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RIVER BED RESPONSE TO CHANNEL WIDTH VARIATION: THEORY AND EXPERIMENTS

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ABSTRACT

The effect of channel width variation on sediment bed deformation was studied with the help of a laboratory flume in which a straight channel of sinusoidally varying width having non-erodible sidewalls and a movable bed was located. The equilibrium bed deformation caused by a steady flow discharge was monitored for two different channel width perturbations and three different bed slopes. For small width perturbations at low flows, migrating alternate bars having characteristics similar to those observed in straight channels of uniform width were observed. An increase in the width perturbation at low flows resulted in a pattern of non-migrating alternate bars. For high flows, the alternate bars were totally suppressed, and point bars were found to form in the wider channel regions with most of the scour occurring in the narrower sections. Migrating alternate bars were found to be increasingly suppressed as the perturbation of the channel width increased and as the flow discharge increased. This behavior is similar to that observed in meandering channels of uniform width for increased channel curvature and increased flow discharge.

A linear theory was used as a basis for one- and two- dimensional models developed to obtain the values of the equilibrium velocity, flow depth, and bed elevation in a channel of sinusoidally varying width. The one-dimensional model shows that the streamwise velocity and the flow depth are 180° out of phase with the channel width meaning that the highest velocity and flow depth occur in the narrowest channel sections and the lowest occur in the widest sections. The two-dimensional model describes a similar situation in which the point of maximum scour occurs just downstream of the narrowest section, where the shape of the bed profile is concave. Just downstream of the widest channel section, the bed elevation reaches its largest value and a central area of deposition gives the profile a convex shape. The one-dimensional model yields width-averaged bed elevations which compare well with laboratory observations. The two-dimensional model gives results that agree with the laboratory observations for only certain conditions. However, the channel wavelength used in the experiments is close to a resonance range in which a linear theory can not be expected to perform well. It is speculated that such resonance conditions may provide a mechanism for the emergence of a central bar as predicted by the two-dimensional model. If this is the case, then resonance may lead to the formation of braids in channels of variable width.

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1. INTRODUCTION

In an alluvial channel, several flow and sediment bed configurations are possible due to the interdependence of flow parameters, sediment parameters, and channel geometry. Herein, the effects induced by a variation in channel width on phenomena in a straight, alluvial channel are considered. A variation in the width of a channel causes flow and sedimentation patterns that are different from those observed in channels of uniform width. In broad terms, an increase in width will result in a slower flow velocity and sediment deposition, whereas quick-moving flows and erosion are expected due to a decrease in width. In many cases, a more accurate description of the flow and sediment behavior is necessary.

Width variation may be introduced to a river in two ways. Under natural conditions, the interaction of the flow and sediment in an alluvial channel may cause a change in channel width under certain circumstances. The channel width may also be altered for civic purposes such as bridge construction. An example of a natural channel width variation is given in Figure 1.1. Taken from Gross and Berg (1981), the aerial photograph shows the confluence of the Kankakee and Iroquois Rivers in Illinois. In the upper left of the figure, a sequence of alternating wider and narrower sections is visible. Deposition in the wider sections is signified by the central bars observed there. The flow must split to move around the bars causing a very different flow pattern than that found in a uniform width channel. Figure 1.2 shows an example of a man-made width variation. A short reach of the Boneyard Creek in Urbana, Illinois, located just east of Wright Street, contains an expansion from the uniform width of the channelized stream. The reach is useful in that it provides storage during flood events. In that wider portion, deposition occurs and persists as shown by the vegetation growing on the bar. The bar is not centralized as in the natural example but is attached to one side so that the flow is forced to the other side of the channel. This again leads to flow and sediment transport conditions different from those expected in a channel of uniform width.

For practical applications, it is often useful to have the ability to predict certain flow and sedimentation characteristics due to width effects. Knowledge concerning the location and amount of scour in a narrow channel section is necessary for the protection of bridge piers and other riverine structures. Channel contractions have also been employed to maintain a certain depth for navigation purposes, therefore the need to obtain a depth that will allow navigation without unnecessary scouring is evident. In a wide channel section, knowledge of the location and amount of deposition is useful in estimating the stream capacity for the prevention of flooding.

From a theoretical standpoint, it is of interest to investigate the mechanics of the flow and sedimentation patterns obtained in a varying width channel. The emphasis of the research

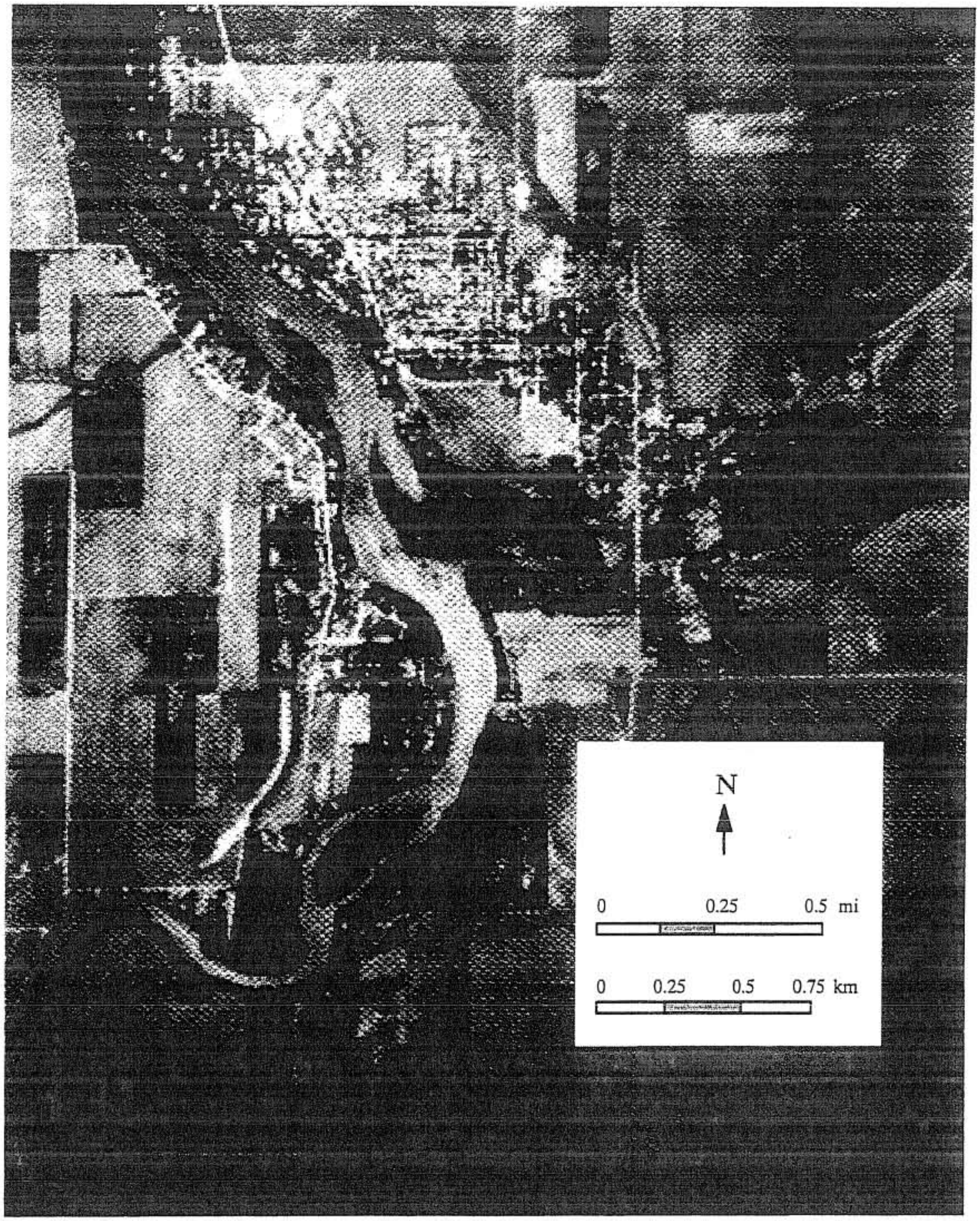


Figure 1.1 Natural channel width variation at the confluence of the Kankakee and Iroquois rivers, Illinois

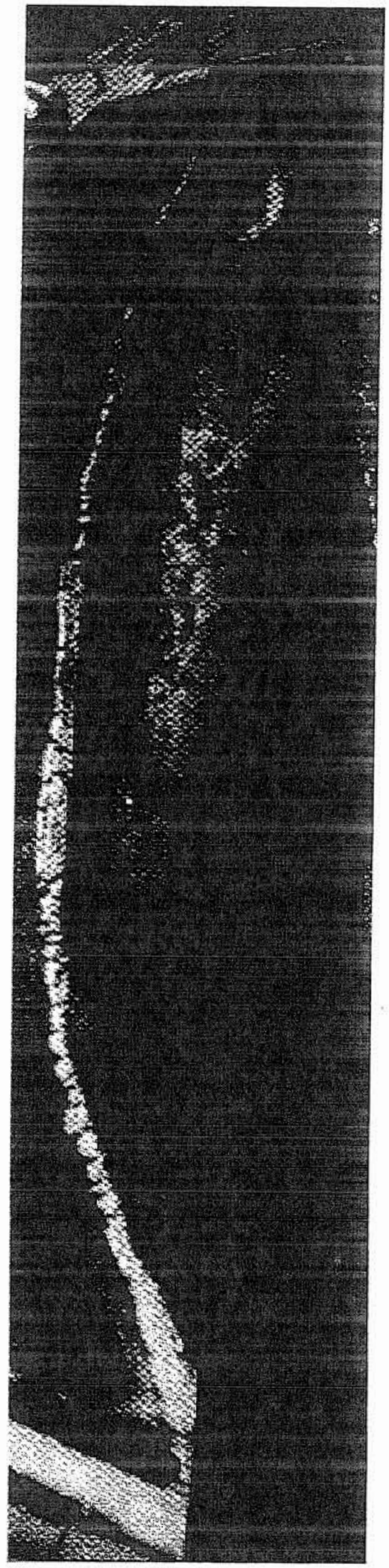


Figure 1.2 Man-made width variation on the Boneyard Creek in Urbana, IL

herein is on the impact of channel width on bed deformation. A great deal of research has been conducted on sediment deformation in channels of uniform width, particularly with respect to the alternate bar phenomenon. Alternate bars are bedforms characterized by a sequence of diagonal fronts having a vertical scale on the order of the flow depth and a horizontal scale on the order of the channel width. One of the goals of this research is to compare the alternate bar characteristics found for channels of uniform width with those, if any, found in the laboratory experiments of the present investigation.

With the aim of obtaining the information discussed above, one- and two- dimensional models are proposed which describe the phenomena that occur in a channel having a sinusoidally varying width. From the one-dimensional model, the variation in streamwise velocity, flow depth, and bed elevation over the length of the channel at equilibrium may be obtained, as well as parameters such as the maximum scour, maximum bar height, and the lag between the narrowest channel cross section and the location of the maximum scour. The two-dimensional model is useful for specifying the velocity profiles, the variation in the flow depth, and the bed deformation in the streamwise and transverse directions for equilibrium conditions.

Verification for the proposed models is provided by experimental evidence. Laboratory experiments were conducted in a tilting, recirculating flume located in the Hydrosystems Laboratory at the University of Illinois in Urbana-Champaign. A straight channel of sinusoidally varying width having an erodible, non-cohesive bed and inerodible sidewalls was placed inside the flume. Two different perturbations of the channel width were tested as well as the effects of three different bed slopes. From the resulting data, variables such as maximum scour, maximum bar height, and the lag between the narrowest channel cross section and the location of the maximum scour, were elicited for comparison with the values generated in the models. The variation of the bed deformation found in the experiments was also compared with that predicted by the models for validation purposes.

2. LITERATURE REVIEW

2.1 Introduction

In the first half of the 1900's, it was widely accepted that during periods of high discharge, there was general bed scour in natural streams. Measurements of flow depth at gaging stations and local scour at bridge piers confirmed the idea that the entire stream bed experienced scour during flood events and then deposition as the flood waters receded. However, measurements of sediment concentration at high discharges were not large enough to support the idea of general bed scour, and questions arose concerning the destination of the scoured material and the origin of the material that replaced it. Since flow depth and local scour measurements were usually gathered at narrow stream sections, it was concluded that during floods, scour occurred at narrow sections of a stream and deposition occurred in the wide stream sections (Lane and Borland, 1953).

Since then, many researchers have conducted laboratory experiments, numerical experiments, and field data analyses supporting the idea that scour occurs at narrow channel sections. Because the emphasis concerning channel width effects is centered mostly on the amount and location of scour, the objective of the research conducted has been to find a means of calculating the equilibrium depth, bed slope, and bed elevation in a channel of varying width. The effects of channel width on bedforms, however, has been generally overlooked.

2.2 Width Effects

Exner (1925) was the first to devise a model for width effects on channel bed deformation. By examining the continuity equation, he stated that deposition is expected where there are diverging streamlines, i.e. where the channel width widens, and erosion where there are converging streamlines, i.e. where the channel width narrows. In addition, he combined continuity with the idea that the time rate of change of the bed elevation is proportional to the change in velocity with respect to the streamwise axis leading to the equation:

$$\frac{\partial \eta^*}{\partial t^*} = \frac{K}{B^{*2} D^*} \frac{\partial B^*}{\partial s^*} - \frac{K}{B^* D^{*2}} \frac{\partial \eta^*}{\partial s^*} \qquad (2.1)$$

where η^* is the bed elevation, t^* is time, K is a constant, B^* is the channel width, D^* is the channel depth, and s^* is the streamwise direction. Equation (2.1) shows that if B^* is small, which corresponds to a channel contraction, then the rate of change in the bed elevation is large. In other words, sediment moves faster in the narrow portions of a stream than in wider stream sections.

