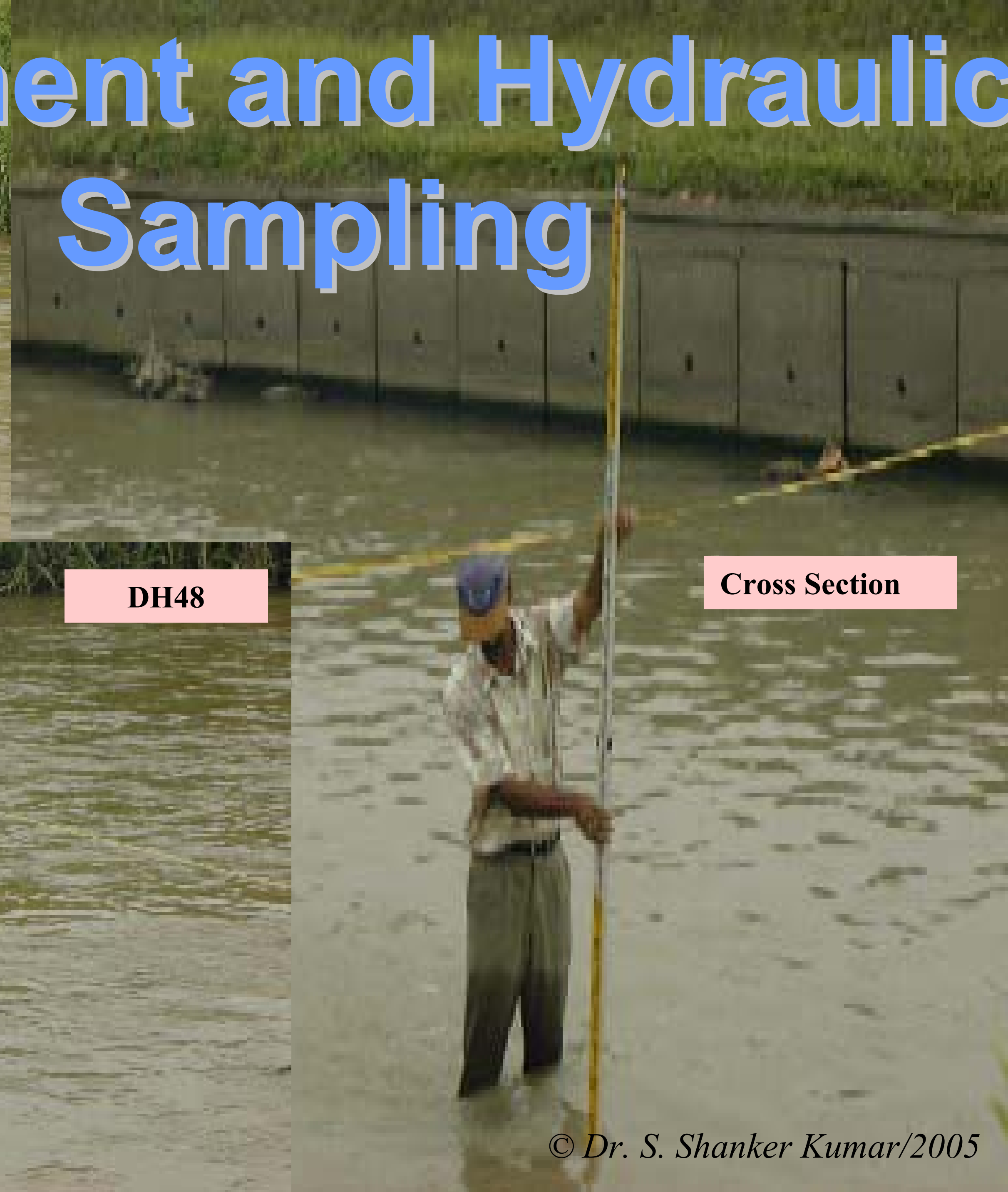
Sediment and Hydraulic Sampling



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Identify Test Parameters

Multiple Linear Regression

Select the Best (R^2, Adj R^2 & MSE)

Select the Outliers

Check the Influential Outliers

Validate

New Total Load Equation for Malaysian River Condition

$$C_v = 1.811 * 10^{-4} \left(\frac{VS_0}{\omega_s} \right)^{0.293} \left(\frac{R}{d_{50}} \right)^{1.390} \left(\frac{\sqrt{g(S_s - 1)d_{50}}}{VR} \right)$$

$$T_j(totalload) = C_v * Q * 2650$$

3

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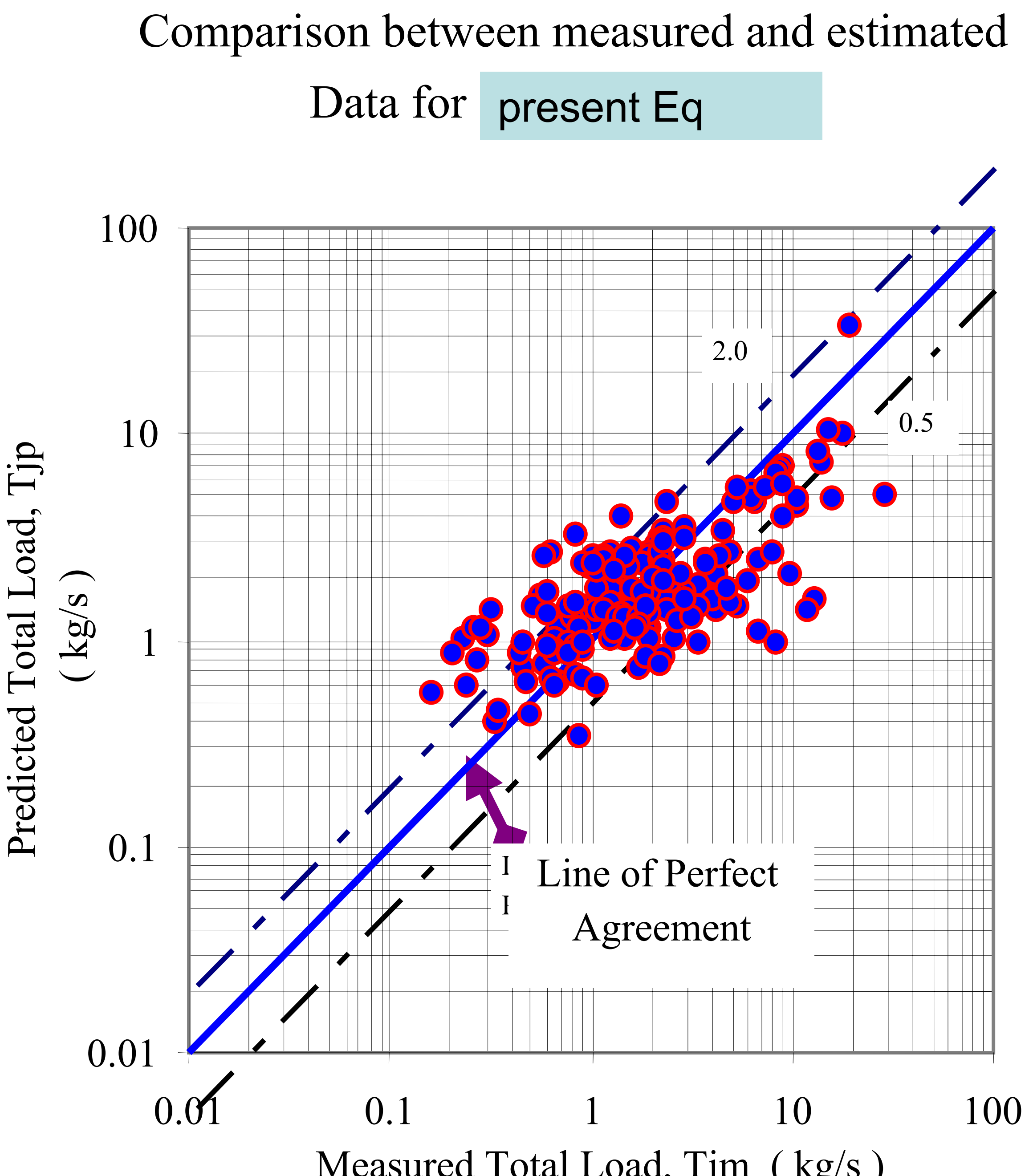

Present Accounts for

71.59 % of the variability in the Learning data

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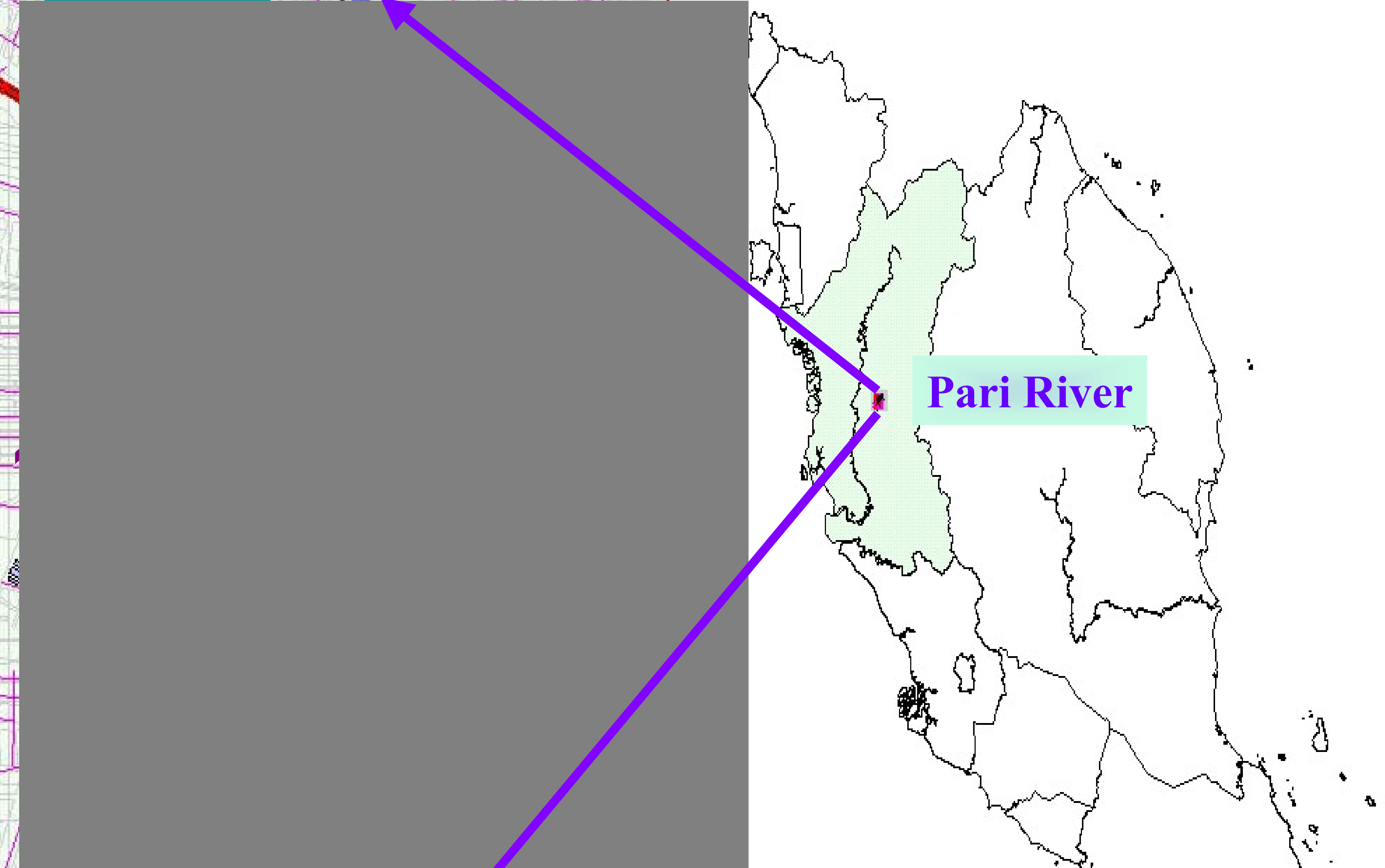
Terrain Modeling

