PRESERVING NAVIGATIONAL CHANNEL DEPTH AT THE BATANG ARAU FLOODWAY MOUTH, PADANG, WEST SUMATRA, INDONESIA: A NUMERICAL STUDY OF JETTY LAYOUT EFFECTIVENESS

ENGINEERING REPORT

MAS MERA
NBP. 25 4 161 2 061

PROFESSIONAL ENGINEER EDUCATION PROGRAM
POSTGRADUATE SCHOOL
UNIVERSITY OF ANDALAS
PADANG
2025

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Submitted to fulfill One of the requirements for completing the study in the Professional Engineer Program, Postgraduate School, University of Andalas

MAS MERA
NBP. 25 4 161 2 061

SUPERVISOR:

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PROFESSIONAL ENGINEER EDUCATION PROGRAM
POSTGRADUATE SCHOOL
UNIVERSITY OF ANDALAS
PADANG
2025

HALAMAN PERSETUJUAN

Judul Laporan Teknik	:	Preserving Navigational Channel Depth at the Batang Arau Floodway Mouth, Padang, West Sumatra, Indonesia: A Numerical Study of Jetty Layout Effectiveness
Nama Mahasiswa	:	Mas Mera
Nomor Buku Pokok	:	25 4 161 2 061
Program Studi	:	Pendidikan Profesi Insinyur

Laporan Teknik ini telah diuji dan dipertahankan di depan Sidang Panitia Ujian Profesi Insinyur pada Program Studi Pendidikan Profesi Insinyur, Sekolah Pascasarjana, Universitas Andalas dan dinyatakan lulus pada hari Selasa tanggal 11 November 2025.

Menyetujui,

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APPROVAL SHEET

Engineering Report Title	:	Preserving Navigational Channel Depth at the Batang Arau Floodway Mouth, Padang, West Sumatra, Indonesia: A Numerical Study of Jetty Layout Effectiveness
Student Name	:	Mas Mera
Student Registration Number	:	25 4 161 2 061
Study Program	:	Professional Engineer Program

This Engineering Report has been examined and defended before the Board of Examiners of the Professional Engineer Examination in the Professional Engineer Program, Postgraduate School, Andalas University, and was declared successful on Tuesday, November 11, 2025.

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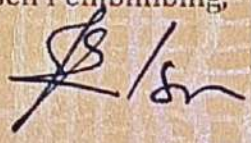
HALAMAN PERSETUJUAN PEMBIMBING
SEBAGAI PERSYARATAN UJIAN INSINYUR

Judul Laporan Teknik	:	Preserving Navigational Channel Depth at the Batang Arau Floodway Mouth, Padang, West Sumatra, Indonesia: A Numerical Study of Jetty Layout Effectiveness
Nama Mahasiswa	:	Mas Mera
Nomor Buku Pokok	:	25 4 161 2 061
Program Studi	:	Pendidikan Profesi Insinyur

Laporan Teknik ini telah diperiksa dan dinyatakan telah memenuhi syarat untuk mengikuti Ujian Profesi Insinyur pada Program Studi Pendidikan Profesi Insinyur, Sekolah Pascasarjana, Universitas Andalas.

Padang, 7 November 2025
Dosen Pembimbing,



Prof. Ir. Elsa Eka Putri, S.T., MSc.(Eng), Ph.D., IPM
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SUPERVISOR APPROVAL SHEET
AS A REQUIREMENT FOR THE ENGINEER EXAMINATION

Engineering Report Title	:	Preserving Navigational Channel Depth at the Batang Arau Floodway Mouth, Padang, West Sumatra, Indonesia: A Numerical Study of Jetty Layout Effectiveness
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Student Registration Number	:	25 4 161 2 061
Study Program	:	Professional Engineer Program

This Engineering Report has been reviewed and declared eligible to participate in the Professional Engineer Examination at the Professional Engineer Program, Postgraduate School, University of Andalas.

Padang, November 7, 2025
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SURAT PERNYATAAN KEASLIAN
LAPORAN TEKNIK

Saya yang bertanda tangan di bawah ini:

Nama	:	Mas Mera
NBP	:	25 4 161 2 061
Tempat, Tanggal Lahir	:	Pasaman, 5 Mei 1967
Alamat	:	Kompleks KODAM Blok J No. 6, RT/RW 2/22, Kelurahan Surau Gadang, Kecamatan Nanggalo, Kota Padang, Provinsi Sumatera Barat

Dengan ini menyatakan bahwa Laporan Teknik dengan judul '*Preserving Navigational Channel Depth at the Batang Arau Floodway Mouth, Padang, West Sumatra, Indonesia: A Numerical Study of Jetty Layout Effectiveness*' adalah hasil pekerjaan saya; dan seluruh ide, pendapat, atau materi dari sumber lain telah dikutip dengan cara penulisan referensi yang sesuai.

Pernyataan ini saya buat dengan sebenar-benarnya dan jika pernyataan ini tidak sesuai dengan kenyataan, maka saya bersedia menanggung sangsi yang akan dikenakan kepada saya termasuk pencabutan gelar Profesi Insinyur yang nanti saya dapatkan.

