OVERVIEW
NCHRP PROJECTS 24-16 AND 24-07 (2)
For

Western Hydraulic Engineers Conference
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By

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AYRES ASSOCIATES

NCHRP Research Project 24-16

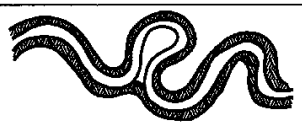
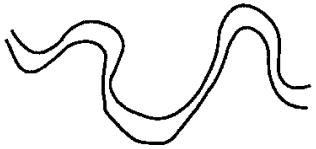
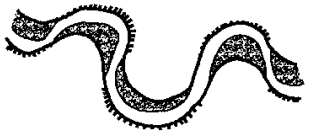
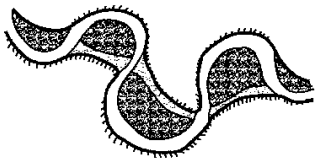
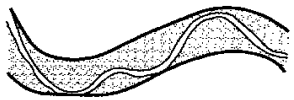
A Methodology for Predicting Channel Migration

OBJECTIVE

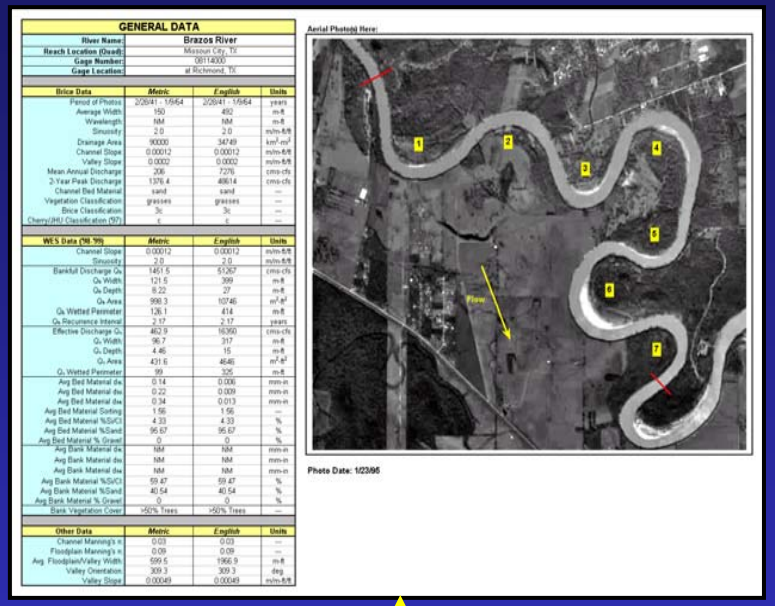
Develop a practical methodology to predict the rate and extent of stream channel migration.

Meander Channel Pattern Classification Scheme

(⊘ = Screened out)

MODIFIED BRICE CLASSIFICATION		SCREEN
	A SINGLE PHASE, EQUIWIDTH CHANNEL INCISED OR DEEP	⊘
	B_1 SINGLE PHASE, EQUIWIDTH CHANNEL	⊘
	B_2 SINGLE PHASE, WIDER AT BENDS, NO BARS	
	C SINGLE PHASE, WIDER AT BENDS WITH POINT BARS	
	D SINGLE PHASE, WIDER AT BENDS WITH POINT BARS, CHUTES COMMON	
	E SINGLE PHASE, IRREGULAR WIDTH VARIATION	
	F TWO PHASE UNDERFIT, LOW-WATER SINUOSITY (WANDERING)	⊘
	G_1 TWO PHASE, BIMODAL BANKFULL SINUOSITY, EQUIWIDTH	⊘
	G_2 TWO PHASE, BIMODAL BANKFULL SINUOSITY, WIDER AT BENDS WITH POINT BARS	

Variables Database for Each Site



GENERAL DATA

River Name:	Brazos River
Reach Location (Quad):	Missouri City, TX
Gage Number:	08114000
Gage Location:	at Richmond, TX