Hydraulic Modeling



Study Area

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Software

GIS Software :

- ArcView GIS 3.2
- ArcView Spatial Analyst
- ArcView 3D Analyst

CAD Software

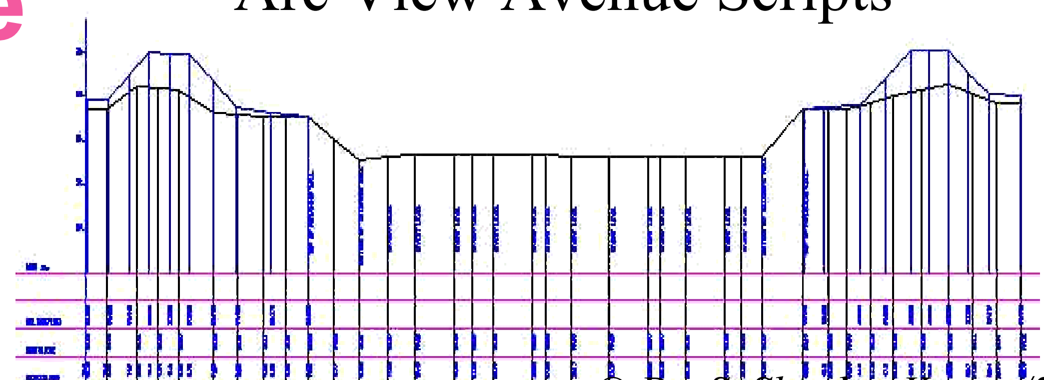
• AutoCAD 14 / 2000

Modeling Software :

• HEC-6N
•HEC-HMS

Programming

•Visual Fortran/ Fortran 77
• Arc View Dialog Designer
• Arc View Avenue Scripts



CH. 5400m

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Data Sources

Data Theme	Types of Data	Data Sources	Data Category
Ground surveys	• River surveys (20 meter section interval) • Finish Road Levels (FRL) • Finish Floor Level for buildings (FFL) • Invert Level (Drains and Waterways)	DID EDM Survey EDM Survey DID and EDM Survey	Primary Data
Photogrammetry	Areial photographs Scale : 1: 10,000 Resolution : 3882 X 2539 pixels	DID, Engineering Consultants	Primary Data
Existing maps	Topo Map • L 905 Series, Sheet Pk.1a – d Scale 1: 10, 000 • L7030, Sheet 3562 Scale 1: 50, 000 • DNMM 8101 Series, Sheet Pk.1a – d Scale 1: 10, 000 Lot Map for Pari River Scale 1: 10, 000	USM	Secondary Data

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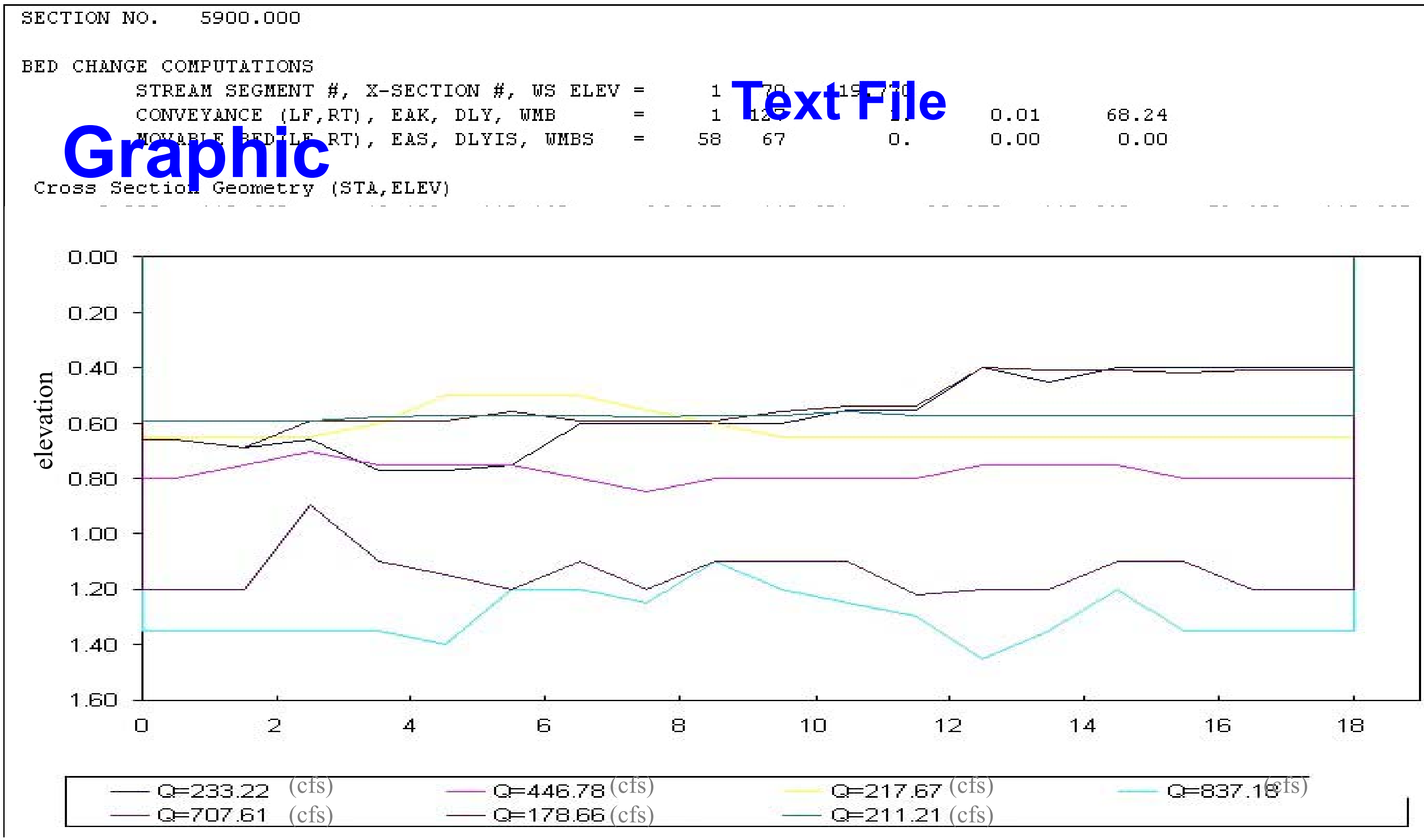
SFlood/HEC-6 : Output



width

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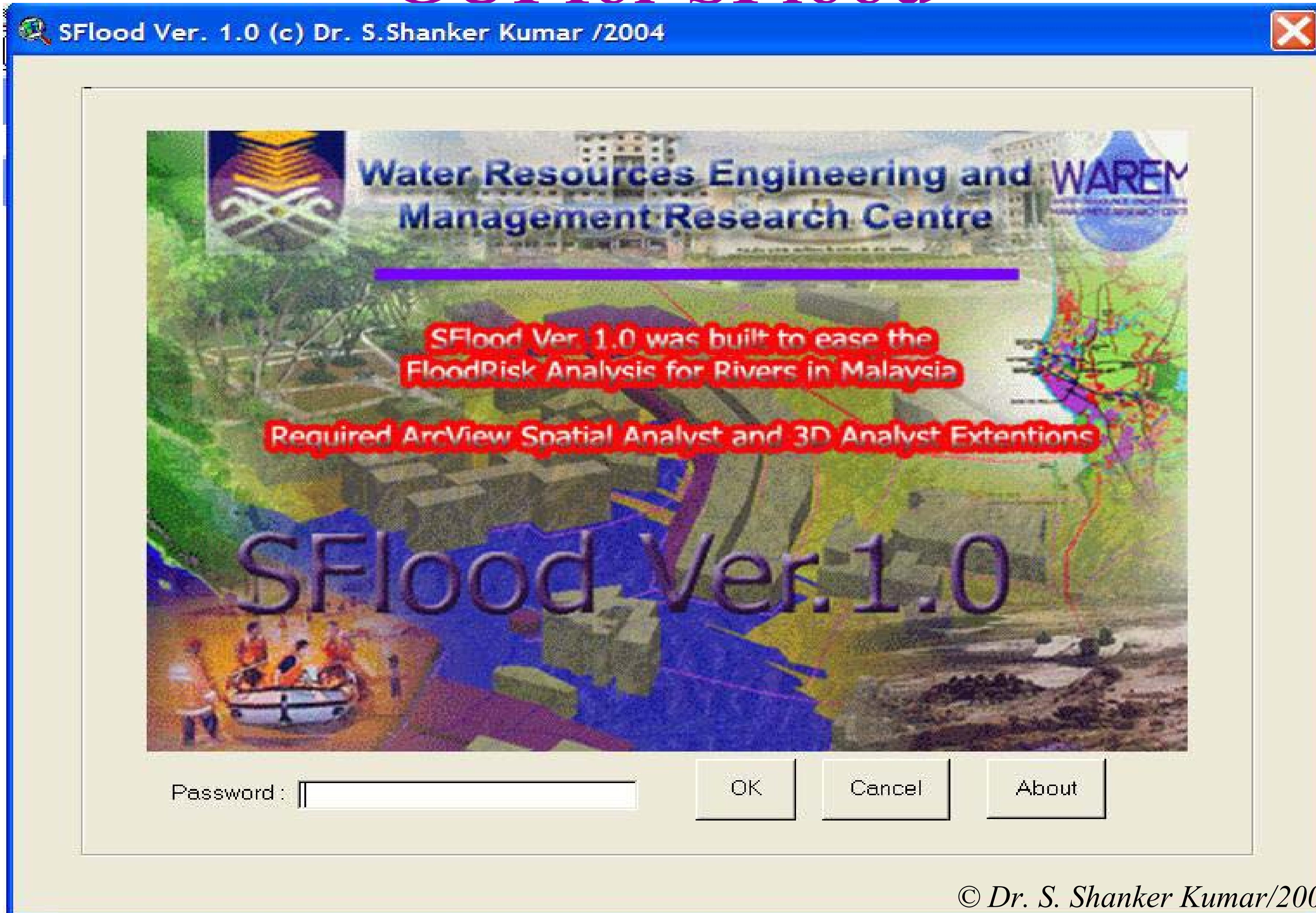
Flood Risk Mapping