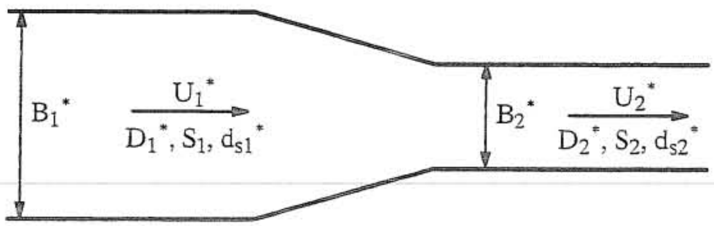


Figure 2.1 Plan view of a long contraction

Much of the experimental research conducted on river bed deformation due to channel width effects has focused on a long contraction in a channel as shown in Figure 2.1 in which U^* is the mean streamwise velocity, S is the bed slope, d_s^* is the mean sediment size, the subscripts 1 and 2 represent the uncontracted and contracted sections, respectively, and the other variables are as described previously. Straub (1934) was the first to perform experiments on the effects of a contraction on a sediment bed and to compare the results to field observations. He used the concept of dynamic equilibrium in which the amount of sediment entering and leaving a contraction is the same. Using a mobile sand bed with non-erodible sidewalls, Straub found that at equilibrium, the bed elevation in the contraction was much lower than in the uncontracted section and that the depth of scour increases with increasing discharge. Based on Manning's (1891) equation for mean flow velocity and DuBoys' (1879) bedload transport equation, he formulated a complicated expression for the equilibrium flow depth in the contracted section which was a function of the depth in the uncontracted section, the variation in width, the bed shear stress, and the slope of the hydraulic gradient in the uncontracted section.

After Straub (1934), several other researchers put forth relations to compute the equilibrium depth in a narrow section. Laursen and Toch (1954) considered the effects of overbank flow, the variation in width, and the roughness. Komura (1966) used an experimental analysis to find the dependence of the equilibrium depth on the Froude number, the variation in width, and the variation of the sediment size. The relation is:

$$\frac{D_2^*}{D_1^*} \sim F_1^{\ 1/5} \left(\frac{B_1^*}{B_2^*}\right)^{2/3} \sigma_{g1}^{\ -1/5} \qquad (2.2)$$

where F_1 is the Froude number in the uncontracted section and σ_{g1} is the standard deviation of the sediment size distribution in the uncontracted section. Colby (1964) combined the continuity equation with a field measurement analysis of bedload transport and observed three significant trends concerning the average depth of scour at equilibrium. From the computations, he concluded that the scour depth increased with increasing discharge, that for a given flow rate, the scour depth was directly proportional to the reduction in width, and that the scour depth was independent of the length of reach between the narrow and wide sections. For comparison, Colby (1964) examined streamflow and average bed position measurements from the Missouri River in South Dakota which demonstrated that a higher discharge creates a larger scour depth.

Following the ideas mentioned above, Garde and Range Raju (1985) utilized the continuity equations for water and sediment with a sediment transport power law and their own resistance equation to produce relationships for the equilibrium bed slope and depth given only the change in channel width. The assumptions to obtain the equations below include steady flow, a wide rectangular channel, and equivalent bed material size and regime of flow in the uncontracted and contracted sections:

$$\frac{D_2^*}{D_1^*} = \left(\frac{B_1^*}{B_2^*}\right)^{\frac{12N}{7(1+2N)}} \qquad (2.3)$$

$$\frac{S_2}{S_1} = \left(\frac{B_1^*}{B_2^*}\right)^{\frac{2}{1+2N}} \frac{D_1^*}{D_2^*} \qquad (2.4)$$

Here, N is the exponent found in the general sediment transport law:

$$\frac{q_s^*}{\gamma_s u_*^* d^*} = c\left(\tau^*\right)^N \qquad (2.5)$$

where $q_s{}^*/\gamma_s u_*{}^* d^*$ is a dimensionless sediment discharge per unit width, c is a constant and τ^* is the dimensionless shear stress on the bed. An N value of 2 represents only bedload transport and gives an exponent in (2.3) of 0.686, whereas for total load transport, which is the sum of bedload transport and suspended load transport, the value of N is 4 and an exponent of 0.760 results. Field data measured by Griffith (1939) produced an exponent of 0.637. Anderson and Davenport (1968) achieved similar results quoting an exponent value between 0.643 and 0.857.

A more general relationship was developed by Hotchkiss (1990) by using the St. Venant equations for momentum and continuity, a simple expression for sediment continuity, and (2.5). It should be noted that the channel configuration was slightly different than in the earlier works. The channel width was a function of the streamwise coordinate where that function was defined as a deviation from a uniform channel of width, B_o, depth, D_o, and bed slope, S_o. Hotchkiss assumed that the channel was very wide, that bedforms had no impact on the sediment height, and that normal flow conditions existed for a time long enough to establish equilibrium conditions , however, pressure and inertial terms encountered in non-uniform flow were taken into account. The resulting dimensionless equations for the equilibrium depth and bed slope are:

$$D = B^{\frac{1-2N}{2N}} \qquad (2.6)$$

$$S = B^{\frac{2N-3}{2N}} - \frac{1}{\omega}\frac{dB}{ds}\left(\frac{1-2N}{2N}F_o^{-2}\,B^{\frac{1-4N}{2N}} - \frac{1}{2N}B^{\frac{-1-N}{N}}\right) \qquad (2.7)$$

where D and B are made dimensionless with $B_o{}^*$, F_o is the Froude number in the uniform width channel, and ω is $B_o{}^*C_f/D_o{}^*$ where C_f is the friction coefficient. If B is a given function of s, then (2.7) can be integrated to yield a relation for the dimensionless deviation from the linearly sloping sediment bed. If (2.6) is worked into the equivalent form of (2.3), the exponent of (2.6) for N=2 is 0.75 and for N=4 is 0.875 which are similar to those found by Garde and Ranga-Raju (1985).

Using this analysis, Hotchkiss developed an expression for the equilibrium depth in a rectangular channel with a small perturbation from the uniform width. The perturbed width took the form:

$$B = 1 + \epsilon \sin(\lambda s) \qquad (2.8)$$

where ε is the dimensionless perturbation amplitude, λ, the dimensionless wavenumber, is $2\pi B_o{}^*/L^*$, and L^* is the perturbation wavelength. Using the expression for B in combination with (2.6) and (2.7), Hotchkiss found the dimensionless equations:

$$D = 1 + \epsilon \sin(\lambda s)\left(\frac{1-2N}{2N}\right) \qquad (2.9)$$

$$S = 1 + a \sin(\lambda s + \delta) \qquad (2.10)$$

and

$$\eta = S_o\left[\frac{a}{\lambda}\cos(\lambda s + \delta) - s\right] \qquad (2.11)$$

where η is the deviation from the mean bed elevation, a is the slope perturbation amplitude, and δ is the phase lag. The equations showed that with no phase lag, the deepest section occurred at the point of maximum curvature in the narrowing channel section and the shallowest section occurred at the point of maximum curvature in the widening channel section. Hotchkiss equated this condition to bankfull flow and noted that the observations of Lane and Borland (1953) supported the analysis.

Tsujimoto (1987) performed experiments in a channel having the geometry described by (2.8) where $B_o{}^*$=0.19 m, ε=0.210, and L=0.40 m, and made an attempt to characterize the flow field and the equilibrium transverse bed profile. Tsujimoto used a potential flow model based on an equation derived by Kennedy (1964) to compute the plane distribution of the flow velocities in the streamwise and transverse directions. The model was found to agree well with the experimental data. Concerning the equilibrium transverse bed profile, Tsujimoto came to the conclusion that at the narrow channel sections, the transverse profile is convex in shape, and at wide sections, the profile is concave. This assertion was also verified by his experiments.

2.3 Alternate Bars

To date, little research has been performed on the effects of channel width on bedforms in an open channel, however extensive work has been done on alternate bars and related phenomena in straight channel and meandering channels of constant width. An example of an alternate bar pattern in a straight channel of uniform width is shown in Figure 2.2. The first theoretical analyses of alternate bars were developed in the late 1960s using linear stability theories. These theories have been continually improved over the last two decades and a comprehensive understanding of the formation of alternate bars in a channel of constant width now exists.

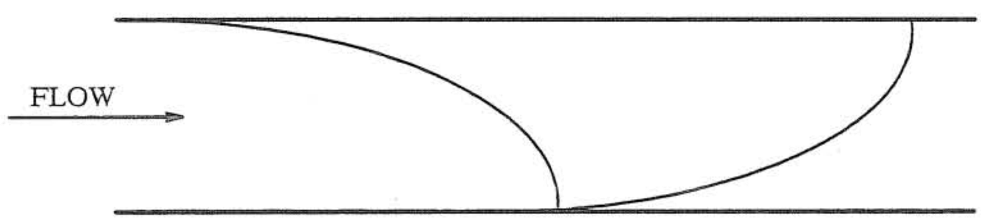


Figure 2.2 Definition sketch of alternate bars in a channel of uniform width

The theory of alternate bar formation is based on the understanding that a flat, non-cohesive sediment bed may, under certain flow conditions, become unstable causing the formation of migrating perturbations characterized by a growing amplitude and a downstream migration speed. Analytically, the theory consists of the two-dimensional St. Venant equations coupled with the Exner sediment continuity equation. A linearization is performed assuming that the quasi-steady approximation holds, and a perturbation is added to the mean variables. The result, as obtained by Blondeaux and Seminara (1985), is a relationship between the wavelength, celerity, and amplitude of the bars and the flow and sediment characteristics.

One problem with the linear theory of alternate bar formation is that it predicts exponential amplitude growth, while in the laboratory, a finite amplitude of bar perturbations has been observed. Ikeda (1984) obtained empirical relations for the equilibrium finite bar amplitude as well as the equilibrium wavelength using data from several experimental studies including his own. A weakly nonlinear theory developed by Colombini, Seminara, and Tubino (1987) has been successful in predicting the equilibrium finite bar amplitude as a function of the channel half-width to depth ratio, the grain size to flow depth ratio, and the bed shear stress.

There are other problems with the linear theory. It is only valid for certain ideal assumptions such as steady flow, uniform sediment, and the like. Also, it cannot describe two important phenomena which have been found to occur in experimental studies such as those of Kinoshita and Miwa (1974), Colombini, Tubino and Whiting (1990), and Niño and García (1992). The first problem is that the linear theory predicts much higher peaks in the flow and bed response near resonance than are found to occur in experiments. The resonance phenomenon is the term used to describe the occurrence of vanishing growth rate and migration speed of bar perturbations for a certain range of values of the wavenumber. The second problem is the inability to account for the simultaneous existence of fixed and migrating bars, also called forced and free bars, respectively. More recently, Tubino and Seminara (1990) and Seminara and Tubino (1992) have developed weakly nonlinear theories which are able to account for some of the complexities of these problems.

As stated previously, the knowledge of alternate bars presented above applies only to channels of uniform width. One of the goals of this research is to observe the effects of channel width on bedforms and to see if the results obtained are comparable to results found for constant width channels.

3. THEORETICAL ANALYSIS

3.1 Introduction

Both one- and two- dimensional models are developed to describe different aspects of the impact of channel width on bed deformation. In an attempt to find the equilibrium depth, bed elevation, and velocity profiles along the channel length as well as related parameters such as maximum scour and maximum bar height in a channel of varying width, a one-dimensional model is proposed. As a means to find the variation in velocity, flow depth, and bed elevation in the streamwise and transverse directions at equilibrium, and specifically the equilibrium shape of the bed deformation in a given cross section, a two-dimensional model is developed. The models are based on and similar to the work of Blondeaux and Seminara (1985) and Colombini et al. (1987), however for this research, the channel width is a sinusoidal function of the distance in the streamwise direction. The one-dimensional model is compared to the theory developed by Hotchkiss (1990).

3.2 One–Dimensional Model

Consider a steady, fully turbulent, uniform flow in a straight, rectangular channel with fixed banks having a sinusoidal shape so that an alternating pattern of narrow and wide sections is formed. The bed is erodible and the non-cohesive sediment is assumed to be transported in steady state, that is, an equilibrium has been reached in the channel. The flow is one-dimensional meaning that the velocity, flow depth, and bed elevation vary only in the streamwise direction.