Brice Data	Metric	English	Units
Period of Photos	2/28/41 - 1/5/64	2/28/41 - 1/5/64	years
Average Width	150	492	m-ft
Wavelength	NM	NM	m-ft
Sinuosity	2.0	2.0	m/m-ft/ft
Drainage Area	90000	34749	km²-mi²
Channel Slope	0.00012	0.00012	m/m-ft/ft
Valley Slope	0.0002	0.0002	m/m-ft/ft
Mean Annual Discharge	206	7276	cms-cfs
2-Year Peak Discharge	1376.4	48614	cms-cfs
Channel Bed Material	sand	sand	—
Vegetation Classification	grasses	grasses	—
Brice Classification	3c	3c	—
Cherry/Hill Classification (92)	c	c	—

WES Data (90-'99)	Metric	English	Units
Channel Slope	0.00012	0.00012	m/m-ft/ft
Sinuosity	2.0	2.0	m/m-ft/ft
Bankfull Discharge Q_b	1451.5	51267	cms-cfs
Q_b Width	121.5	399	m-ft
Q_b Depth	8.22	27	m-ft
Q_b Area	998.3	10746	m^2-ft^2
Q_b Wetted Perimeter	126.1	414	m-ft
Q_b Recurrence Interval	2.17	2.17	years
Effective Discharge Q_e	462.9	16350	cms-cfs
Q_e Width	96.7	317	m-ft
Q_e Depth	4.46	15	m-ft
Q_e Area	431.6	4646	m^2-ft^2
Q_e Wetted Perimeter	99	325	m-ft
Avg Bed Material d_{16}	0.14	0.006	mm-in
Avg Bed Material d_{50}	0.22	0.009	mm-in
Avg Bed Material d_{84}	0.34	0.013	mm-in
Avg Bed Material Sorting	1.56	1.56	—
Avg Bed Material %Si/Cl	4.33	4.33	%
Avg Bed Material %Sand	95.67	95.67	%
Avg Bed Material % Gravel	0	0	%
Avg Bank Material d_{16}	NM	NM	mm-in
Avg Bank Material d_{50}	NM	NM	mm-in
Avg Bank Material d_{84}	NM	NM	mm-in
Avg Bank Material %Si/Cl	59.47	59.47	%
Avg Bank Material %Sand	40.54	40.54	%
Avg Bank Material % Gravel	0	0	%
Bank Vegetation Cover	>50% Trees	>50% Trees	—

Other Data	Metric	English	Units
Channel Manning's n	0.03	0.03	—
Floodplain Manning's n	0.09	0.09	—
Avg. Floodplain/Valley Width	599.5	1966.9	m-ft
Valley Orientation	309.3	309.3	deg
Valley Slope	0.00049	0.00049	m/m-ft/ft

Aerial Photo(s) Here:

Photo Date: 1/23/95

Workbooks for Each River Site

Spreadsheets for Individual Bends

Brazos River

BEND #5

(Each bend has a separate worksheet in this workbook.)

Location:	at Thompsons, TX
USGS 7.5' Quad Name:	Missouri City, TX
Nearest Gage Name and Number:	at Richmond, TX 08114000

SITE CLASSIFICATION

Flow Habit:	PERENNIAL
River Classification:	C
Sediment Load Type:	Mixed Load
Brice Bend Type:	Simple Symmetrical