GUI for SFlood



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SFlood Menu's

SFlood_PreProcessor

- River Thalweg Line
- River Bank Lines
- Flow Path Lines
- Cross Section Cut Lines
- Theme Setup
- 3D Thalweg Line
- Cross Section Attributes
- 3D Cross Section
- SFlood Import File
  - Tittle Infomation
  - Cross Section Records
  - Hydro_Sediment Records
  - Hydro. Header Records
  - Export I to RC Records
- Format SFlood GIS Import File
- Run SFlood Hydraulic Model

SFlood_Post Processor

- LB Import Data
  - 1997 Channel Survey
  - 1999 Channel Survey
- RB Import Data
- Stream Format
- Modeling Boundary
- Cross Section Mapping
- Cross Section Boundary
- Channel Break Lines
- Integrated TIN
- WSE Lines
- WSE Boundary
- WSE TIN
- Flood Depth_Extend Grid

SFlood_Tools

- Script Header
- Offset Line
- EDM 2 File
- ADDRecNumber
- Flow Direction
- Clip Grid_Poly
- Manning Table
- Cross Section Viewer
- Scaled Flood Risk Maps
  - A4 Size Output
  - A3 Size Output
  - A1 Size Output
- Poly Area

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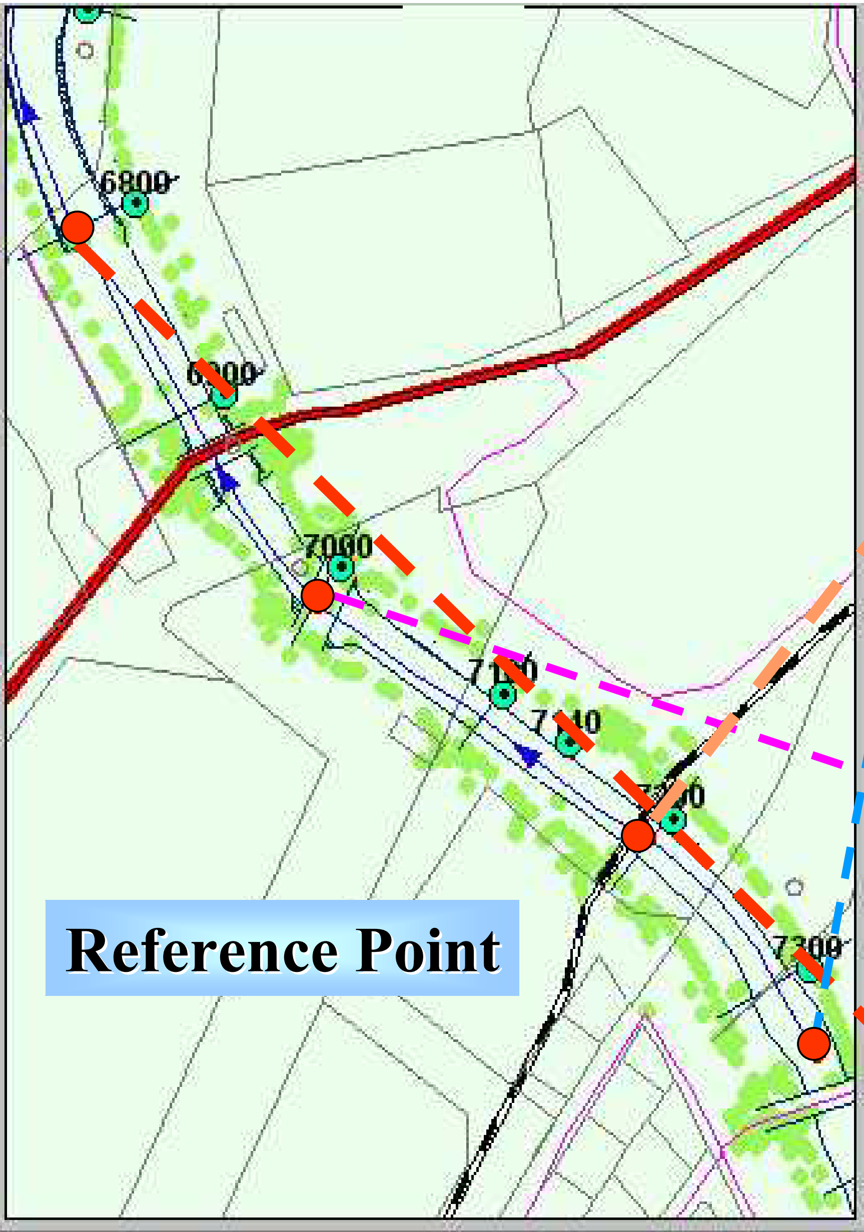
One to One



Chainage	Thalz	Thalx	WSE	CSDist	LBankX	LBankZ	RB
7340	31.10	229.46	34.89	0.00	213.46	36.04	
7320	31.26	218.25	34.89	20.61	202.25	35.95	
7300	30.78	221.70	34.89	40.33	205.70	35.39	
7280	30.20	222.69	34.89	56.88	206.69	35.11	
7260	30.47	222.57	34.89	75.71	206.57	35.04	
7240	30.32	220.54	34.89	94.39	204.54	35.51	
7220	30.41	223.44	34.89	114.39	207.44	35.67	
7200	30.77	241.95	34.89	132.16	225.95	35.83	
7180	30.38	236.21	34.89	151.76	220.21	35.63	
7160	30.52	232.72	34.89	172.03	216.72	35.50	
7140	30.51	239.58	34.89	190.57	223.58	35.43	
7120	30.79	240.76	34.89	212.45	224.76	35.17	
7100	30.48	228.29	34.89	229.79	212.29	35.11	
7080	30.57	220.40	34.89	253.54	204.40	34.28	
7060	30.85	218.41	34.89	273.61	202.41	34.32	
7040	30.65	235.10	34.89	292.50	219.10	34.47	
7020	31.00	240.62	34.89	310.02	224.62	34.52	
7000	31.00	240.23	34.89	328.79	224.23	34.57	
6980	30.73	223.77	34.89	357.37	207.77	34.46	
6960	30.91	225.10	34.89	378.03	209.10	34.42	
6940	30.83	228.99	34.89	401.25	212.99	34.56	
6900	30.94	213.48	34.89	439.30	197.48	34.52	
6880	30.96	[illegible]	[illegible]	[illegible]	[illegible]	.75	
6860	31.15	[illegible]	[illegible]	[illegible]	[illegible]	.71	
6840	31.18	225.42	34.89	500.91	209.42	34.27	
6820	31.41	241.96	34.89	520.84	225.96	34.17	
6800	31.81	252.21	34.89	[illegible]	236.21	[illegible]	

Spatial Attribute

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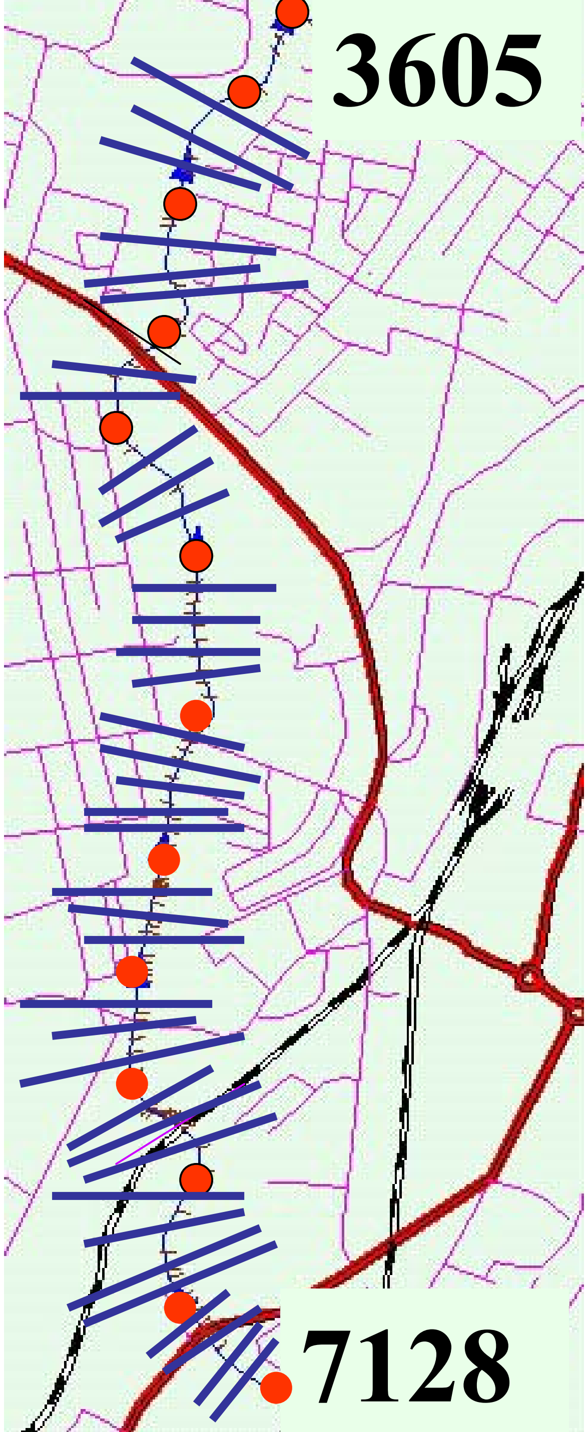
Cross Section Mapping

- Assume Straight Cross Section
- Placement between 2 reference point
- Placement may controlled by the modeler