The problem is described using the depth-averaged and width-averaged governing equations which include the shallow water St. Venant equation in the streamwise direction and the continuity equation of the flow. Invoking the quasi-steady approximation which states that changes in the flow take place much more quickly than changes in the bed elevation, the equations are:

$$U^* \frac{\partial U^*}{\partial s^*} = -g\left(\frac{\partial D^*}{\partial s^*} - S_o + \frac{\partial \eta^{*\prime}}{\partial s^*}\right) - \frac{\tau_s^*}{D^*} \qquad (3.1a)$$

$$Q_w^* = 2B^* D^* U^* \qquad (3.1b)$$

where D^* is the local mean flow depth, B^* is the local channel half-width, U^* is the local mean flow velocity, s^* is the coordinate in the streamwise direction, S_o is the bed slope, $\eta^{*\prime}$ is the local mean bed deviation above the general mean bed elevation which is given by the bed slope, τ_s^*

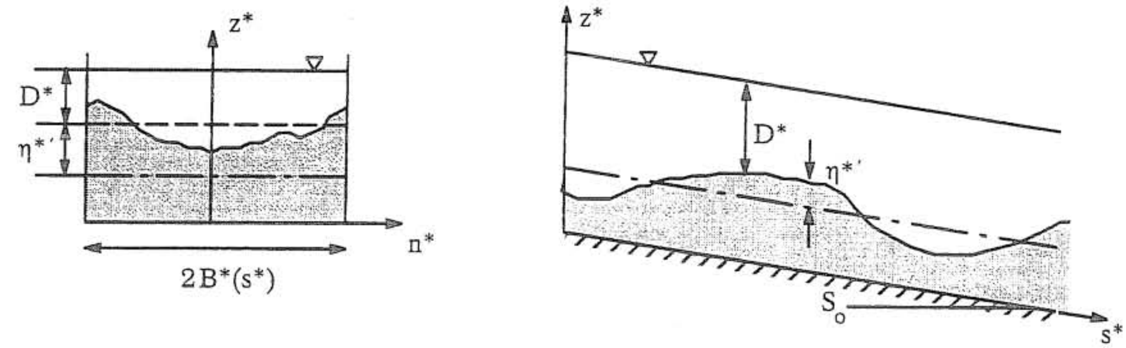


Figure 3.1 Definition of Variables

is the bed shear stress, ϱ is the water density, and $Q_w{}^*$ is the flow discharge. Multiplying (3.1a) by D^*B^* and manipulating the first term yields the following set of relations:

$$\frac{\partial(D^*B^*U^{*2})}{\partial s^*} = -\, gD^*B^*\left(\frac{\partial D^*}{\partial s^*} - S_o + \frac{\partial \eta^{*\prime}}{\partial s^*}\right) - B^*\frac{\tau_b^*}{\varrho} \qquad (3.2a)$$

$$Q_w^* = 2B^*D^*U^* \qquad (3.2b)$$

If it is assumed that the sediment transport is predominantly bedload and that the bed deformation has reached equilibrium, then the continuity of sediment equation is defined as:

$$Q_s^* = 2B^*q_s^* \qquad (3.3)$$

where $Q_s{}^*$ is the bedload discharge and $q_s{}^*$ is the bedload discharge per unit width. Some of the parameters are described in Figure 3.1.

In order to close the set of equations, it is necessary to have expressions for flow resistance and bedload transport. The resistance relationship utilized is:

$$\frac{\tau_b^*}{\varrho} = C_f U^{*2} \qquad (3.4a)$$

where

$$C_f = \left[6 + 2.5\ln\left(\frac{D^*}{2.5d_s^*}\right)\right]^{-2} \qquad (3.4b)$$

which is the Engelund-Hansen equation for flat bed conditions. The flat bed relation is appropriate because the bed is assumed to be only slightly perturbed from the condition of steady, uniform flow in a straight channel. In (3.4b), d_s^* is the mean sediment grain size. The sediment transport rate is described by the Engelund-Hansen formula:

$$q_s = \Phi = \frac{0.05}{C_f}\theta^{\frac{5}{2}} \tag{3.5a}$$

where θ is the Shields parameter defined as:

$$\theta = \frac{\tau_o^*}{(\rho_s - \rho)\, g\, d_s^*} \tag{3.5b}$$

where τ_o * is the normal bed shear stress and ϱ_s is the sediment density. The dimensionless sediment transport, q_s, from (3.5a) is related to the dimensional sediment transport, q_s *, from (3.3) by Einstein (1950):

$$q_s = \frac{q_s^*}{\sqrt{R\, g\, d_s^{*3}}} \tag{3.6}$$

where R, the submerged specific gravity of the sediment, is $(\varrho_s/\varrho)-1$.

The other variables are made dimensionless using half of the average channel width, B_o *, as the length scale, the mean normal velocity, U_o *, as the velocity scale, and B_o */U_o * as the time scale. For some of the parameters such as the depth, the bed elevation, and the sediment size, it is more convenient to use the mean normal depth, D_o *, as the length scale. The resulting dimensionless variables are $s=s^*/B_o^*$, $n=n^*/B_o^*$, $B=B^*/B_o^*$, $D=D^*/D_o^*$, $U=U^*/U_o^*$, $\eta'=\eta^{*\prime}/D_o^*$, and $d_s=d_s^*/D_o^*$. A width to depth ratio may also be defined as $\beta=B_o^*/D_o^*$. Substituting these variables and (3.4a) into (3.2) and (3.3) yields the following dimensionless governing equations:

$$\frac{\partial\, BDU^2}{\partial s} = -\frac{DB}{F_o^2}\left(\frac{\partial D}{\partial s} - \beta S_o + \frac{\partial \eta'}{\partial s}\right) - \beta B C_f U^2 \tag{3.7a}$$

$$BDU = 1 \tag{3.7b}$$

$$B\frac{q_s}{q_{so}} = 1 \tag{3.7c}$$

where F_o is the Froude number, q_{so} is the bedload transport per unit width and their subscript denotes values computed with normal flow variables, D_o *, U_o * and B_o * or values corresponding to the base state.

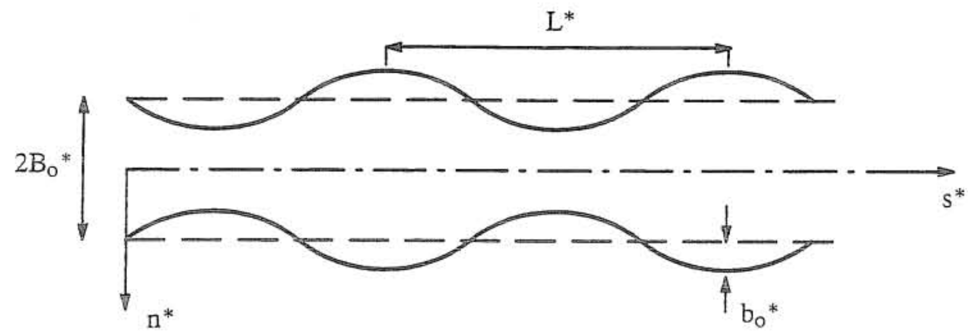


Figure 3.2 Plan view of channel width variation

The above equations are valid for a channel with any choice of width function. In this work, a sinusoidal channel width consisting of a small perturbation from a mean channel width is considered. The varying width takes the dimensionless form:

$$B = 1 + \epsilon \sin(\lambda s) \tag{3.8}$$

where ε is the dimensionless perturbation defined as b_o^*/B_o^* and the dimensionless wavenumber, λ, is $2\pi B_o^*/L^*$. The plan view, showing b_o^*, B_o^*, and L^*, is shown in Figure 3.2.

It is now assumed that all the flow variables in (3.7) are perturbed from the base state of uniform flow in a straight channel of width, $2B_o^*$, in the same manner as the channel width. In doing so, the equations can be linearized as long as the perturbation is small compared to the channel width. This condition may be written as $\varepsilon \ll 1$. The resulting terms are then expanded to the first order in ε, noting that $sin(\lambda s) = -0.5\ [\ i\ exp(\ i\lambda s\ ) + c.c.]$:

$$U = 1 + \epsilon (\mathcal{U} e^{i\lambda s} + c.c.) + O(\epsilon^2) \tag{3.9a}$$

$$D = 1 + \epsilon (\mathcal{D} e^{i\lambda s} + c.c.) + O(\epsilon^2) \tag{3.9b}$$

$$\eta' = 0 + \epsilon (\mathcal{F} e^{i\lambda s} + c.c.) + O(\epsilon^2) \tag{3.9c}$$

where $c.c.$ represents the complex conjugate. At this linear level, only fully developed, non-migrating, steady-state bed deformation with a longitudinal dimensionless wavenumber, λ, is considered. Any interaction between migrating bedforms and the steady forced bed deformation introduced by the variable width is neglected.

The closure equations are treated similarly which leads to the relations:

$$\tau_s = C_{fo} + \epsilon (\mathcal{T} e^{i\lambda s} + c.c.) + O(\epsilon^2) \tag{3.10a}$$

$$q_s = \Phi_o + \epsilon (\mathcal{Q} e^{i\lambda s} + c.c.) + O(\epsilon^2) \tag{3.10b}$$

where C_{fo} and Φ_o are the resistance coefficient and Engelund-Hansen sediment transport in the base state, respectively. The parameters, $\mathcal{T}$ and $\mathcal{Q}$, may be described in terms of $\mathcal{U}$, $\mathcal{D}$, and $\mathcal{F}$ by a perturbation at O(ε) of each term in the resistance and bedload relationships given in (3.4a) and (3.5a). The perturbed resistance relation is obtained by using (3.9a) and an expression for the perturbation of the resistance coefficient which is assumed to be a function of the flow depth and θ:

$$C_f = C_{fo} + \left.\frac{\partial C}{\partial D}\right|_{D=1} (D - 1) + \left.\frac{\partial C}{\partial \theta}\right|_{\theta=\theta_o} (\theta - \theta_o) + h.\ o.\ t. \qquad (3.11a)$$

The perturbed bedload relationship is found by perturbing Φ which is also a function of the flow depth and θ:

$$\Phi = \Phi_o + \left.\frac{\partial \Phi}{\partial D}\right|_{D=1} (D - 1) + \left.\frac{\partial \Phi}{\partial \theta}\right|_{\theta=\theta_o} (\theta - \theta_o) + h.\ o.\ t. \qquad (3.11b)$$

Equating the term by term perturbed resistance and bedload relations with (3.10) leads to the following expressions for $\mathcal{T}$ and $\mathcal{Q}$:

$$\mathcal{T} = C_{fo} (s_1 \mathcal{U} + s_2 \mathcal{D}) \qquad (3.12a)$$

$$\mathcal{Q} = \Phi_o (f_1 \mathcal{U} + f_2 \mathcal{D}) \qquad (3.12b)$$

where

$$s_1 = 2 (1 - C_T)^{-1} \quad , \quad s_2 = C_D (1 - C_T)^{-1} \qquad (3.13a)$$

$$f_1 = \Phi_T\, s_1 \quad , \quad f_2 = \Phi_D + \Phi_T\, s_2 \qquad (3.13b)$$

and

$$C_T = \frac{\theta_o}{C_{fo}}\left.\left(\frac{\partial C}{\partial \theta}\right)\right|_{\theta=\theta_o}, \quad C_D = \frac{1}{C_{fo}}\left.\left(\frac{\partial C}{\partial D}\right)\right|_{D=1}, \quad \Phi_T = \frac{\theta_o}{\Phi_o}\left.\left(\frac{\partial \Phi}{\partial \theta}\right)\right|_{\theta=\theta_o}, \quad \Phi_D = \frac{1}{\Phi_o}\left.\left(\frac{\partial \Phi}{\partial D}\right)\right|_{D=1} \qquad (3.14)$$

Simpler relations for the terms s_1, s_2, f_1, and f_2 can be obtained by combining the Engelund-Hansen transport equation, (3.5a), with the flat-bed Engelund-Hansen resistance relation, (3.4b). The results are:

$$s_1 = 2 \quad , \quad s_2 = -5\sqrt{C_{fo}} \quad , \quad f_1 = 5 \quad , \quad f_2 = -7.5\sqrt{C_{fo}} \qquad (3.15)$$

Inserting (3.9) and (3.10) into (3.7) yields a system of equations to be solved for $\mathcal{U}$, $\mathcal{D}$, and $\mathcal{F}$:

$$\begin{bmatrix} 2\,i\,\lambda + \beta\, C_{fo}\, s_1 & i\,\lambda\left(1+\frac{1}{F_o^2}\right) - \beta\frac{S_o}{F_o^2} + \beta\, C_{fo}\, s_2 & \frac{i\,\lambda}{F_o^2} \\ 1 & 1 & 0 \\ f_1 & f_2 & 0 \end{bmatrix} \begin{bmatrix} \mathfrak{U} \\ \mathfrak{D} \\ \mathfrak{F} \end{bmatrix} = \begin{bmatrix} -\frac{\lambda}{2} \\ 0 \\ 0 \end{bmatrix} \qquad (3.16)$$

Solving the system (3.16) and placing the solutions of $\mathfrak{U}$, $\mathfrak{D}$, and $\mathfrak{F}$ in (3.9) gives:

$$U = 1 + \epsilon\frac{|k_2|}{2}\exp\left[i\left(\lambda s + sgn\,[k_2]\frac{\pi}{2}\right)\right] \qquad (3.17a)$$

$$D = 1 + \epsilon\frac{|k_1|}{2}\exp\left[i\left(\lambda s + sgn\,[k_1]\frac{\pi}{2}\right)\right] \qquad (3.17b)$$

$$\eta' = \epsilon\frac{F_o^2}{2}\sqrt{k_3^2 + k_4^2}\,\exp\left[i\left(\lambda s + \operatorname{atan}\frac{k_4}{k_3}\right)\right] \qquad (3.17c)$$

where

$$k_1 = \frac{1 - f_1}{f_2 - f_1} \qquad\qquad k_2 = \frac{f_2 - 1}{f_2 - f_1} \qquad (3.18a)$$

$$k_3 = \frac{\beta C_{fo}}{\lambda}\left[k_1(\,1 - s_2\,) - s_1\right] \qquad\qquad k_4 = 1 - 2k_2 - \left(1 + \frac{1}{F_o^2}\right)k_1 \qquad (3.18b)$$

and *sgn* is an operator which takes into account only the sign of the variable and not the magnitude. The equation for the channel width may be arranged similarly as:

$$B = 1 + 0.5\epsilon\,\exp\left[i\left(\lambda s - \frac{\pi}{2}\right)\right] \qquad (3.19)$$

Therefore, given the channel geometry, the sediment properties, and the normal flow parameters, the average local streamwise velocity, flow depth, and bed elevation at equilibrium can be calculated. For example, if a problem is specified such that the mean flow depth is 1.0 meter, the river slope is 0.0009, the mean river half-width is 40 m, the mean sediment size is 0.45 mm, the wavelength of the channel width perturbation is 800 m, and the dimensionless perturbation, ε, is 0.10, then the solutions are shown as in Figure 3.3. The mean velocity and flow depth are smallest where the channel is widest and largest where the channel is narrowest. The deviation from the mean bed elevation lags the channel width somewhat.