Group	Variable	English Value 1941	English Value 1964	English Value 1995	Units	Metric Value 1941	Metric Value 1964	Metric Value 1995	Units
Planform	Outside Bank Avg. Radius of Curvature	1063	1192	1277	feet	324.0	363.4	389.4	meter
	Right or Left Hand Bend	L	L	L	---	L	L	L	---
	Center Point of Bend - Northing	10723107	10722996	10722950	feet	3268410	3268376	3268362	meter
	Center Point of Bend - Easting	818133	818039	817937	feet	249367	249339	249308	meter
	Valley Orientation	309.3	309.3	309.3	deg.	309.3	309.3	309.3	deg.
	Bend Orientation	307.6	292.9	289.4	deg.	307.6	292.9	289.4	deg.
	Channel Sinuosity	1.60	1.69	1.80	ft/ft	1.60	1.69	1.80	m/m
	Meander Wavelength	5176	6491	5475	feet	1577.8	1978.6	1668.9	meter
	Meander Amplitude	1240	1507	1197	feet	377.9	459.3	364.9	meter
Geometry	Channel Width at Crossing	452	446	417	feet	137.7	136.0	127.1	meter
	Channel Width at Bend Apex	512	751	436	feet	156.0	228.9	132.8	meter
	Channel Hydraulic Depth at Crossing	27	27	27	feet	8.2	8.2	8.2	meter
	Maximum Channel Depth at Bend Apex	NM	NM	NM	feet	NM	NM	NM	meter
	Crossing Width/Depth Ratio	16.8	16.5	15.5	ft/ft	16.8	16.5	15.5	m/m
	Maximum Point Bar Width in Bend	0.0	0.0	107.3	feet	0.0	0.0	32.7	meter
	Average Floodplain Width	1967	1967	1967	feet	599.5	599.5	599.5	meter
Slope	Channel Slope	0.00030	0.00029	0.00027	ft/ft	0.00030	0.00029	0.00027	m/m
	Valley Slope	0.00049	0.00049	0.00049	ft/ft	0.00049	0.00049	0.00049	m/m
Roughness	Estimated Channel Manning's n	0.03	0.03	0.03	---	0.03	0.03	0.03	---
	Estimated Floodplain Manning's n	0.09	0.09	0.09	---	0.09	0.09	0.09	---
Sediment	Bed Material D50	0.009	0.009	0.009	in	0.2	0.2	0.2	mm
	Bed Material % Si/Cl	4.33	4.33	4.33	%	4.33	4.33	4.33	%
	Bank Toe Material D50	NM	NM	NM	in	NM	NM	NM	mm
	Bank Toe Material % Si/Cl	59.47	59.47	59.47	%	59.47	59.47	59.47	%
Riparian Veg	Percent Vegetation Cover	NM	NM	>50% T	%	NM	NM	>50% T	%
	Root Depth as Percent of Bank Height	19	19	19	%	19	19	19	%
Discharge Data	Mean Annual Discharge	7882	6624	7854	cfs	223.2	187.6	222.4	cms
	Average Peak Discharge	66057	51268	54265	cfs	1870.7	1451.9	1536.8	cms
	Bankfull Discharge	---	---	51267	cfs	---	---	1451.9	cms
	Effective Discharge	---	---	16350	cfs	---	---	463.0	cms

REACH LIST

Vegetation Types:

Dense trees, swampland, and farming

***Activity Indicators:**

Old oxbows in floodplain; farming to edge of channel (vertical eroding banks) along most of right bank

Upstream Controls:

Flows regulated since 1941 by upstream reservoirs, floodwater-retarding structures, and irrigation diversions.

Downstream Controls:

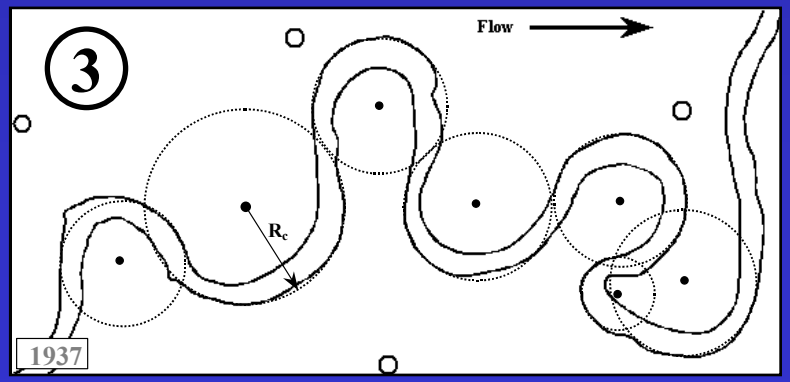
0

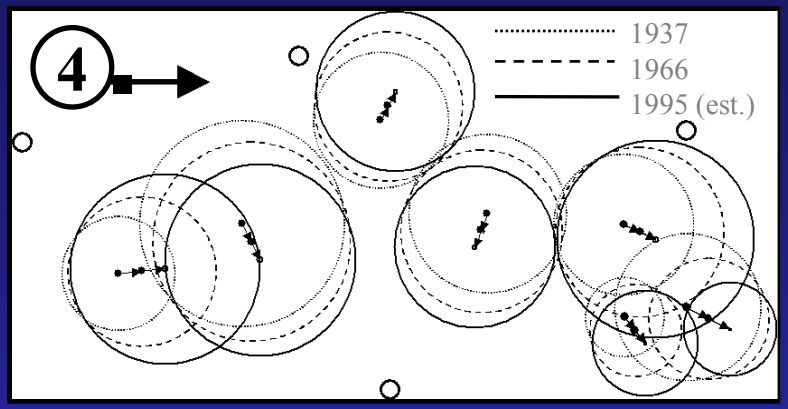
*Activity Indicators (e.g. ridges and swales, neck cutoffs, chute cutoffs, recently abandoned meander bends, farming to edge of channel, crevasse splays, etc.)
NM = Not Measured or No Data