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EDM Survey

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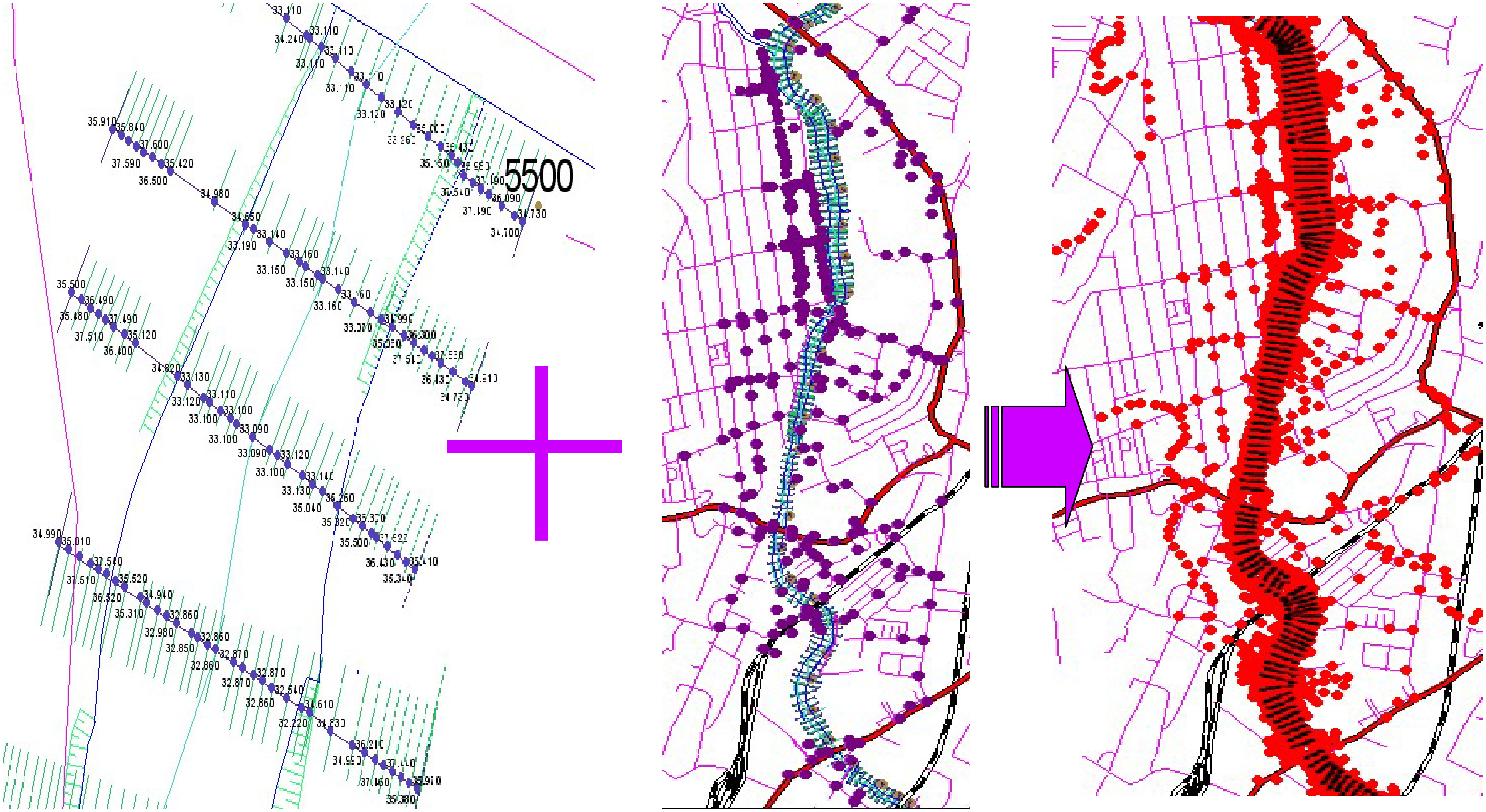
Cross Section Survey Data

EDM Survey Points for the Study Area

Combined Elevation Data



The elevation point map created from various elevation sources for Pari catchment area

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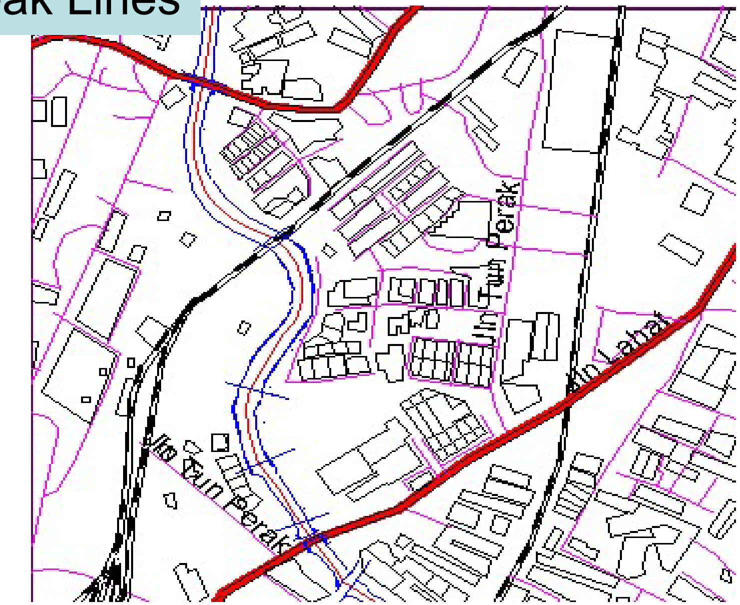
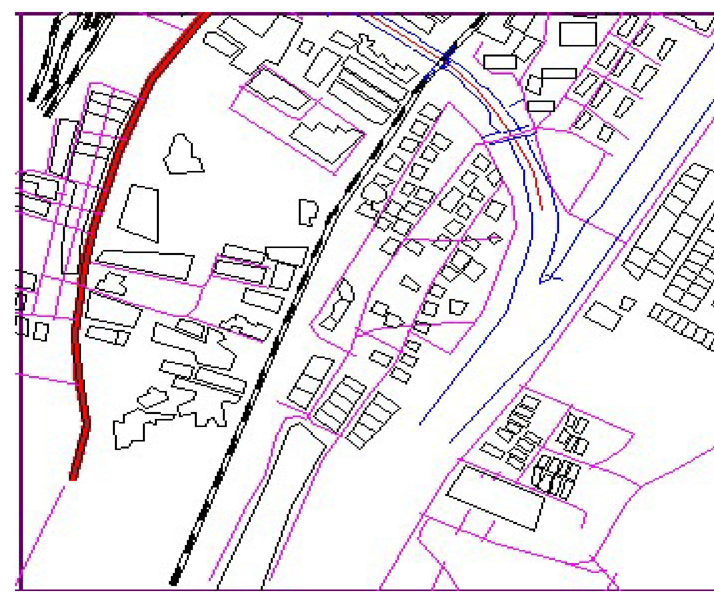
Soft and Hard Break Lines

a.Silibin



b. Birch Garden

c. Buntong



d. Kuala Pari

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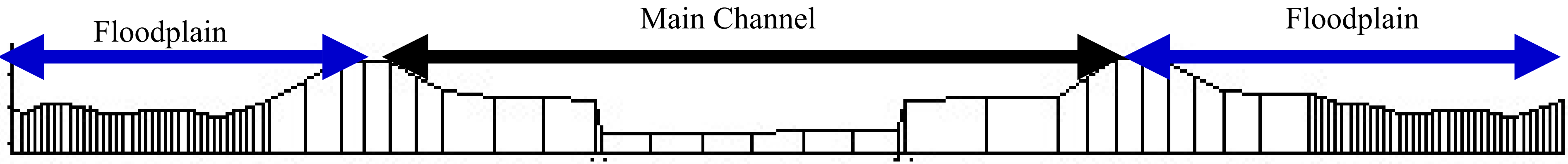
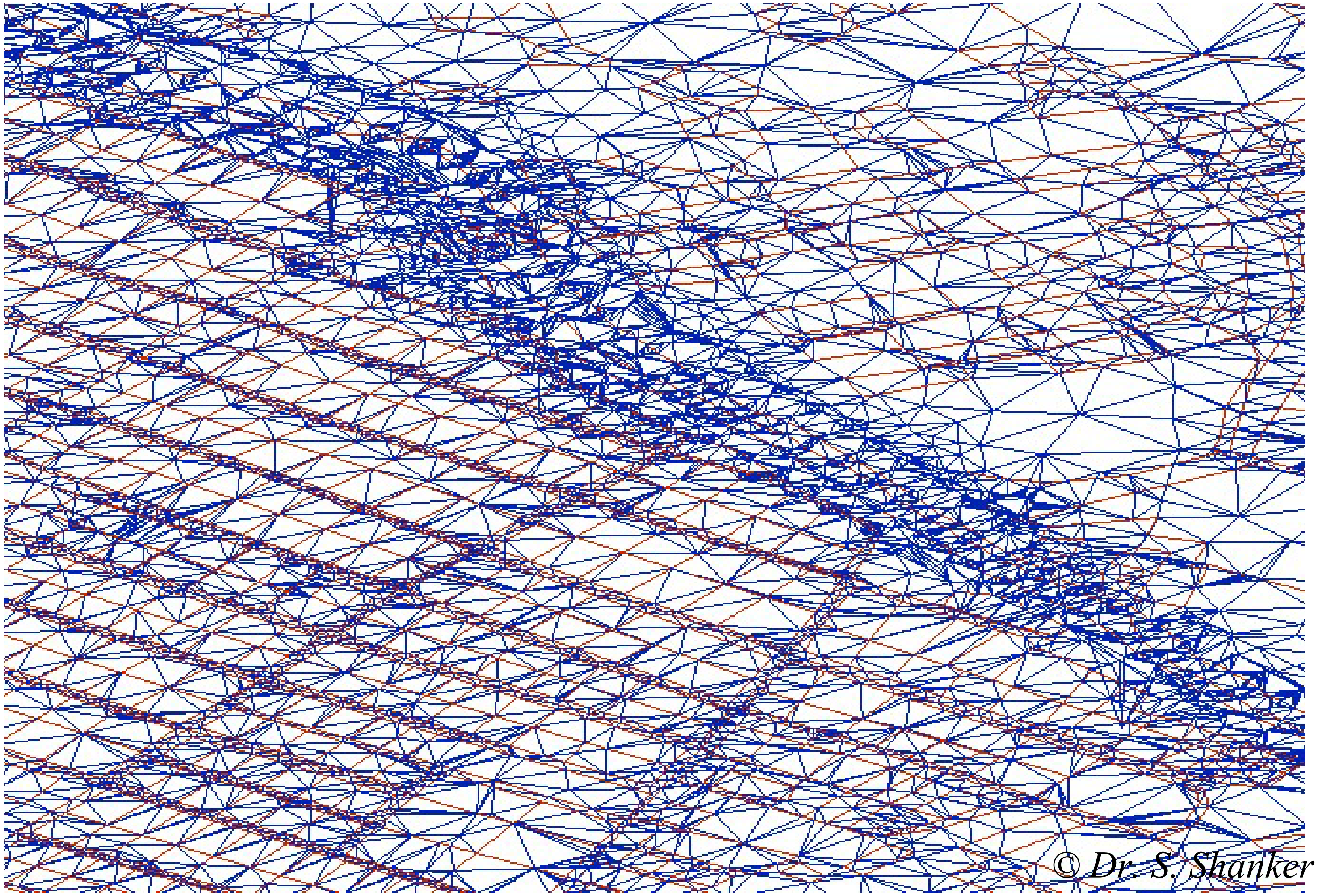
ITIN created with various level of spatial resolution