The lags shown in Figure 3.3 may be described as follows. The exponential portions of (3.17) and (3.19) have the form of $exp(\lambda s+\delta)$ where δ is a phase angle shift. A relative phase shift or lag may be defined by subtracting the lag of (3.17) from that of (3.19):

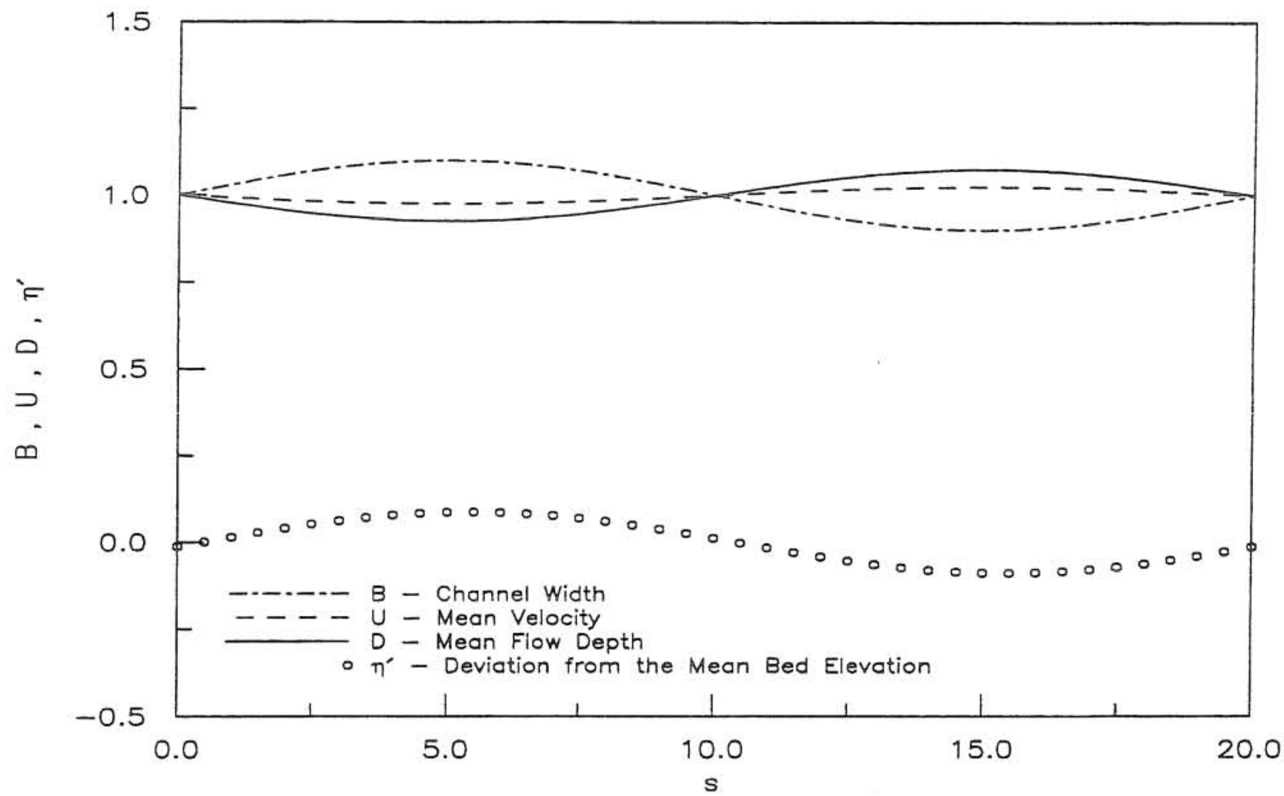


Figure 3.3 Results of the one-dimensional theory for the example problem

$$\delta_U = -\left(\frac{\pi}{2} + sgn\,[k_2]\,\frac{\pi}{2} \right) \tag{3.20a}$$

$$\delta_D = -\left(\frac{\pi}{2} + sgn\,[k_1]\,\frac{\pi}{2} \right) \tag{3.20b}$$

$$\delta_{\eta'} = -\left(\frac{\pi}{2} + \text{atan}\,\frac{k_4}{k_3} \right) \tag{3.20c}$$

in which a positive value of δ indicates that there is a phase lag in the downstream direction. Figure 3.4 shows the behavior of k_1, k_2, and $atan(k_4/k_3)$ as a function of d_s and θ. The plots of k_1 and k_2 show no dependence on θ due to the resistance and bedload relationships used in this analysis. From Figure 3.4, it is observed that k_1 and k_2 are always positive for any values of d_s. Therefore, from (3.20a) and (3.20b), $\delta_U = \delta_D = \pi$, or the average streamwise velocity and the flow depth are always completely out of phase with the channel width which is consistent with what is observed in Figure 3.3. Figure 3.4 also demonstrates that $atan(k_4/k_3)$ does not vary much over the normal range of d_s and θ but maintains a value between 1.2 and 1.6. These values correspond to the conditions of $\beta = 20.0$ and $\lambda = 0.8$ which are similar to those used in the experimental study described in Chapter 4.

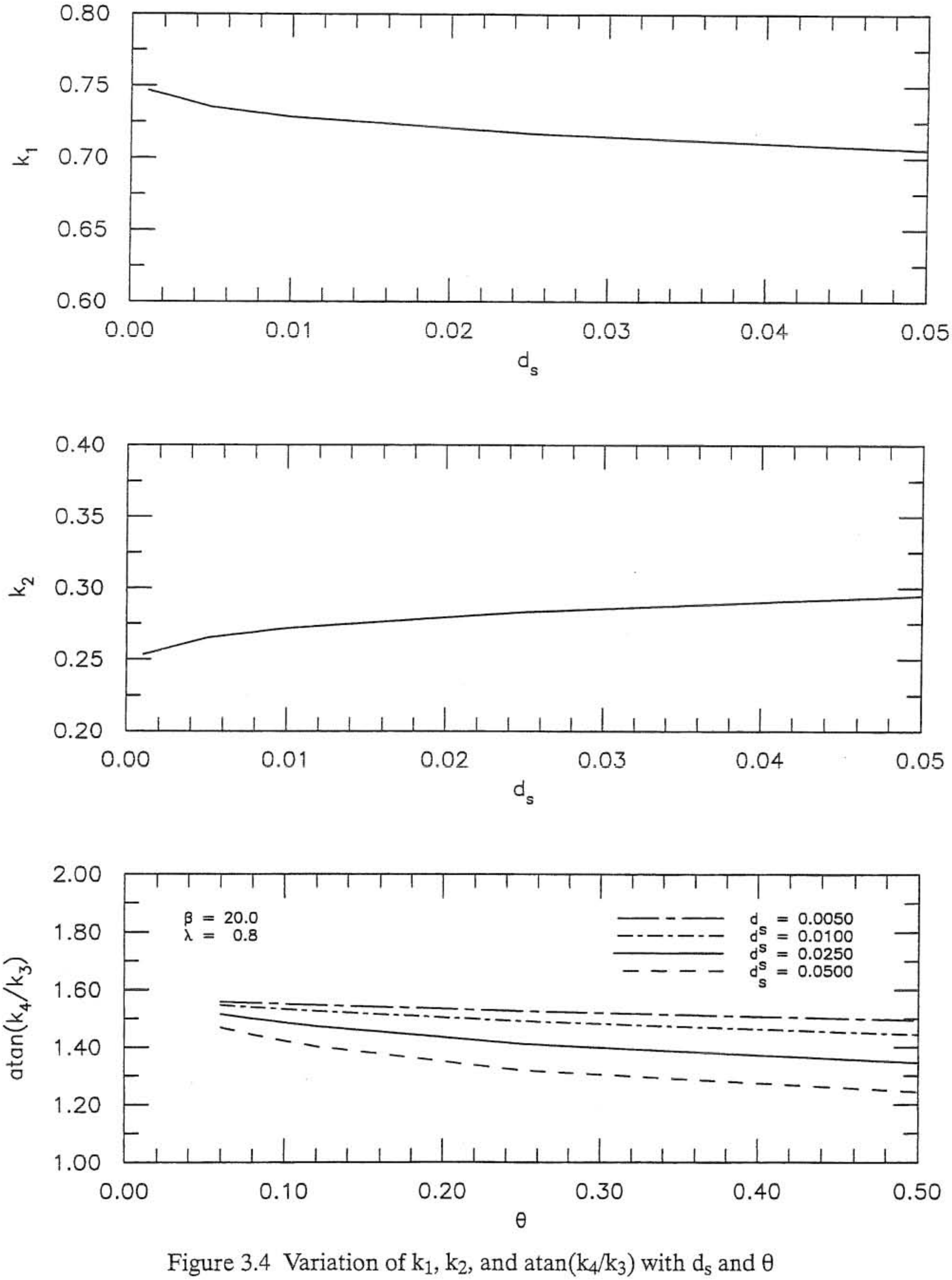


Figure 3.4 Variation of k_1, k_2, and atan(k_4/k_3) with d_s and θ

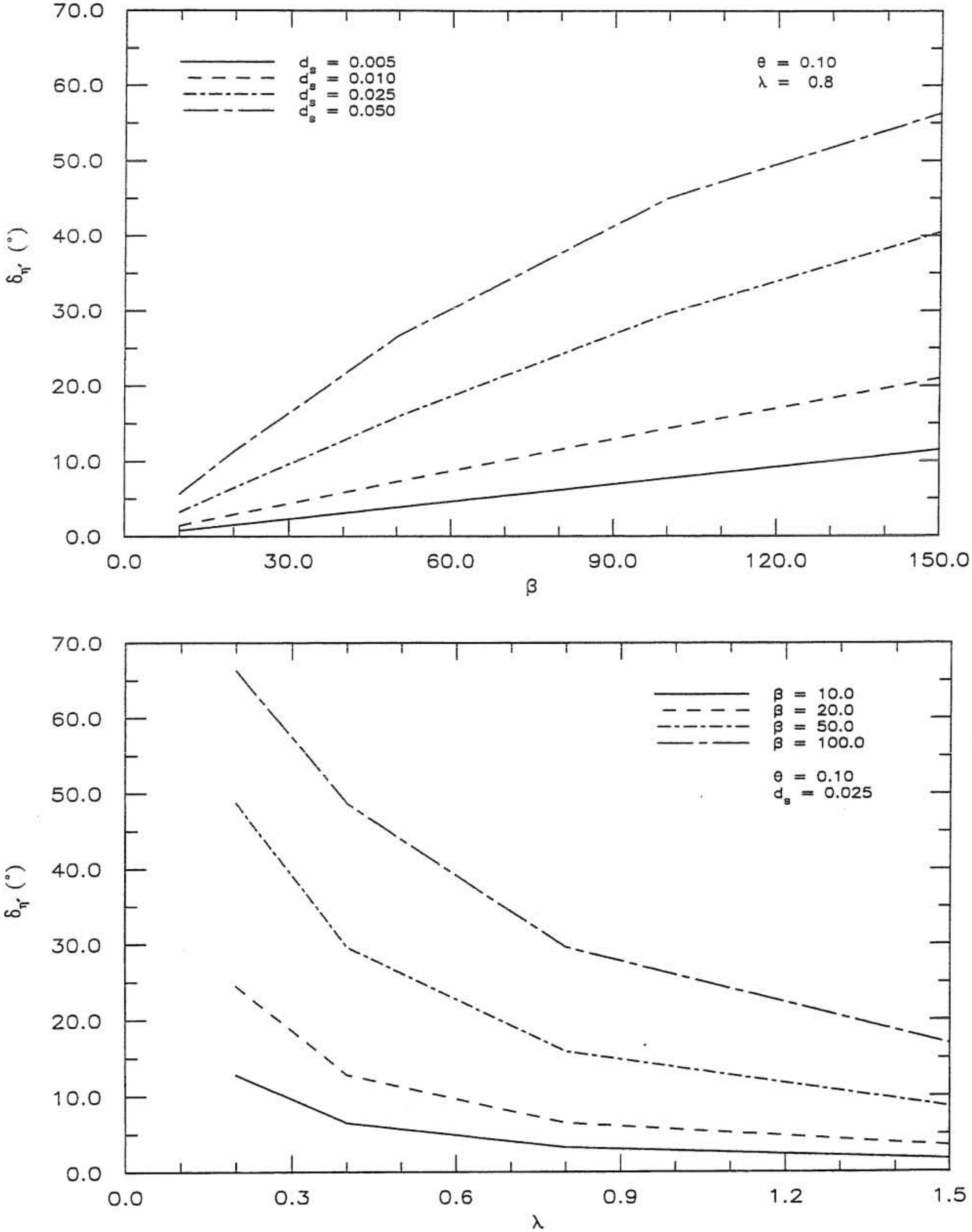


Figure 3.5 Lag of the deviation from the mean bed elevation, in degrees, as a function of β, λ, d_s, and θ