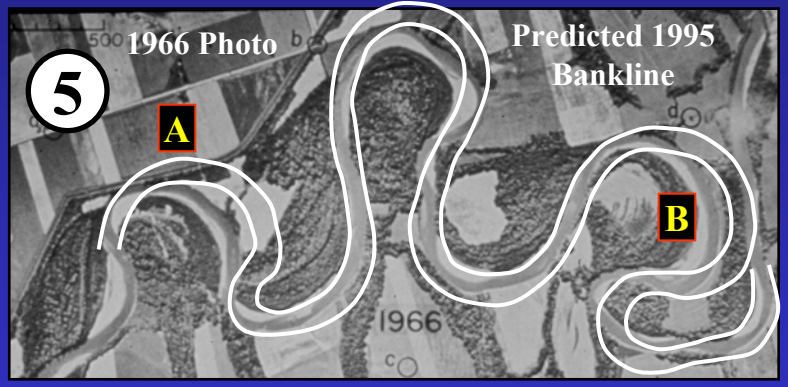
METHODOLOGIES

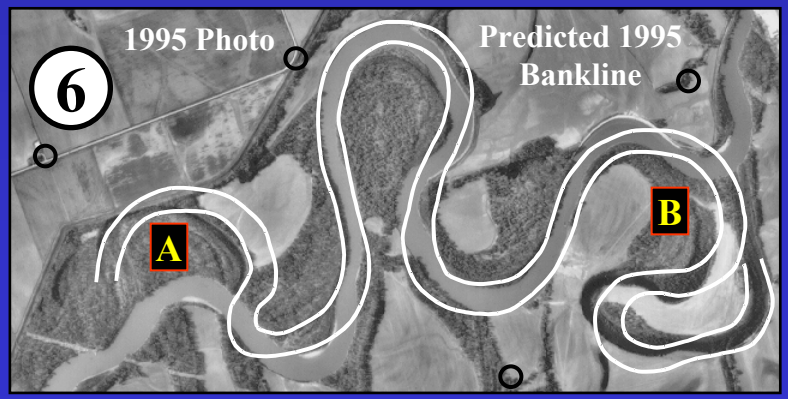
- Guidelines on simple comparison techniques using historic maps and aerial photos
- Development of the ArcView-based *Channel Migration Predictor* extension that uses the *Data Logger* database and historic bankline positions to predict channel migration