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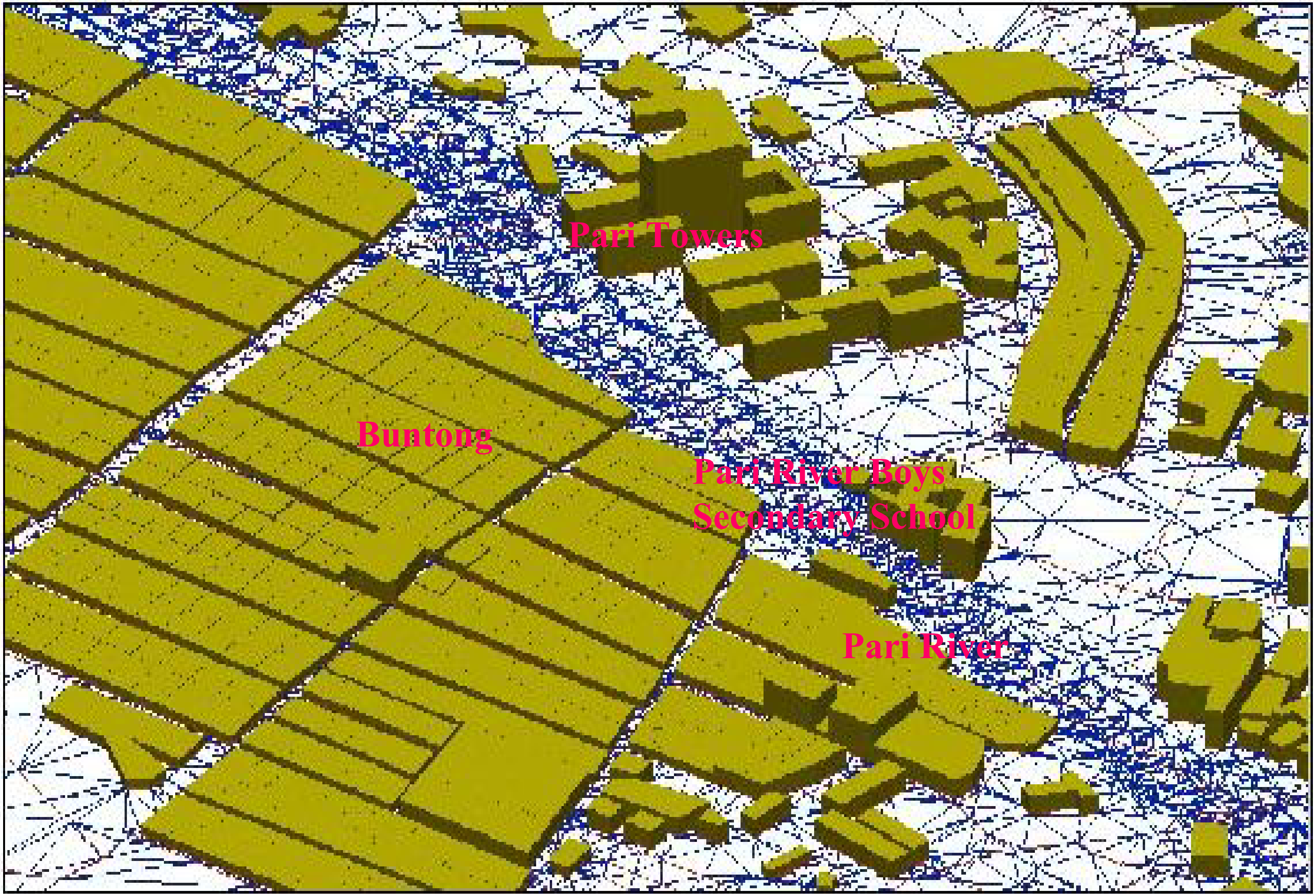

Sample 3D Mesh of Integrated TIN (ITIN) for study area

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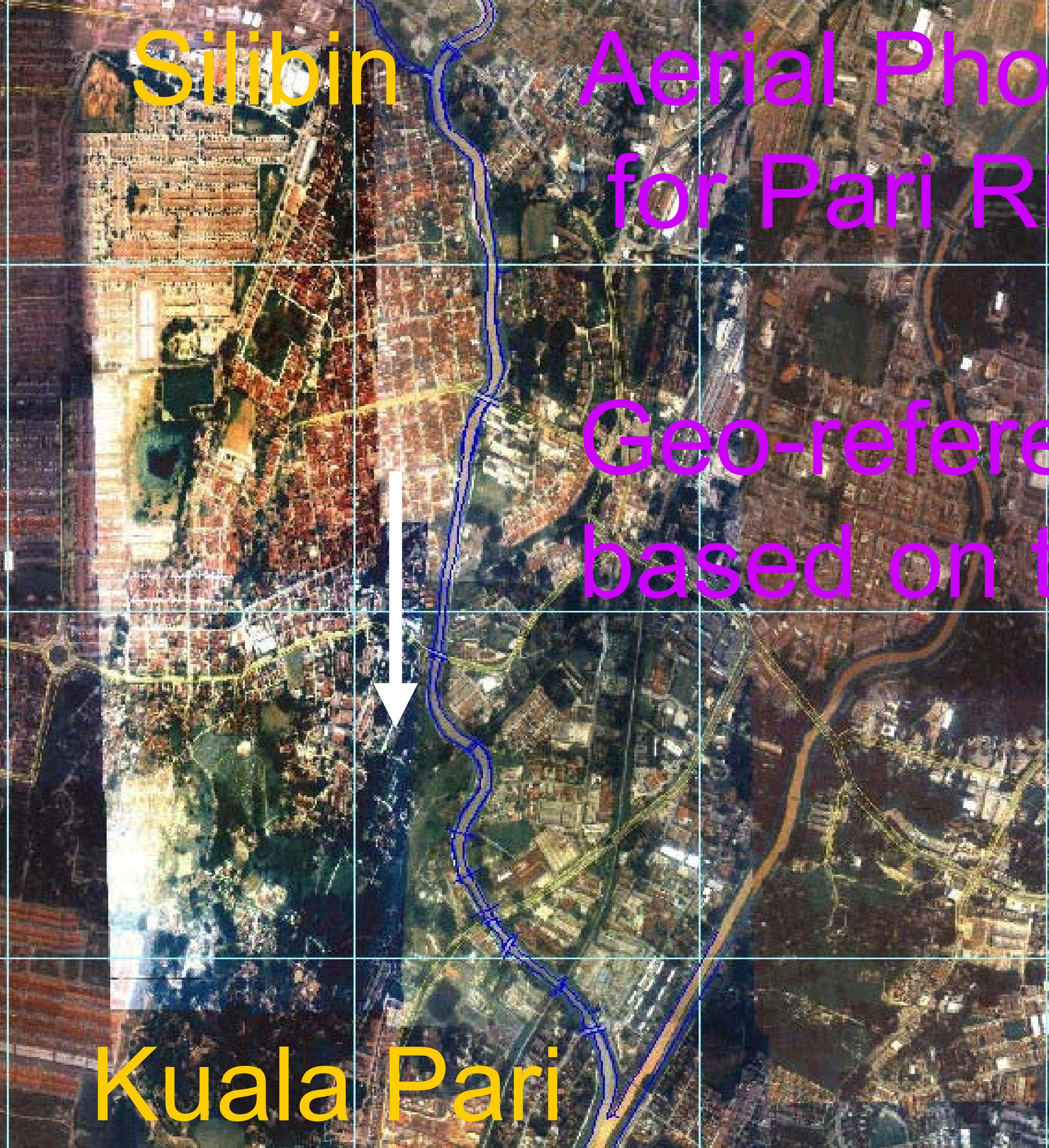