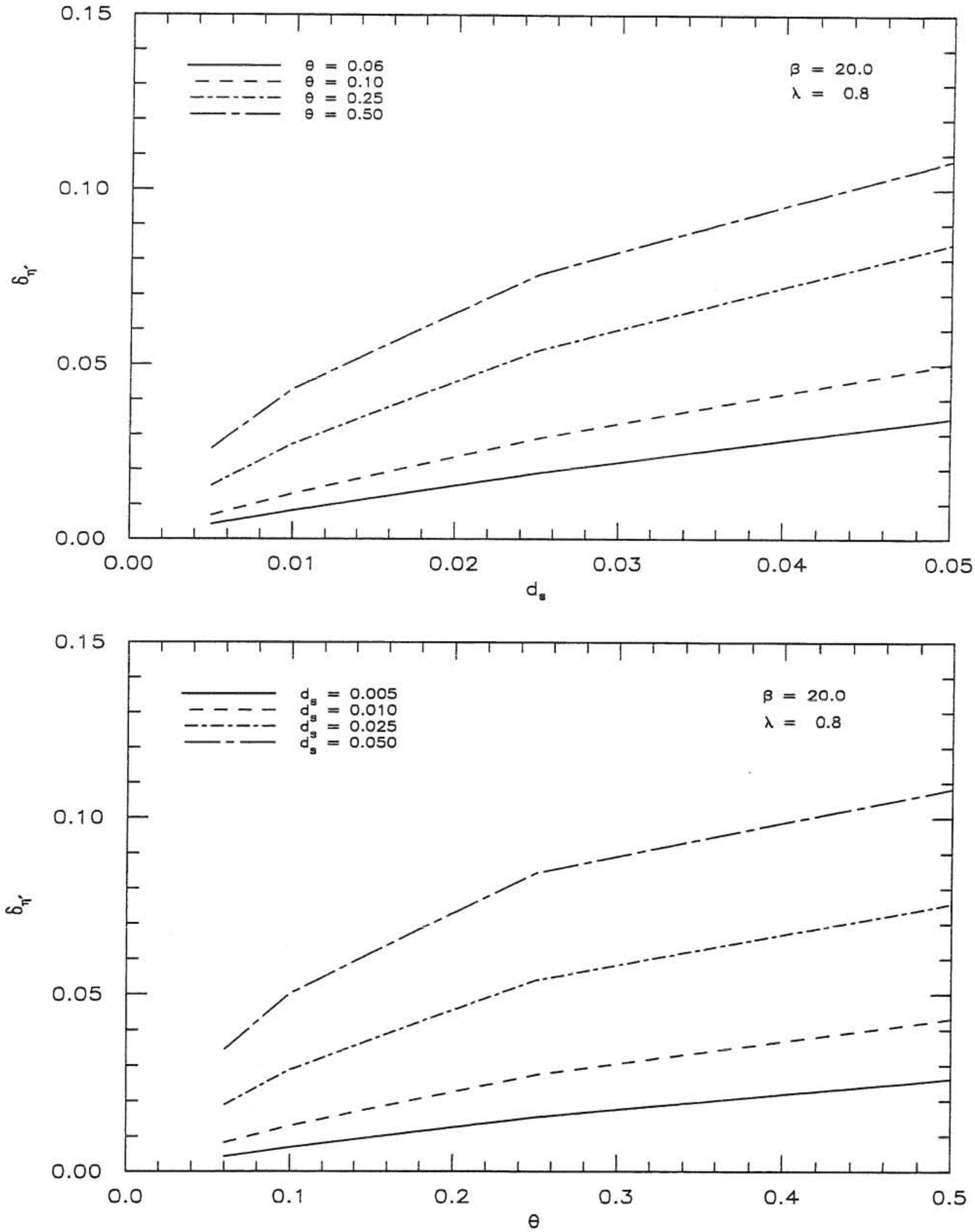


Figure 3.6 Lag of the deviation from the mean bed elevation, as a fraction of the wavelength, as a function of β, λ, d_s, and θ

The lag of the deviation from the mean bed elevation may be expressed in two ways. The first is as a phase angle shift in degrees, and the second is as a fraction of some distance, in this case, the wavelength of the channel width variation. Figure 3.5 and 3.6 show the variation in $\delta\eta'$ as a function of β, λ, d_s, and θ. The bed elevation lag in Figure 3.5 is presented in degrees whereas in Figure 3.6, it is shown as a fraction of the width variation wavelength of the channel. From the plots, it is observed that for an increase in β, which is equivalent to a decrease in the flow depth or the flow discharge, the value of $\delta\eta'$ increases. Conversely, $\delta\eta'$ decreases as the dimensionless wavelength increases which can be caused either by an increase in the mean channel width or a decrease in the wavelength of the channel width perturbation. Also, the lag of the bed elevation increases as the sediment size increases and as the Shields parameter increases. The values of the lag fall in the range of $0-70$ degrees which is equivalent to $0-0.15$ of the wavelength for all of the plots.

The derivation of the one-dimensional model includes many ideal assumptions. Only equilibrium conditions are taken into account, however most actual flood durations are not long enough to produce such conditions. Also, a one-dimensional, depth-averaged model is applied which implies that the velocity, flow depth, and bed elevation are averaged over the depth and the cross section. There may be local scour holes created by bedforms such as bar formations or dunes that can not be described by the model.

3.2.1 Comparison to the theory of Hotchkiss (1990)

To see how the present theory compares with others, an hypothetical field example is taken from Hotchkiss (1990). The example is based on data taken from the Minnesota River at Granite Falls, Minnesota and the parameters that must be specified for the present theory are those used to create Figure 3.3. They are $S=0.0009$, $B_o{}^*=40$ m, $d_s{}^*=0.45$ mm, $\lambda=0.3$, and $\varepsilon=0.10$. Three different flow rates causing three different mean depths are analyzed. The flow rates correspond to a flow exceeded 50 percent of the time, the mean annual discharge, and the bankfull discharge. The flow parameters and resulting lags are tabulated in Table 3.1.

TABLE 3.1 Parameters for the Hypothetical Field Case

				Hotchkiss theory	Present theory
Q (m^3/s)	D (m)	F_o	β	$\delta_{\eta'}$ (°)	$\delta_{\eta'}$ (°)
7.1	0.21	0.30	190	−84	36.5
22.4	0.43	0.32	93	−76	19.1
135.0	1.04	0.51	38	−4	14.3

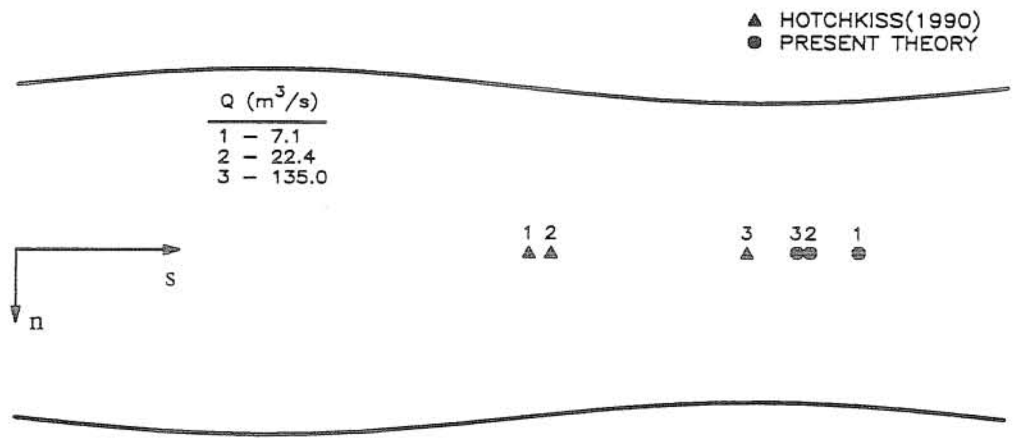


Figure 3.7 Maximum scour point locations for hypothetical field case

Figure 3.7 shows a plan view of the hypothetical field case with the position of maximum scour for each of the three flows as predicted by both theories. The filled triangles are the results from Hotchkiss (1990) and the filled circles are the results from the present theory. The numerals denote the different flow rates where 1, 2, and 3 represent 7.1 m^3/s, 22.4 m^3/s, and 135 m^3/s, respectively. The values found by Hotchkiss suggest that the point of maximum scour migrates downstream as the flow discharge increases. However, the results of the present theory shows the point of lowest bed elevation moving upstream with increasing discharge. Also, the positions of maximum scour in Hotchkiss (1990) are located upstream of the narrowest section with the maximum scour for the bankfull flow occurring precisely at the narrowest section, whereas all of the maximum scour points for the present theory occur after the narrowest section. It seems more likely for the point of maximum scour to be located after the narrowest section because the sediment transport is reacting to the change in channel width. The reaction does not take place instantaneously so there is a lag between the reduction of the channel width and the bed deformation.

3.3 Two-Dimensional Model

The problem description for the two-dimensional model is the same as for the one-dimensional model. The flow is assumed to be steady, uniform, and fully turbulent, and the bed is erodible and non-cohesive. The channel is straight, wide, and rectangular with fixed sidewalls, and the channel half-width has a sinusoidal variation described by (3.8) or equivalently (3.19). Sediment transport has reached an equilibrium state. Flow near the walls cannot be described because velocity gradients are important there, however the effect of secondary flow on sediment transport is included.

The two-dimensional St. Venant equations and the Exner equation for sediment continuity are used to analyze the system. The flow adjustment to bed variations is assumed to be a relatively fast process compared to the bed variation process itself, therefore the quasi-steady approximation is valid. The resulting dimensionless equations are:

$$U\frac{\partial U}{\partial s} + V\frac{\partial U}{\partial n} = -\frac{\partial H}{\partial s} - \frac{\beta \tau_s}{D} \qquad (3.21a)$$

$$U\frac{\partial V}{\partial s} + V\frac{\partial V}{\partial n} = -\frac{\partial H}{\partial n} - \frac{\beta \tau_n}{D} \qquad (3.21b)$$

$$\frac{\partial (UD)}{\partial s} + \frac{\partial (VD)}{\partial n} = 0 \qquad (3.21c)$$

$$\frac{\partial (F_o^2 H - D)}{\partial t} + Q_o\left[\frac{\partial Q_s}{\partial s} + \frac{\partial Q_n}{\partial n}\right] = 0 \qquad (3.21d)$$

where U and V are the depth-averaged velocities, τ_s and τ_n are the bed shear stresses, and Q_s and Q_n are the volumetric sediment flow rate per unit width components, all of which are in the streamwise and transverse directions, respectively. The water surface elevation is designated by H, and Q_o is defined by the relation:

$$Q_o = \frac{d_s^* \sqrt{(\rho_s/\rho - 1)\, g d_s^*}}{(1-p)\, D_o^*\, U_o^*} \qquad (3.22)$$

where p denotes the porosity of the sediment bed. All the other variables in (3.21) and (3.22) are as defined previously. The newly defined parameters are made dimensionless in the following way:

$$V^* = U_o^*\, V \qquad (3.23a)$$

$$H^* = D_o^*\, F_o^* H \qquad (3.23b)$$

$$(\tau_s^*, \tau_n^*) = \rho U_o^{*2}\, (\tau_s, \tau_n) \qquad (3.23c)$$

$$(Q_s^*, Q_n^*) = d_s^* \sqrt{(\rho_s/\rho - 1) g d_s^*}\, (Q_s, Q_n) \qquad (3.23d)$$

The system of equations (3.21) is homogeneous in nature, however the width variation introduces a forcing which is imposed through the boundary conditions. Considering that the channel walls are impermeable to both water and sediment flows, the boundary conditions for the problem can be written in dimensionless form as follows:

$$\boldsymbol{V} \cdot \boldsymbol{k} = \boldsymbol{Q} \cdot \boldsymbol{k} = 0 \qquad at \quad n = \pm B = \pm (1 + \epsilon \sin(\lambda s)) \qquad (3.24)$$

where $\boldsymbol{V}$ and $\boldsymbol{Q}$ denote the dimensionless velocity and sediment vectors, and $\boldsymbol{k}$ represents a unit vector which is locally normal to the channel walls.

Resistance and sediment transport relations are necessary to close the set of equations formed by (3.21) and (3.24). The resistance relationship is specified by:

$$(\tau_s , \tau_n) = (U,V) \sqrt{U^2 + V^2} \; C_f \tag{3.25}$$

where C_f is the given by the flat bed Engelund-Hansen resistance relation defined in (3.4b).

Like the 1-D model, bedload transport is assumed to be dominant, however the direction and intensity of the bedload transport due to secondary flow and transverse bed slope is accounted for using a model of the form (Engelund, 1981; Parker, 1984):

$$(Q_s , Q_n) = (\cos\delta , \sin\delta \;) \; \Phi_o \tag{3.26a}$$

$$\sin\delta = \frac{V}{\sqrt{U^2 + V^2}} - \frac{r}{\beta\sqrt{\theta}} \frac{\partial (F_o^2 - D \;)}{\partial n} \tag{3.26b}$$

where δ is the angle between the particle velocity direction and the streamwise direction, and r is taken to be equal to 0.3 from Colombini et al. (1987). The relationship for the bedload in an unperturbed, straight channel, Φ_o, is computed using the Engelund-Hansen formula given by (3.5).

In order to obtain a steady state solution for the flow and bed deformation in the channel under consideration, a linearization of the set of governing equations, boundary conditions, and closure relationships is performed, under the assumption that the amplitude of the width variation is small compared to the channel width itself, i.e. from (3.8), $\varepsilon \ll 1$. At the linear level, only the case of fully developed, non-migrating bed deformation of the longitudinal dimensionless wavenumber, λ, is considered, neglecting at this level any possible interaction between migrating bedforms and the steady forced bed deformation introduced by the variable width of the channel. To implement the linearization, a regular expansion in powers of ε is made, where the base state corresponds to the condition, $\varepsilon = 0$, which represents uniform flow in a straight channel of width $2B_o{}^*$, having a mean velocity, $U_o{}^*$, and a depth, $D_o{}^*$, such that:

$$(U \; , \; V \; , \; D \; , \; \eta' \;) = (\; 1 \; , \; 0 \; , \; 1 \; , \; 0 \;) + \epsilon \; (\; U_1 \; , \; V_1 \; , \; D_1 \; , \; \eta'_1 \;) \; + \; O \; (\; \epsilon^2 \;) \tag{3.27}$$

In order to solve at $O(\varepsilon)$, the following separation of variables is introduced:

$$(\; U_1 \; , \; V_1 \; , \; D_1 \; , \; \eta'_1 \;) = (\; \mathcal{U} \; . \; \mathcal{V}, \; \mathcal{D} \; , \; \mathcal{F} \;) \; exp \; (\; i \; \lambda \; s \;) \; + \; c.c. \tag{3.28}$$

where *c.c.* denotes the complex conjugate, and $\mathcal{U}$. $\mathcal{V}$, $\mathcal{D}$, and $\mathcal{F}$ are assumed to be functions of the transverse coordinate n only. It is important to note, however, that the boundary conditions, (3.24), introduce an $O(\varepsilon)$ dependence on s over these functions, and therefore an overall $O(\varepsilon^2)$ dependence on s when replaced in (3.28). Because of this, and for the purpose of solving at $O(\varepsilon)$, $\mathcal{U}$, $\mathcal{V}$, $\mathcal{D}$, and $\mathcal{F}$ can still be assumed to be functions of n only.