Comparison & Prediction Techniques

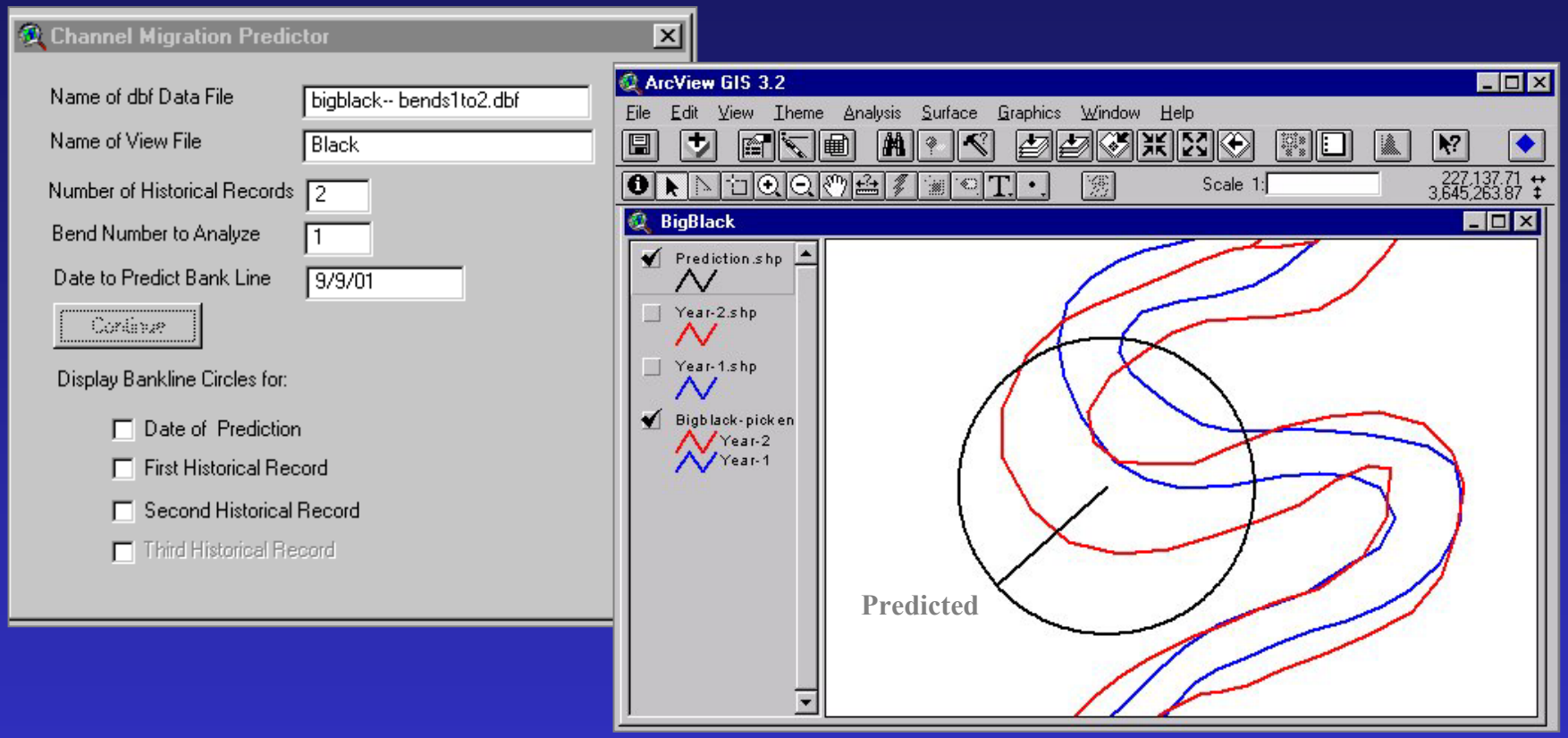








Channel Migration Predictor



An ArcView extension that uses the database and documented historic channel positions compiled using *Data Logger* to predict the approximate bankline position for a year in the future.

PROJECT COMPLETION

- June 2003 Final Report
- Handbook
  - Guidance
  - Examples
  - GIS software
- Archive Data Base
  - 141 meander sites
  - 1503 bends
  - 89 rivers in U.S.

NCHRP Research Project 24-07 (2)