Aerial Photo for Pari River

Geo-referenced based on topo map

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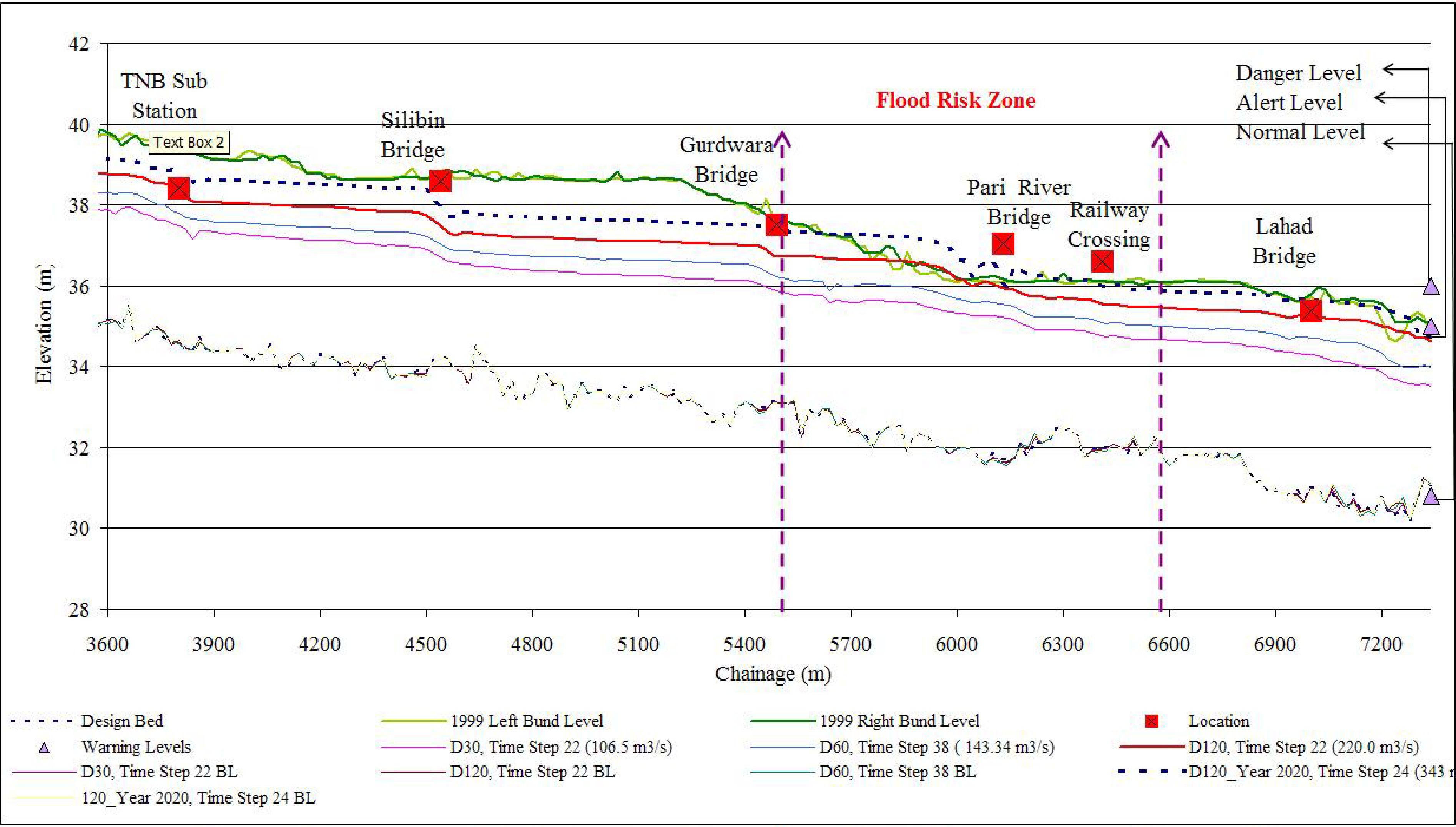
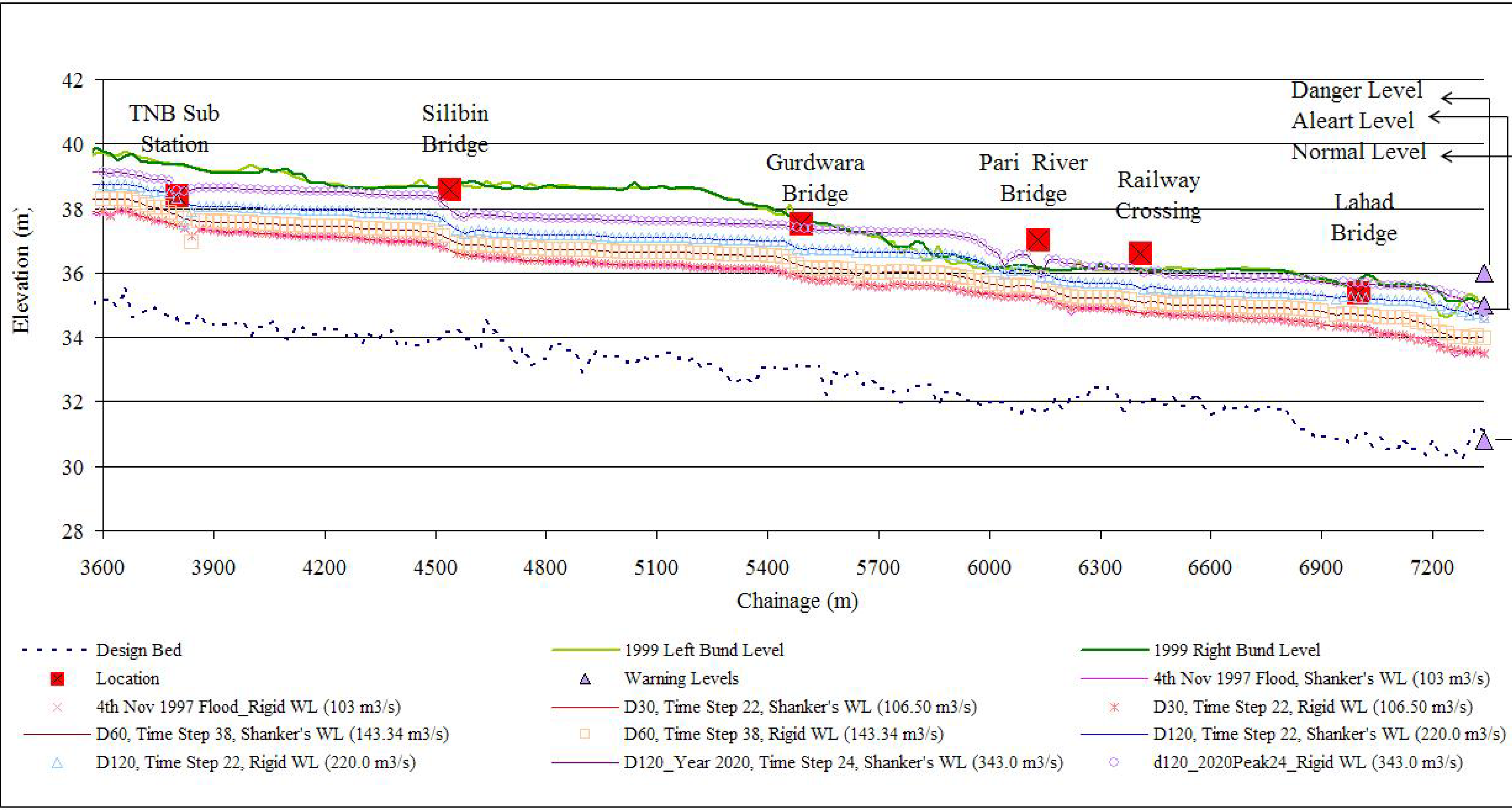
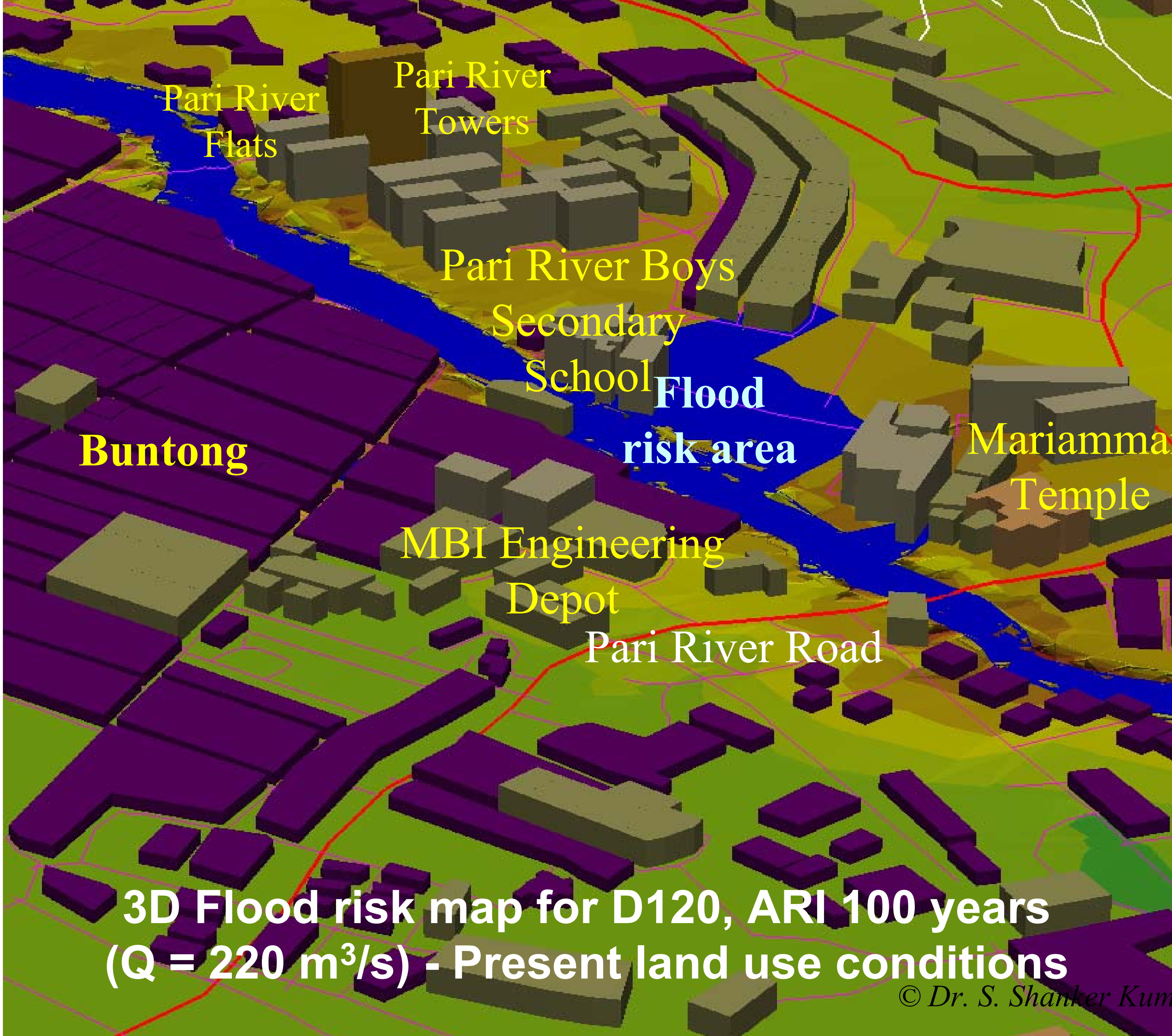


Comparisons of peak flows for ARI 100 with D30, D60, D120 minutes rainfall duration - Year 2020 land use conditions



Water level changes at the Crest for rigid and loose boundary comparison
(ARI 100 years - Peak Flow with D30, D60 and D120 (2020) land use conditions)



3D Flood risk map for D120, ARI 100 years ($Q = 220\ m^3/s$) - Present land use conditions