Similarly, a regular expansion for the shear stresses and bedload transport rates is introduced as well as a separation of variables such that:

$$(\tau_s , \tau_n , Q_s , Q_n) = (C_{fo} , 0 , \Phi_o , 0) + \epsilon (\tau_{s1} , \tau_{n1} , Q_{s1} , Q_{n1}) + O (\epsilon^2) \qquad (3.29a)$$

$$(\tau_{s1} , \tau_{n1} , Q_{s1} , Q_{n1}) = (t_s , t_n , q_s , q_n) \, exp (i \lambda s) + c.c. \qquad (3.29b)$$

where t_s, t_n, q_s, and q_n are assumed to be functions of n only, at least for the purpose of solving at $O(\varepsilon)$.

Substituting the expansions from (3.27) and (3.29b) into the governing system (3.21), the boundary conditions (3.24), and the closure relationships (3.25) and (3.26), the following results are obtained. At $O(\varepsilon^0)$, the solution for uniform flow in a straight channel of width, $2B_o*$ is recovered. At $O(\varepsilon)$, a linear problem for $\mathcal{U}$, $\mathcal{V}$, $\mathcal{D}$, and $\mathcal{F}$ results:

$$\begin{bmatrix} a_1 & 0 & a_2 & a_3 \\ 0 & a_4 & a_3 \frac{d}{dn} & a_3 \frac{d}{dn} \\ a_5 & \frac{d}{dn} & a_5 & 0 \\ a_6 & a_7 \frac{d}{dn} & a_8 & a_9 \frac{d^2}{dn^2} \end{bmatrix} \begin{bmatrix} \mathcal{U} \\ \mathcal{V} \\ \mathcal{D} \\ \mathcal{F} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \qquad (3.30)$$

with boundary conditions:

$$\mathcal{V} = \pm \frac{\lambda}{2} \quad \text{and} \quad \frac{d\mathcal{F}}{dn} = 0 \qquad \text{at } n = \pm B = \pm (1 + \epsilon \sin(\lambda s)) \qquad (3.31a,b)$$

where

$$a_1 = i \lambda + \beta C_{fo} s_1 \qquad a_2 = \frac{i \lambda}{F_o^2} + \beta C_{fo} (s_2 - 1) \qquad a_3 = \frac{i \lambda}{F_o^2} \qquad (3.32a-c)$$

$$a_4 = i \lambda + \beta C_{fo} \qquad a_5 = i \lambda \qquad a_6 = i \lambda \Phi_o f_1 \qquad (3.32d-f)$$

$$a_7 = - \Phi_o \qquad a_8 = i \lambda \Phi_o f_2 \qquad a_9 = \Phi_o R \qquad (3.32g-i)$$

and s_1, s_2, f_1, and f_2 are given by (3.13) and (3.14). The value of R in (3.32i) is determined by:

$$R = \frac{r}{\beta \sqrt{\theta_o}} \qquad (3.33)$$

The system (3.30) is solved in closed form subject to the boundary conditions (3.31), however, the following integral conditions, stating that the flow discharge and average valley slope are not affected by the flow field or bed topography perturbations, need to be imposed:

$$\int_{-B^*}^{B^*} U^* D^* \, dn^* = Q^* \qquad , \qquad \int_0^{L^*} \int_{-B^*}^{B^*} \eta'^* \, dn^* = 0 \tag{3.34a,b}$$

which after non-dimensionalizing and linearizing, correspond to:

$$\int_{-B}^{B} (\mathcal{U} + \mathcal{D}) \, dn = i \qquad , \qquad \int_0^{\frac{2\pi}{\lambda}} \exp(i \lambda s) \int_{-B}^{B} \mathcal{F} \, dn \, ds = 0 \tag{3.35a,b}$$

After some algebra, the system of equations (3.30) subject to the boundary conditions (3.31) and integral conditions (3.35) is easily reduced to the following 4th-order ordinary differential problem for $\mathcal{V}$:

$$A_1 \frac{d^4 \mathcal{V}}{dn^4} + A_2 \frac{d^2 \mathcal{V}}{dn^2} + A_3 \mathcal{V} = 0 \tag{3.36a}$$

$$\mathcal{V} = \pm \frac{\lambda}{2} \qquad \text{at} \quad n = \pm B = \pm (1 + \epsilon \sin(\lambda s)) \tag{3.36b}$$

$$\frac{d^2 \mathcal{V}}{dn^2} = \pm A_4 \frac{\lambda}{2} \qquad \text{at} \quad n = \pm B = \pm (1 + \epsilon \sin(\lambda s)) \tag{3.36c}$$

where A_1, A_2, A_3, and A_4 are functions of the coefficients a_1 through a_9 given in (3.32):

$$A_1 = \frac{a_1 a_9}{a_5 (a_1 - a_2 + a_3)} \tag{3.37a}$$

$$A_2 = \frac{a_3 a_5 a_7 (a_1 - a_2 + a_3) + a_3 (a_2 a_6 - a_1 a_8) - a_3^2 a_6 + a_4 a_5 a_9 (a_2 - a_1)}{a_3 a_5 (a_1 - a_2 + a_3)} \tag{3.37b}$$

$$A_3 = \frac{a_4 (a_6 - a_8)}{a_1 - a_2 + a_3} \qquad , \qquad A_4 = \frac{a_4 a_5}{a_1 a_3} (a_1 - a_2) \tag{3.37c,d}$$

The system (3.36) is readily solved, giving $\mathcal{V}$ as an odd function of n, such that:

$$\mathcal{V} = B_1 \sinh (l_1 n) + B_2 \sinh (l_2 n) \tag{3.38}$$

where

$$l_1 = \sqrt{\frac{- A_2 + \sqrt{A_2^2 - 4 A_1 A_3}}{2 A_1}} \qquad , \qquad l_2 = \sqrt{\frac{- A_2 - \sqrt{A_2^2 - 4 A_1 A_3}}{2 A_1}} \tag{3.39a,b}$$

and

$$B_1 = \frac{\lambda}{2} \frac{1}{\sinh (l_1 B)} \left(1 - \frac{A_4 - l_1^2}{l_2^2 - l_1^2} \right) \quad , \quad B_2 = \frac{\lambda}{2} \frac{1}{\sinh(l_2 B)} \frac{A_4 - l_1^2}{l_2^2 - l_1^2} \qquad (3.40a,b)$$

with B given by (3.8) as an $O(\varepsilon)$ function of s.

Using the solution for $\mathcal{V}$ given by (3.38), solutions for $\mathcal{U}$, $\mathcal{D}$, and $\mathcal{F}$ are easily obtained from (3.30), (3.31), and (3.35) as:

$$\mathcal{F} = C_1 \cosh(l_1 n) + C_2 \cosh(l_2 n) \qquad (3.41a)$$

$$\mathcal{D} = D_1 \cosh(l_1 n) + D_2 \cosh(l_2 n) \qquad (3.41b)$$

$$\mathcal{U} = E_1 \cosh(l_1 n) + E_2 \cosh(l_2 n) \qquad (3.41c)$$

where

$$C_1 = \frac{B_1}{l_1} (A_5 l_1^2 - A_6) \quad , \quad C_2 = \frac{B_2}{l_2} (A_5 l_2^2 - A_6) \qquad (3.42a,b)$$

$$D_1 = \frac{a_3 C_1}{a_1 - a_2} - \frac{a_1 l_1 B_1}{a_5(a_1 - a_2)} \quad , \quad D_2 = \frac{a_3 C_2}{a_1 - a_2} - \frac{a_1 l_2 B_2}{a_5(a_1 - a_2)} \qquad (3.42c,d)$$

$$E_1 = -\left(\frac{a_2}{a_1} D_1 + \frac{a_3}{a_1} C_1 \right) \quad , \quad E_2 = -\left(\frac{a_2}{a_1} D_2 + \frac{a_3}{a_1} C_2 \right) \qquad (3.42e,f)$$

and

$$A_5 = \frac{a_1}{a_5 (a_1 - a_2 + a_3)} \quad , \quad A_6 = \frac{a_4}{a_3} \frac{a_1 - a_2}{a_1 - a_2 + a_3} \qquad (3.43a,b)$$

Therefore, if the normal flow and sediment parameters as well as the channel configuration are given, then the equilibrium values for the velocities in the streamwise and transverse directions, the flow depth, and the deviation from the mean bed elevation may be computed. Figures 3.8, 3.9, and 3.10 show the computed values of the channel width, the water surface elevation, the flow depth, and the bed elevation for one channel wavelength in the streamwise direction along the channel centerline, in the transverse direction at the widest channel section, and in the transverse direction at the narrowest channel section, respectively. The computation was performed for a mean flow depth of 0.020 m, a slope of 0.0040, a mean sediment diameter of 0.53 mm, an average channel width of 0.40 m, a dimensionless wavelength of 0.8, and two average dimensionless width perturbations of 0.375 and 0.150, all of which are comparable to the values used in the experimental study which will be discussed subsequently. Figure 3.8 shows that the water surface elevation is slightly lower in the wider

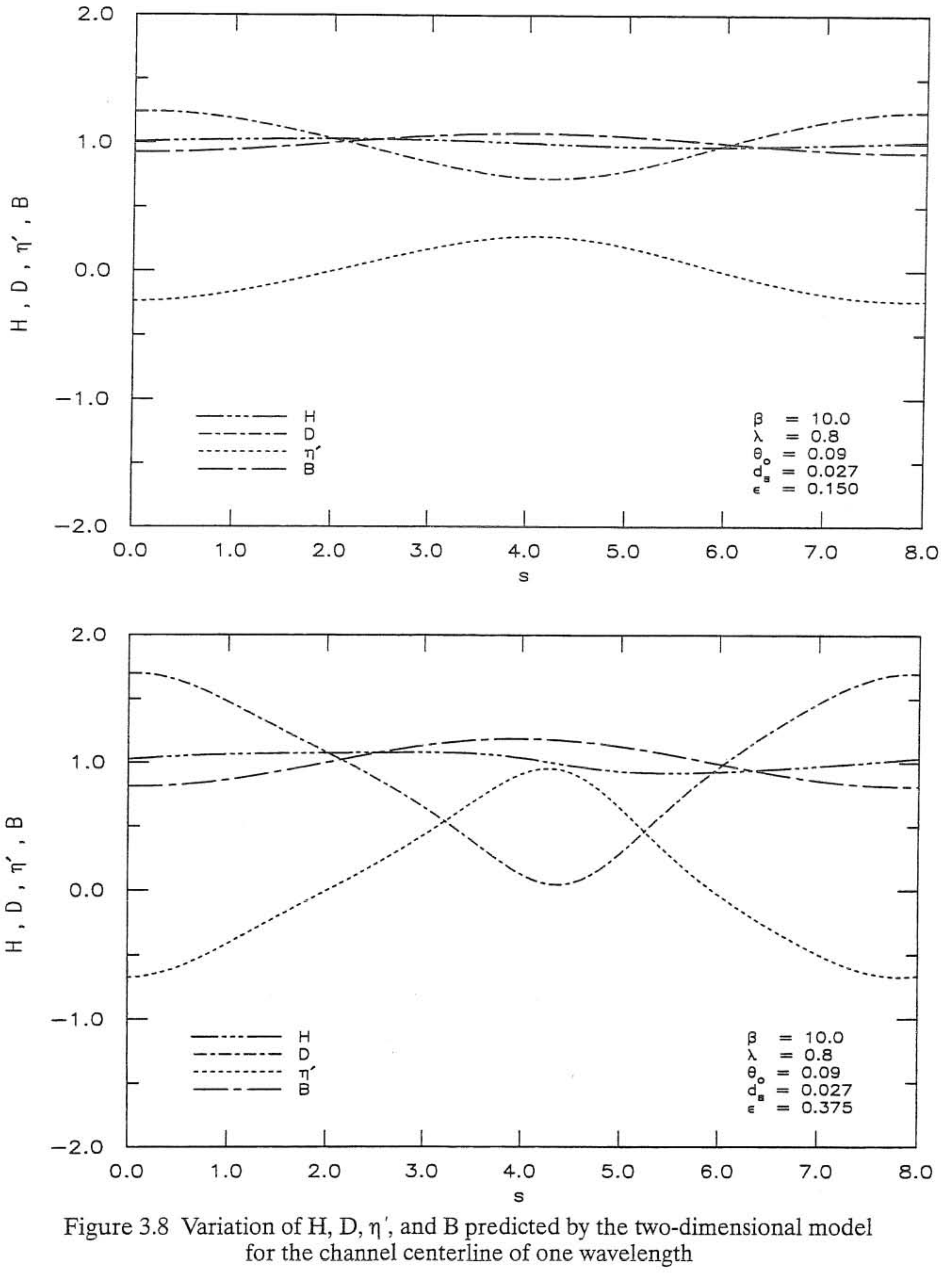


Figure 3.8 Variation of H, D, η′, and B predicted by the two-dimensional model for the channel centerline of one wavelength