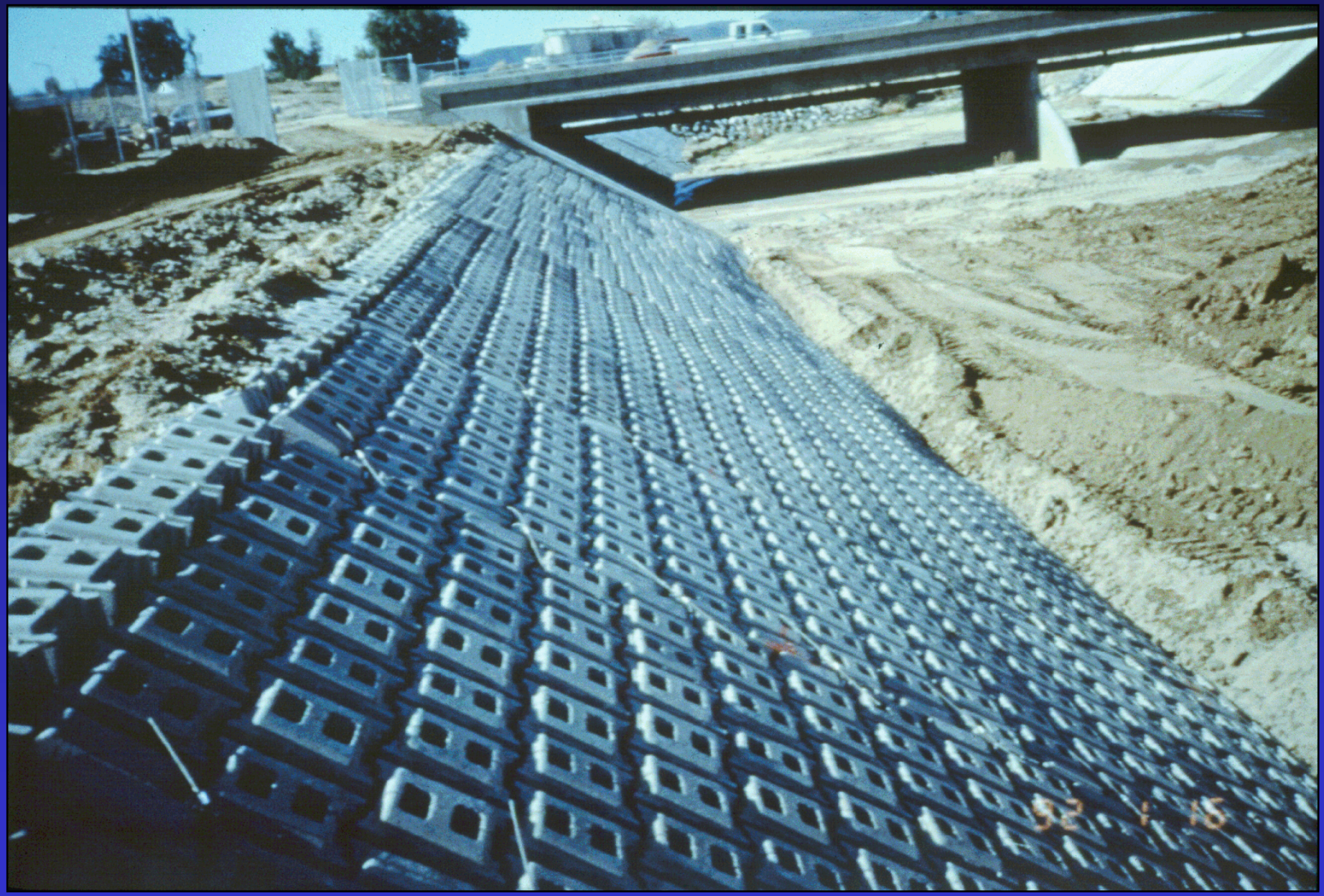
Countermeasures to Protect Bridge Piers from Scour