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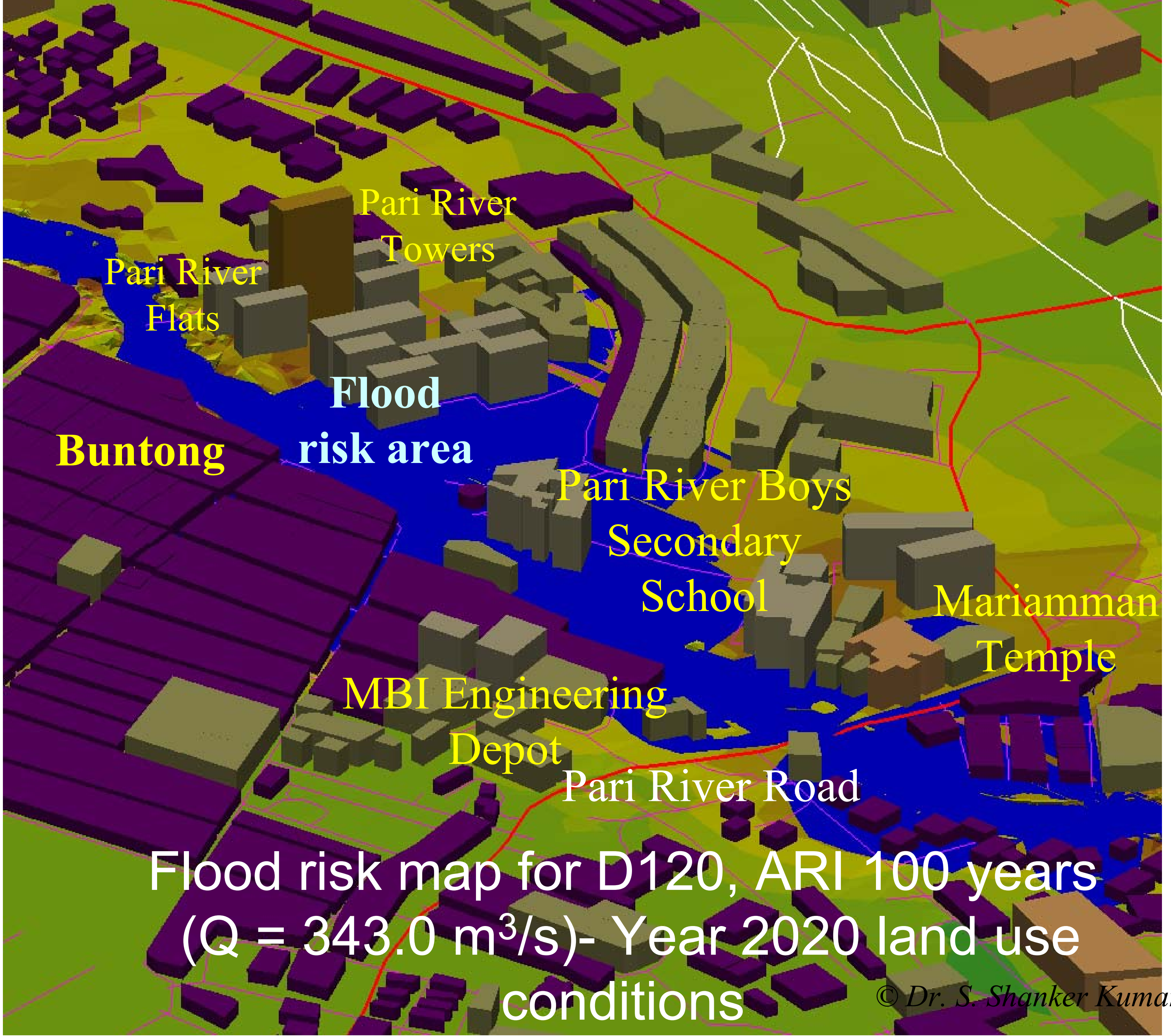
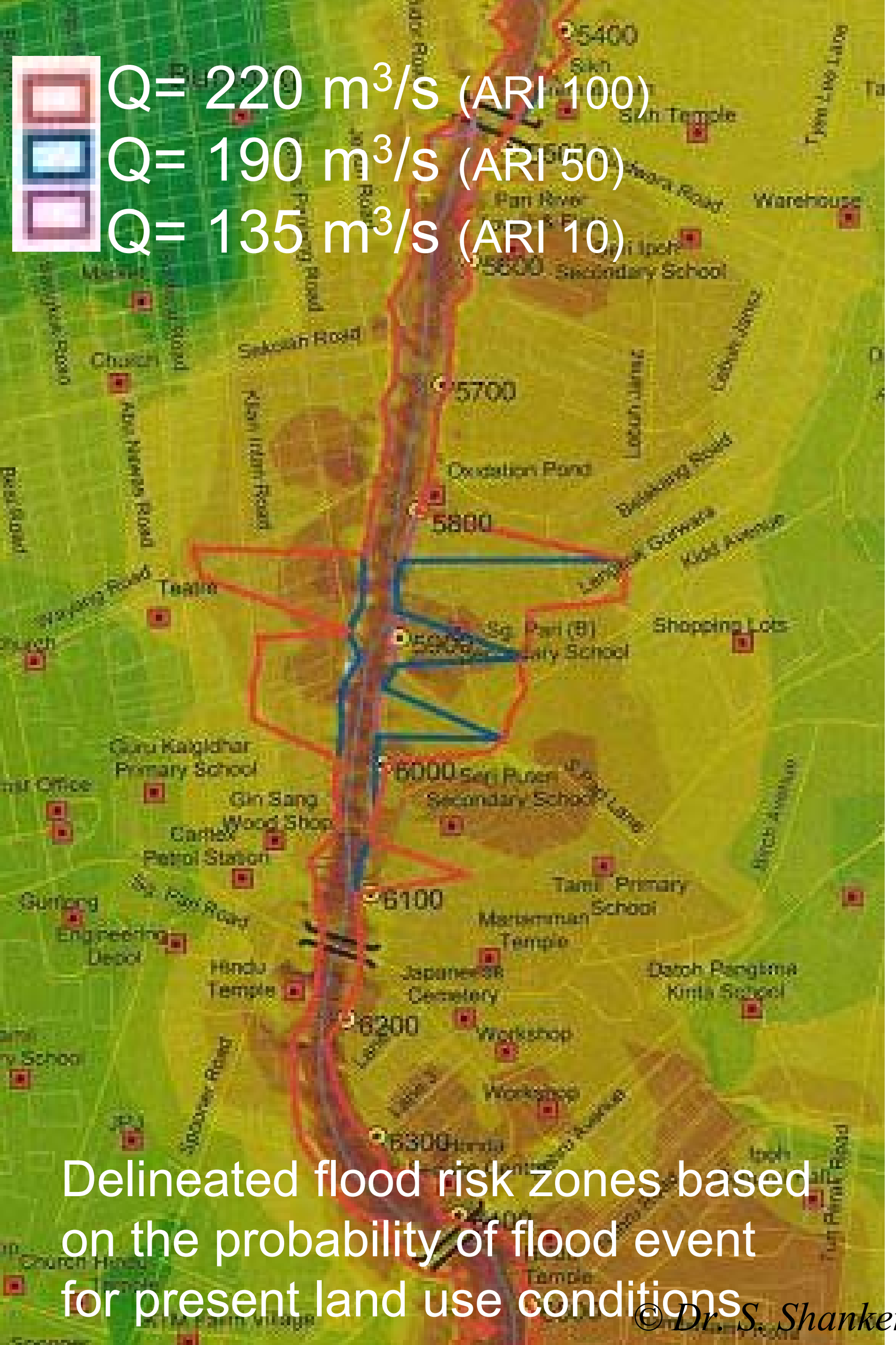
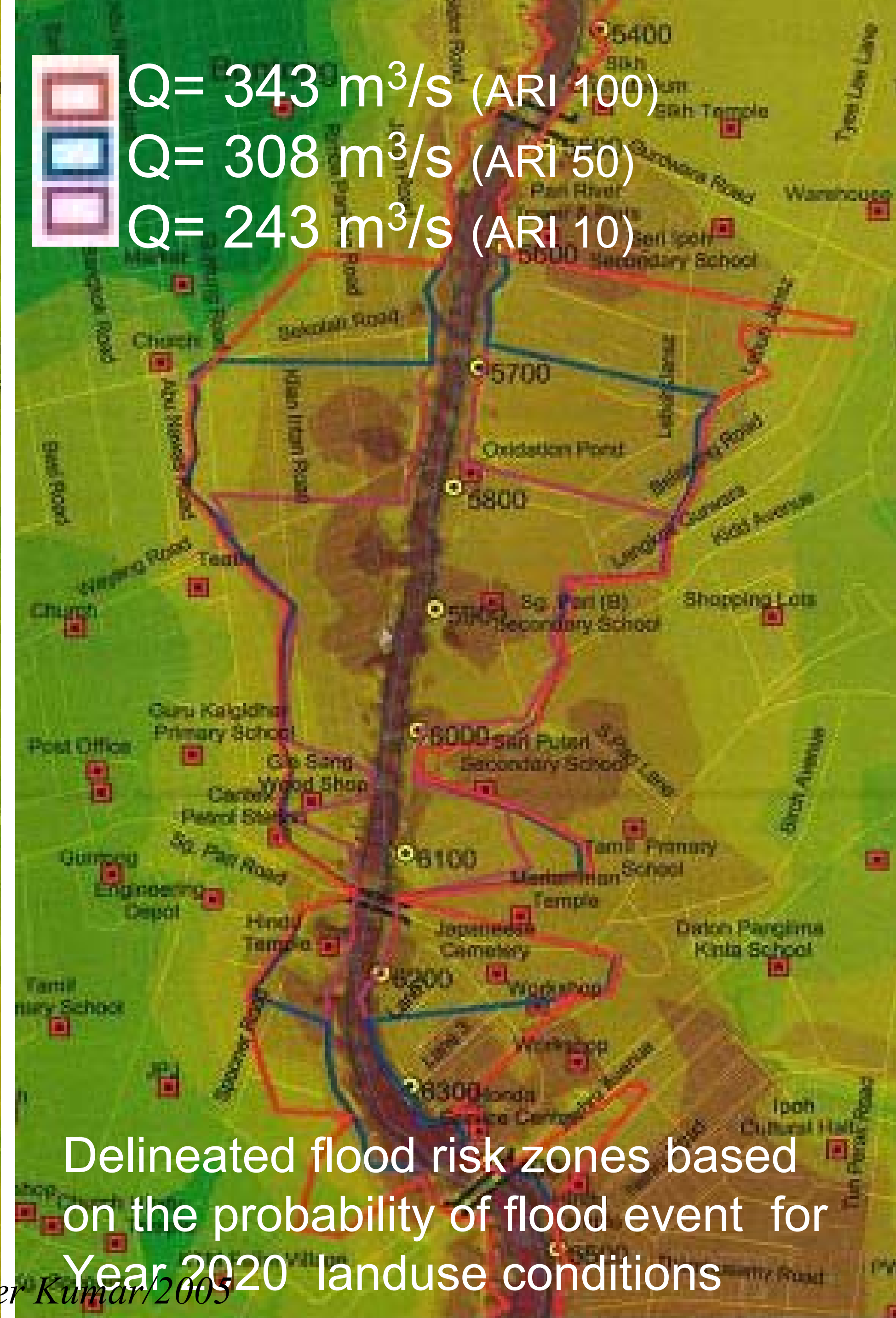


Flood risk map for D120, ARI 100 years ($Q = 343.0\ m^3/s$)- Year 2020 land use conditions





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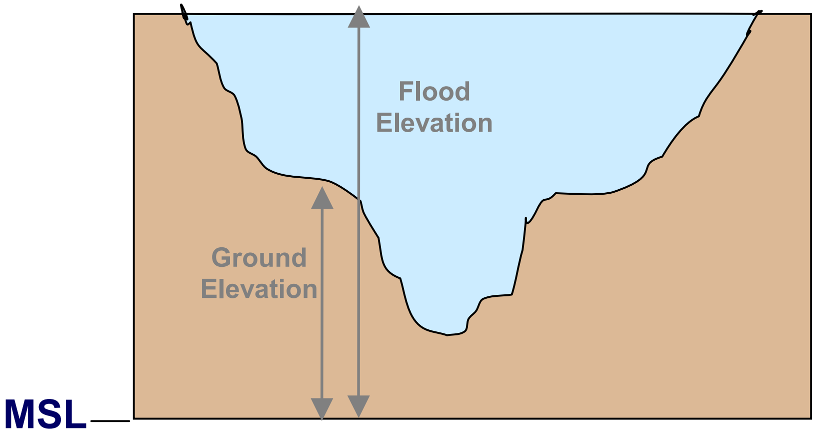
Flood Model Flood Depth Determination



Subtract ground surface from flood surface to determine flood depth at all locations in the study area