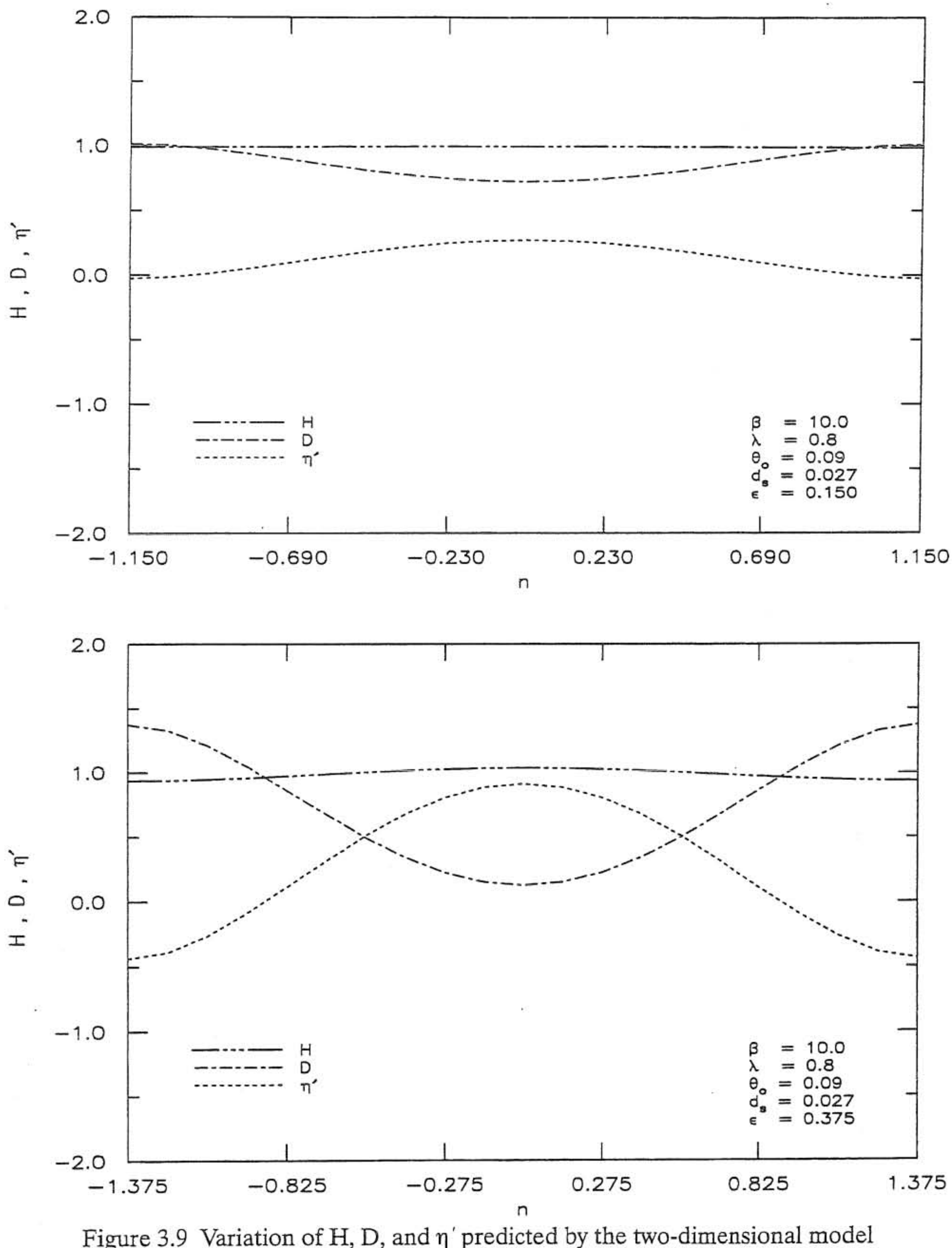


Figure 3.9 Variation of H, D, and η′ predicted by the two-dimensional model for the widest channel cross section

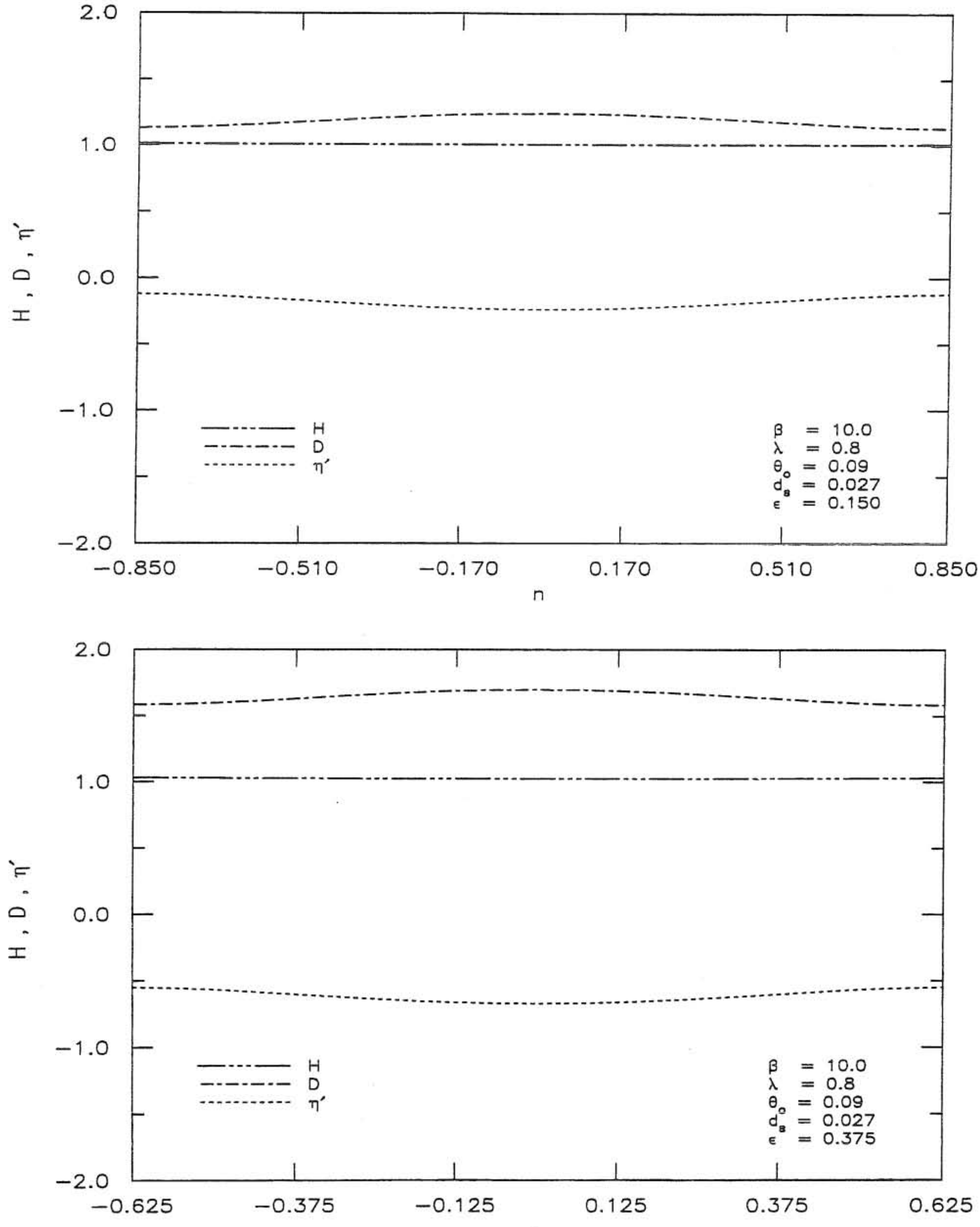


Figure 3.10 Variation of H, D, and η' predicted by the two-dimensional model for the narrowest channel cross section

sections than in the narrower sections. Also, the flow depth is lowest just downstream of the widest section and highest just downstream the narrowest section which is exactly opposite to the behavior of the bed elevation. There is a slight lag of the flow depth and bed elevation downstream of the channel width. Figures 3.9 and 3.10 show that the bed elevation in the widest section has a convex shape whereas in the narrowest section, it has a concave shape. The flow depth, again, displays the opposite behavior and the water surface elevation varies little in the transverse direction. Figures 3.8, 3.9, and 3.10 demonstrate that a larger perturbation creates larger variations in water surface elevation, flow depth, and bed elevation. Figure 3.11 shows grayscale plots of the magnitude of the streamwise velocity in the varying width channel for two values of ε at the same conditions given above. A grayscale image uses the monochromatic scale where black represents the lowest velocity and white the highest velocity to demonstrate the variation in the speed of the flow. The range of the streamwise velocity for the two different channel configurations are only slightly different with the less perturbed channel having a smaller variation. The streamwise velocity does not vary greatly, but it is apparent for both channel configurations that in the channel center, the flow is slowest within and just downstream of the narrowest sections and fastest within and downstream of the widest sections. At the walls, the flow increases its speed as the channel opens up and decreases as the channel narrows. Figure 3.12 shows grayscale plots of the magnitude of the transverse velocity for two values of ε for the same flow and bed conditions as the previous figures. The values of the transverse velocity are very small, and again, the variation is less for the smaller channel perturbation. The pattern for both channel configurations is the same. As the channel widens, the flow moves away from the center of the channel and toward the walls. Then, as the channel narrows, the flow funnels back to the center again. Figure 3.13 shows grayscale images of the bed elevation predicted by the two-dimensional model. The narrow channel sections are dark representing areas of scour, and the wide channel sections are white in the center denoting an area of deposition or a central bar. It is of interest to note that the pattern of scour and deposition shown in Figure 3.13 is directly opposite to the findings of Tsujimoto (1987). In that work, a convex profile was observed in the narrow sections and a concave profile in the wide sections.

In summary, Figures 3.8−3.13 describe the following equilibrium situation. The largest amount of scour occurs just slightly downstream of the narrowest channel section as shown by the high flow depths and low bed elevations found there. The shape of the bed profile is concave whereas the flow depth has a convex shape. The flow velocity in that section is not affected by the transverse velocity, however as the flow moves to the wider sections, the transverse velocity plays a role and the flow spreads out to either side of a central area of deposition. The central bar has its peak just downstream of the widest channel section. At this

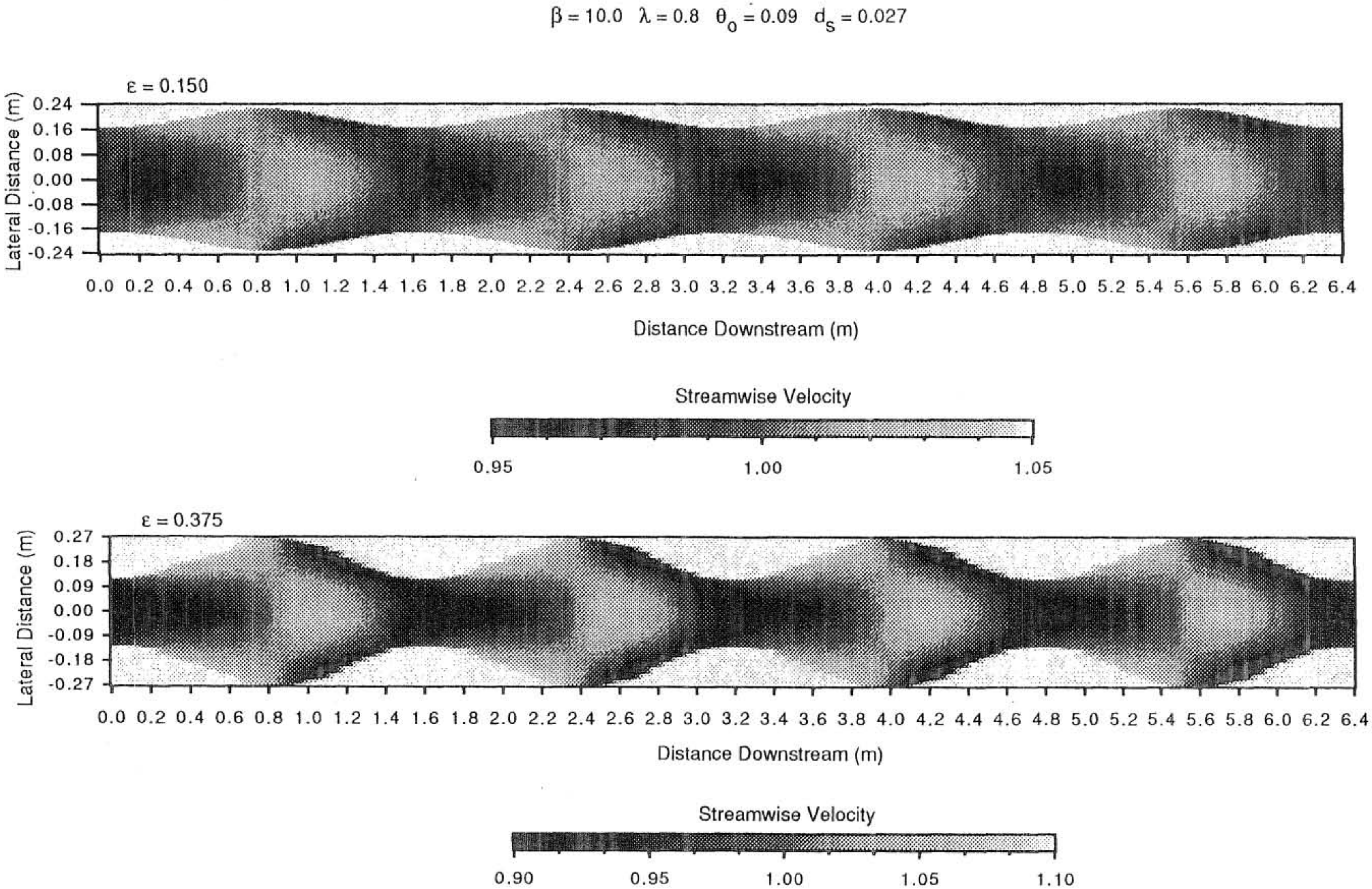


Figure 3.11 Grayscale plot of the streamwise velocity as predicted by the two-dimensional model