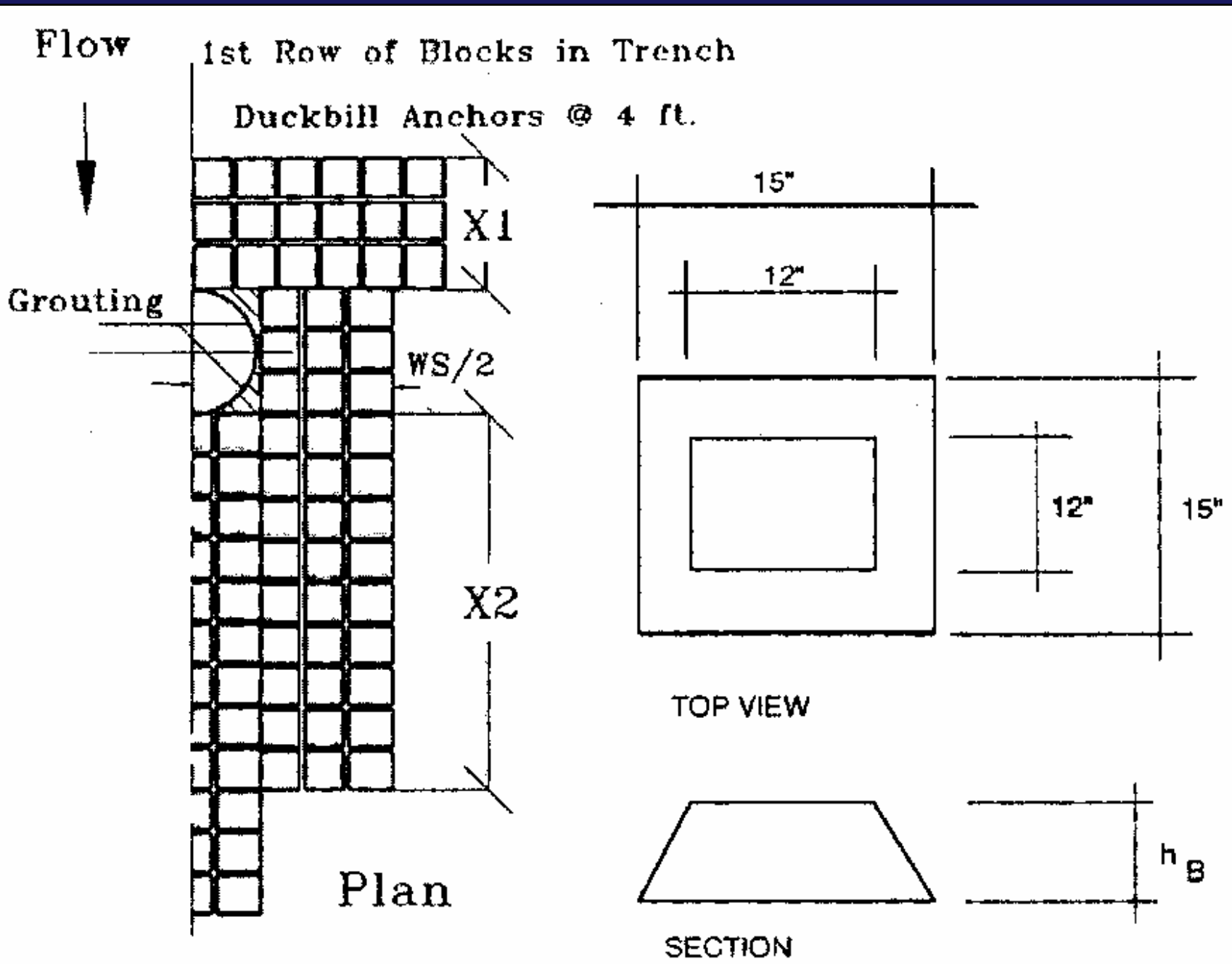
OBJECTIVES
To Develop and Recommend for Bridge Piers