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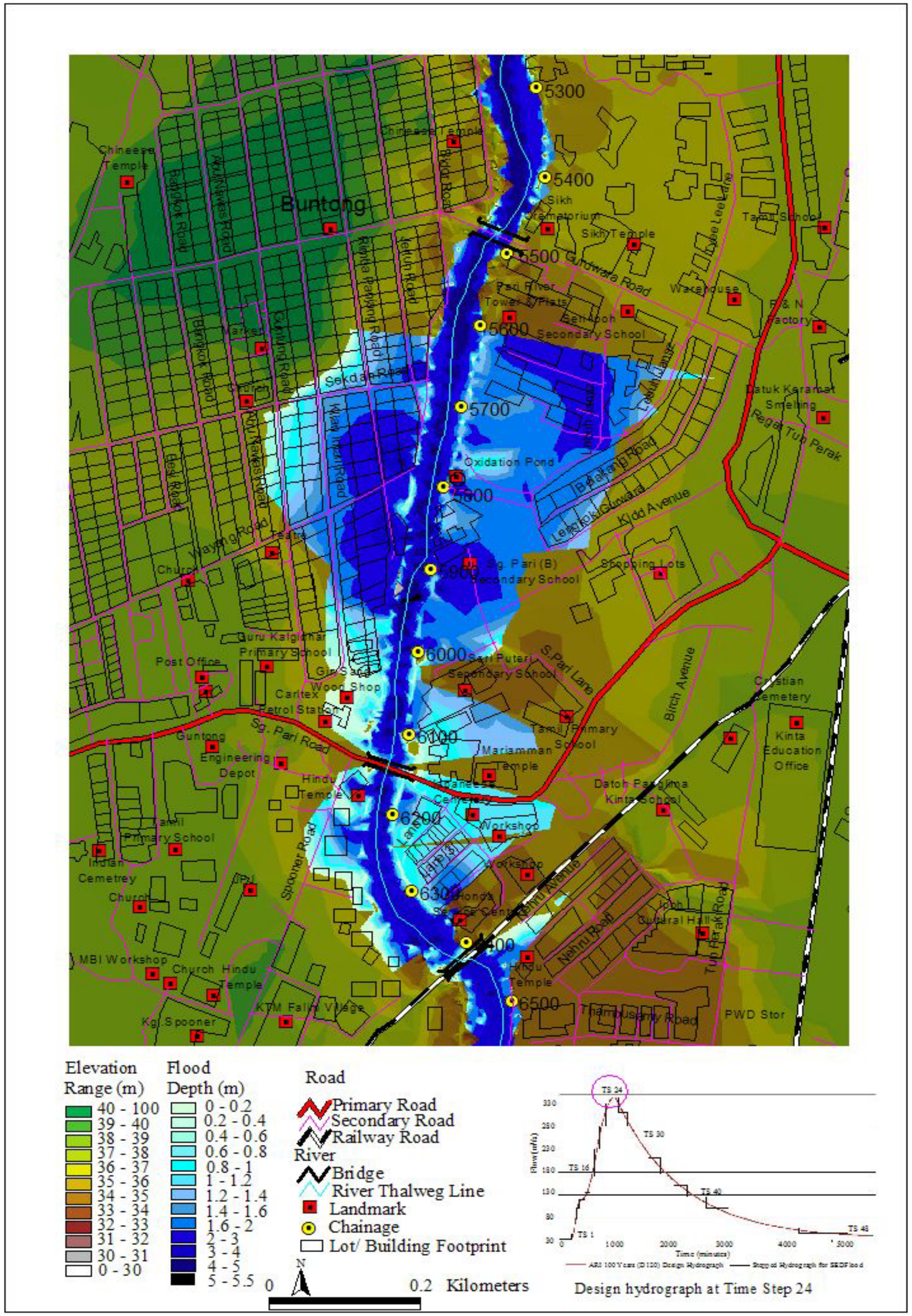
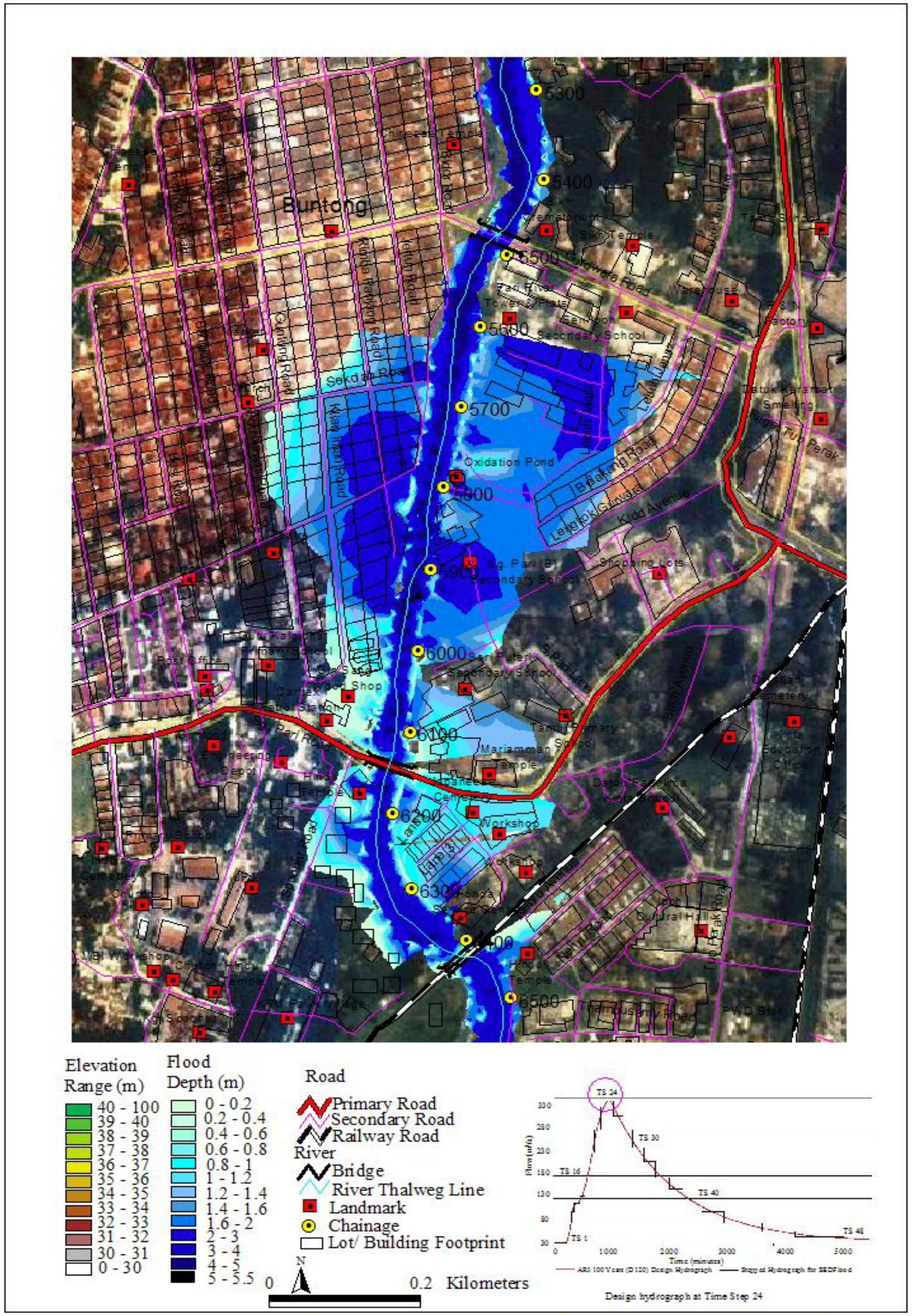


2D Flood depth map for D120, ARI 100 Years (Q = 343.0 m^3/s)
Year 2020 land use conditions



2D Flood depth map overlaid with aerial photo for D120, ARI 100 Years (Q = 343.0 m^3/s)
Year 2020 land use conditions

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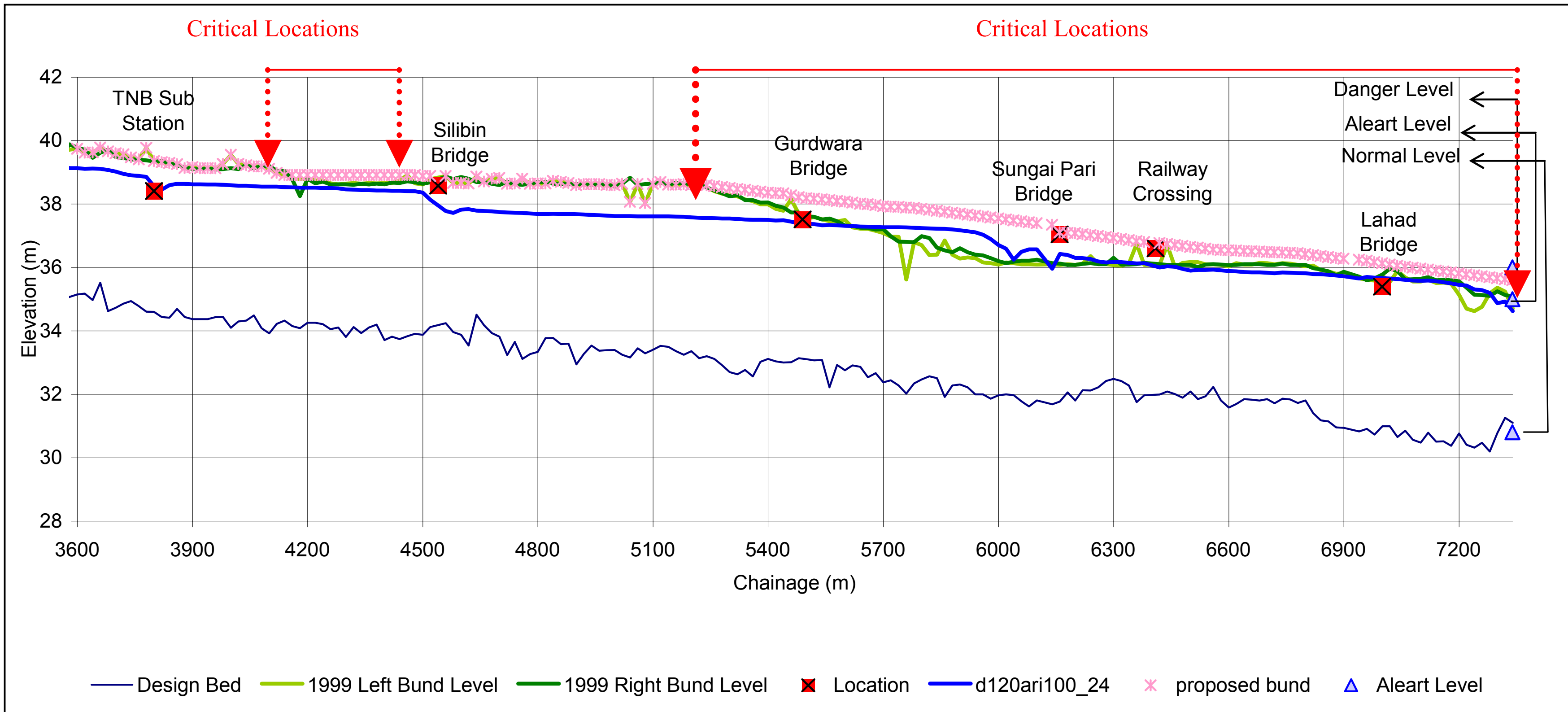
Proposed Design for Flood Proofing



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"…models are like maps: never final, never complete until they grow as large and complex as the reality they represent."

(James Gleick,1999)

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Keep the flood
away from people

keep the people
away from floods

Or accept floods & clean up later

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Issues ?

1. What is the optimal resolution ?
- for flood plain?
- for river channel?
2. Multi Resolution in Modeling ?
- DEM ??
- TIN ??
3. Sediment or No Sediment ?

4. Compound Channel ?

5. Storage Effect ?

6. How reliable is your Prediction ?

7. Prediction vs Validation (is your validation data is Ok or KO?)

8. Online or Offline ?

9. 1 D, 2 D or 3D & 4D modeling ? and how about the missing Dimension?
   The HUMAN DIMENSION ……….

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Questions ?

Thank You

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