Padang, 7 November 2025
Yang menyatakan,

Mas Mera
NBP. 25 4 161 2 061

STATEMENT OF ORIGINALITY FOR ENGINEERING REPORT

I, the undersigned:

Name	:	Mas Mera
Student Registration Number (NBP)	:	25 4 161 2 061
Place and Date of Birth	:	Pasaman, 5 Mei 1967
Address	:	Kompleks KODAM Blok J No. 6, RT/RW 2/22, Surau Gadang Sub-District, Nanggalo District, Padang City, West Sumatra Province

Hereby declare that the Engineering Report entitled 'Preserving Navigational Channel Depth at the Batang Arau Floodway Mouth, Padang, West Sumatra, Indonesia: A Numerical Study of Jetty Layout Effectiveness' is my own work; and all ideas, opinions, or materials from other sources have been cited with appropriate referencing style.

This statement is made truthfully, and should this statement prove to be untrue, I am willing to bear the sanctions imposed upon me, including the revocation of the Professional Engineer title that I may obtain later.

Padang, November 7, 2025
The Undersigned,

Mas Mera
NBP. 25 4 161 2 061

ABSTRAK

Sedimentasi di wilayah pesisir menimbulkan ancaman kritis terhadap perekonomian perikanan setempat dan keselamatan navigasi, sehingga menuntut adanya solusi rekayasa yang efektif. Di muara Kanal Banjir (*floodway*) Batang Arau di Padang, Sumatera Barat, Indonesia, sedimentasi signifikan menghambat operasional kapal penangkap ikan dengan panjang melebihi 10 meter, meskipun sudah terdapat struktur *jetty* eksisting. Penelitian ini berfokus pada optimasi konfigurasi tata letak *jetty* untuk memitigasi sedimentasi dan meningkatkan kedalaman alur navigasi di muara Kanal Banjir ini menggunakan pendekatan simulasi numerik.

Sebanyak enam skenario tata letak *jetty* yang berbeda—termasuk skenario dasar (*baseline*), konfigurasi eksisting, dan empat desain optimasi yang diusulkan—disimulasikan dan dianalisis untuk mengevaluasi efektivitasnya. Simulasi hidrodinamika dan perpindahan sedimen kami, yang menggabungkan aksi gelombang spektral, dievaluasi berdasarkan stabilitas kedalaman alur (yaitu, sedimentasi atau erosi mendekati nol) dan kestabilan luas penampang melintang navigasi, menunjukkan bahwa Skenario 5—yaitu *jetty* kanan lurus pendek dikombinasikan dengan *jetty* kiri panjang kemudian miring 66° ke kanan—menawarkan perlindungan paling efektif terhadap pengaruh gelombang dan proses sedimentasi. Konfigurasi ini secara konsisten menghasilkan kedalaman alur yang stabil dengan hampir tidak ada sedimentasi atau erosi bersih (*no net sedimentation or erosion*) di muara dan di dalam alur utama, sehingga kedalaman navigasi dapat dipertahankan.

Peningkatan kinerja ini terutama disebabkan oleh pengaruh dominan arus sejajar pantai yang mengalir ke arah barat laut, konsisten dengan perpindahan sedimen sepanjang pantai yang didorong oleh gelombang di wilayah tersebut. Lebih lanjut, simulasi yang menggabungkan skenario pengerukan Kanal Banjir dalam kondisi debit normal maupun banjir menunjukkan bahwa upaya pengerukan yang substansial diperlukan untuk mencapai dan

mempertahankan kedalaman air yang memadai bagi lintasan aman kapal penangkap ikan yang lebih besar. Simulasi lanjutan yang dilakukan setelah pengerukan menunjukkan laju sedimentasi yang relatif rendah di dalam alur navigasi yang dikeruk, mengisyaratkan potensi peningkatan kenavigasian jangka panjang.

Kata kunci: Kanal Banjir pantai, Optimisasi tata letak, simulasi numerik, perpindahan sedimen, Kedalaman alur

ABSTRACT

This sedimentation poses a critical threat to the local fishing economy and safe navigation, necessitating effective engineering solutions. At the Batang Arau Floodway Mouth in Padang, West Sumatra, Indonesia, significant sedimentation impedes the operation of fishing vessels exceeding 10 m in length, despite the presence of existing jetty structures. This study investigates the optimization of jetty layout configurations to mitigate sedimentation and enhance the navigational channel depth at this coastal floodway mouth using a numerical simulation approach. Six distinct jetty layout scenarios, including a baseline, the existing configuration, and four proposed optimized designs, were simulated and analysed to evaluate their effectiveness. Our hydrodynamic and sediment transport simulations, incorporating spectral wave action, evaluated by the stability of channel depth (i.e., near-zero sedimentation or erosion) and maintenance of navigational cross-sectional area, reveal that Scenario 5—featuring a short straight right jetty combined with a long-left jetty angled 66° rightward—offers the most effective protection for the floodway mouth against wave action and sedimentation. This configuration consistently yields a stable floodway channel depth with almost no net sedimentation or erosion at the mouth and within the main channel, thereby preserving navigational conditions. This enhanced performance is primarily attributed to the dominant influence of the alongshore current flowing towards the northwest, consistent with the prevailing wave-driven longshore transport in the area. Furthermore, simulations incorporating a floodway dredging scenario under both normal and flood discharge conditions indicate that substantial dredging efforts are necessary to achieve and maintain adequate water depths for the safe passage of larger fishing vessels. Subsequent simulations conducted after the simulated dredging demonstrate a relatively low rate of sedimentation within the dredged navigation channel, suggesting the potential for a long-term improvement in navigability.

Keywords: Coastal Floodway, Jetty Optimization, Numerical Simulation, Sediment Transport, Channel Depth

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