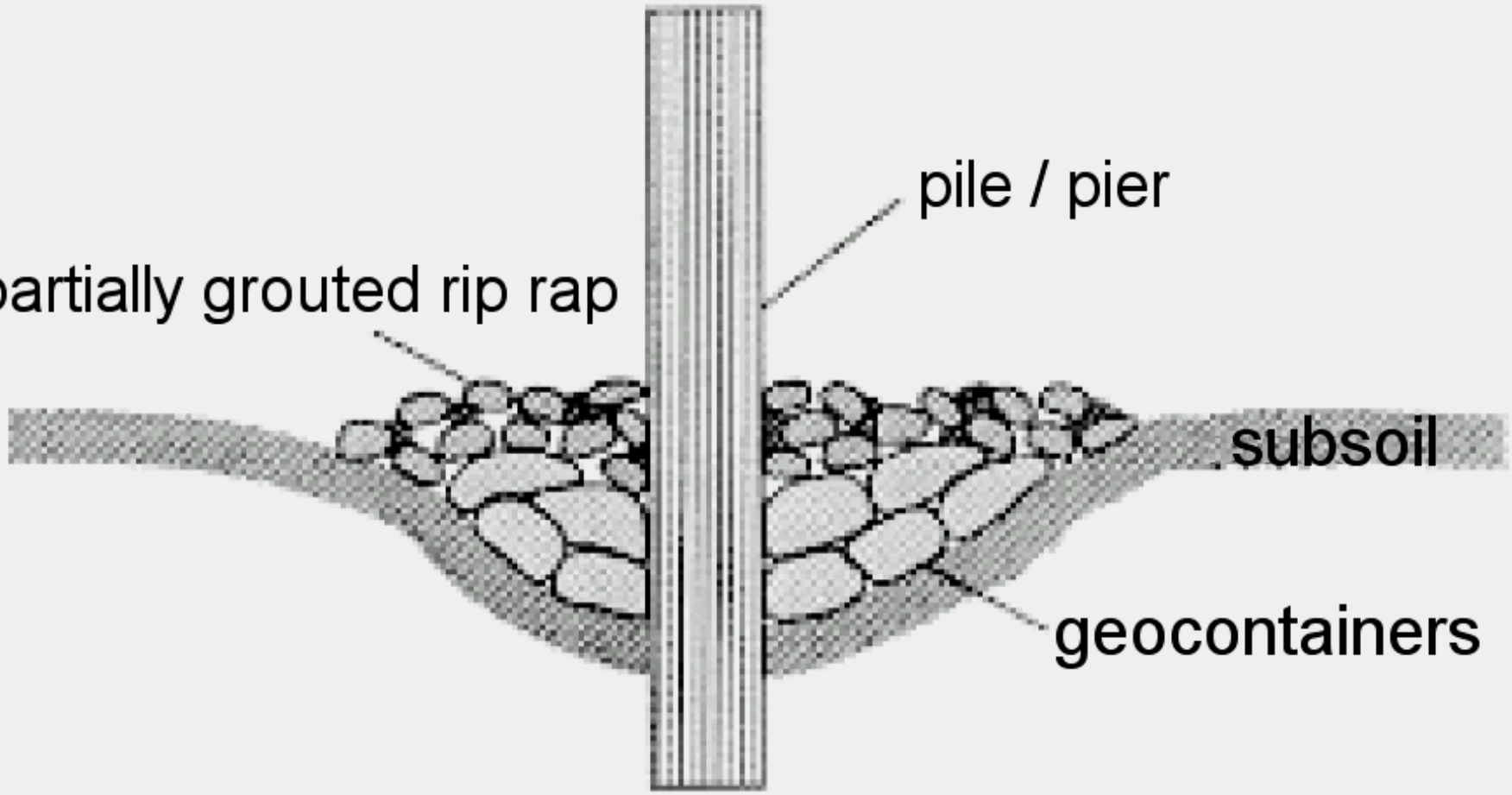
- Practical selection criteria for scour countermeasures
- Guidelines and specifications for design and construction
- Guidelines for inspection, maintenance, and performance evaluation

COUNTERMEASURES TO BE CONSIDERED

- Riprap
- Partially grouted riprap (small scale)
- Articulating concrete blocks
- Partially grouted riprap and geotextile containers (prototype scale)
- Gabions
- Grout-filled bags and mats
- Geotextile containers (as a stand-alone countermeasure, or as a filter)


92 1 15


Flow
1st Row of Blocks in Trench
Duckbill Anchors @ 4 ft.
X1
Grouting
WS/2
X2
Plan
15"
12"
12"
15"
TOP VIEW
h_B
SECTION



Flexible scour repair using geocontainers as filter and fill, partially grouted rip rap as cover layer

PROJECT SCHEDULE

Project Initiation	Apr 2001
Installations in US	May – Oct 2001
Installations in Germany	Sep 2001
Interim Report	Apr 2002
Research Panel Meeting	Jun 2002
Laboratory Testing	Apr 2003 – Jan 2004
Selection Criteria and Recommendations	Jun 2002 – Aug 2004
Final Report	Mar 2005

NCHRP Research Project 24-23

Riprap Design Criteria, Specifications, and Quality Control

OBJECTIVES

- Design guidelines
- Material specifications and test methods
- Construction specifications
- Construction inspection and quality control

APPLICATIONS

- Riprap at:
  - Streams and riverbanks
  - Piers and abutments
  - Guidebanks
  - Other countermeasures

PHASES AND TASKS

Task 1 – Review literature

Task 2 – Survey current state of practice

Task 3 – Synthesize current state of practice

Task 4 – Interim report

Task 5 – Design guidelines

Task 6 – Specifications and test methods

Task 7 – Construction guidelines

Task 8 – Final report

PROJECT SCHEDULE

Project Initiation	Apr 2003
Survey	May – Sep 2003
Interim Report	Dec 2003
Guidelines and Specs	Mar 2004 – Mar 2005
Final Report	Sep 2005