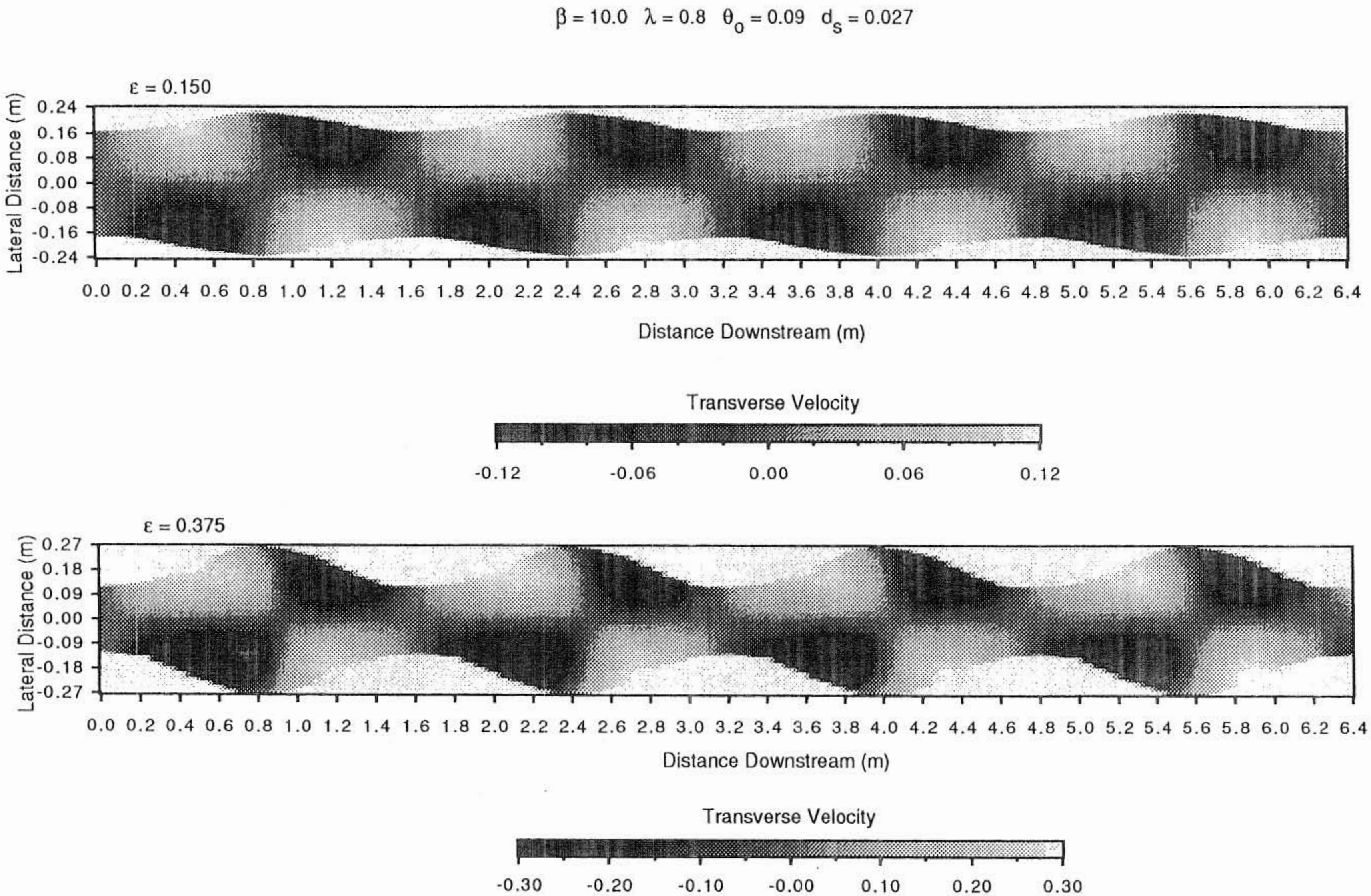


Figure 3.12 Grayscale plot of the transverse velocity as predicted by the two-dimensional model

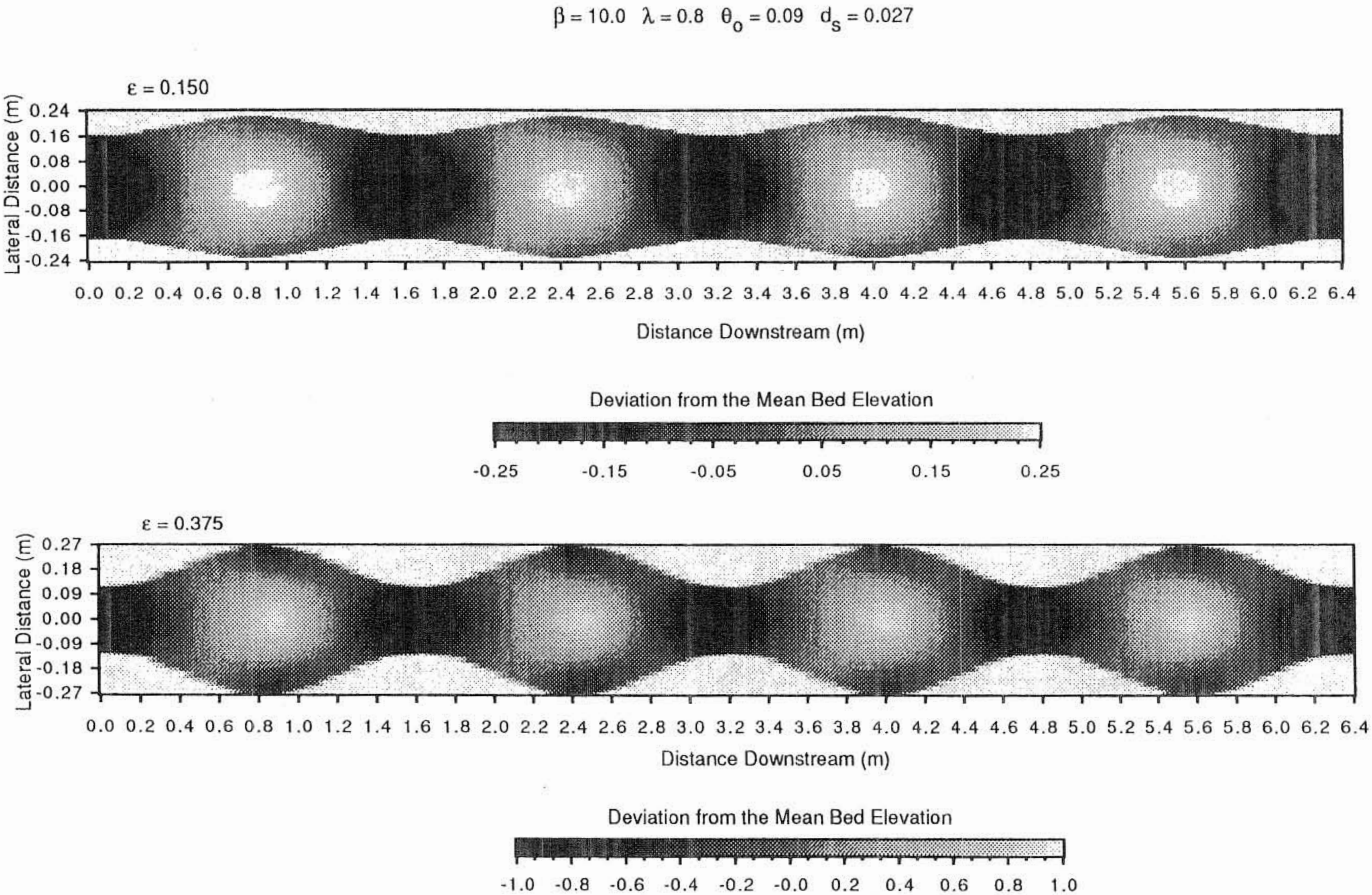


Figure 3.13 Grayscale plot of the deviation from the mean bed elevation as predicted by the two-dimensional model

section, the central bar gives the bed profile a convex shape, however the flow depth is very shallow in the center and has a concave profile.

4. EXPERIMENTAL STUDY

4.1 Introduction

In order to verify the theoretical models developed in Chapter 3, experiments were performed in a channel of varying width. The experiments consisted of passing a steady flow through a channel with a sinusoidally varying width, a movable bed, and non-erodible sidewalls in order to observe and measure the equilibrium deformation of the sediment. A detailed description of the experiments is given below.

4.2 Dimensional Analysis

In the same manner as Niño and García (1992), the variables involved in designing the experiments were obtained by examining the dimensionless two-dimensional governing equations for the system. As shown previously, the equations are:

$$U\frac{\partial U}{\partial s} + V\frac{\partial U}{\partial n} = -\frac{\partial H}{\partial s} - \frac{\beta \tau_s}{D} \qquad (3.21a)$$

$$U\frac{\partial V}{\partial s} + V\frac{\partial V}{\partial n} = -\frac{\partial H}{\partial n} - \frac{\beta \tau_n}{D} \qquad (3.21b)$$

$$\frac{\partial(UD)}{\partial s} + \frac{\partial(VD)}{\partial n} = 0 \qquad (3.21c)$$

$$\frac{\partial(F_o^2 H - D)}{\partial t} + Q_o\left[\frac{\partial Q_s}{\partial s} + \frac{\partial Q_n}{\partial n}\right] = 0 \qquad (3.21d)$$

and

$$Q_o = \frac{d_s^* \sqrt{(\varrho_s/\varrho - 1)\, g d_s^*}}{(1 - p)\, D_o^*\, U_o^*} \qquad (3.22)$$

where

$$(\tau_s , \tau_n) = T (U , V , D , d_s' , S_o , \varrho_s/\varrho) \qquad (4.1a)$$

$$(Q_s , Q_n) = Q (U , V , D , \eta' , d_s' , S_o , \varrho_s/\varrho\ \beta) \qquad (4.1b)$$

which are specified by the closure relationships defined in (3.4b), (3.5), (3.23), and (3.24) and $d_s' = B^*/d_s^*$. The other variables above are as described in Chapter 3. Therefore, the parameters involved in the experimental design are $U, V, D, B, F_o, \beta, S_o, \eta, d_s', p$, and ϱ_s/ϱ. From a dimensional analysis perspective, the relation may be written as:

$$(U , V , D , \eta') (s , n , t) = \phi_o (B , F_o , \beta , S_o , d_s' , \varrho_s/\varrho) \qquad (4.2)$$

However, if a particular channel configuration is chosen, then a function for the width is known. Also, the values of d_s', p, and ϱ_s/ϱ are fixed if a certain type of sediment is chosen. The slope may also be fixed to give the relation:

$$(U , V , D , \eta') (s , n , t) = \phi_1 (F_o , \beta) \tag{4.3}$$

In addition, the Froude number can be expressed as:

$$F_o^2 = \frac{R \theta d_s}{C_{fo}} \tag{4.4}$$

where d_s and the submerged specific gravity, R, are set with the choice of sediment and C_{fo} depends only on the particular resistance and bedload relationships chosen; in this case, the Engelund-Hansen resistance and bedload equations specified by (3.4) and (3.5). Also, θ may be expressed in terms of S_o and d_s' so that (4.3) becomes:

$$(U , V , D , \eta') (s , n , t) = \phi_2 (\beta) \tag{4.5}$$

From this analysis, it is clear that the design of the experiments must include the choice of a channel width configuration, sediment size and type, and channel slope. A fixed value of the flow rate will then establish F_o and β values. The resulting water depth and bed elevation are measured.

4.3 Experimental Setup

The experiments were conducted in a 20 meter by 0.9 meter flume located at the Hydrosystems Laboratory at the University of Illinois. The flume was equipped with a mechanism which allowed it to be tilted to a desired slope. Channel slopes for the current research ranged from 0.0030−0.0054. There are two methods of obtaining an equilibrium bed deformation in the channel so that the mean bed slope and channel slope are equal. One method is to constantly feed sediment into the channel from an external source and allow the sediment to move through and out of the channel. Another method is to recirculate the water and sediment within the flume system. Since the flume was capable of recirculating a mixture of water and sediment, the second method was used to obtain equilibrium. A hopper was located at the downstream end of the flume in order to funnel the water-sediment mixture into a 2-inch PVC pipe which led to a pump. The mixture was then pumped up to a manifold at the channel entrance at a flow rate controlled by a valve just downstream of the pump. A venturi meter was also located in the circuit to measure the flow rate.

Inside the flume, a straight channel was constructed with PVC sidewalls which were manipulated with metal bracket supports to take the shape of a sinusoidal curve having the equation:

$$B^* = Bo^* + bo^* \sin(k^* s^*) \quad (4.6)$$

where $B_o{}^*$ is the mean channel half-width, $b_o{}^*$ is the perturbation from the mean half-width, k^* is the wavenumber, and s^* is the coordinate in the streamwise direction. Silicon caulk and duct tape were used to affix the walls to the wooden base of the channel. The sidewalls were placed 180° out of phase with each other so that the channel width alternated from a maximum to a minimum with an average channel width of $2B_o{}^*=0.40$ m. The wavelength of the channel was $L^*=1.6$ m which allowed 8 full wavelengths to be placed inside the flume. At the channel entrance, the channel width was constant for a short distance in order to reduce any entrance effects. The setup of the flume is shown in Figure 4.1.

Two different channel shapes were constructed for the experiments. As shown in Table 4.1, the characteristics of the channels were the same except for the value of the perturbation from the average channel width. The perturbation, $b_o{}^*$, of channel 1 was 0.15 m which gave a dimensionless perturbation, ε, of 0.375. The equivalent values for channel 2 were $b_o{}^*=0.06$ m and $\varepsilon=0.15$. The perturbation for channel 2 was a little less than half that of channel 1 and was chosen in order to observe the possible formation of migrating alternate bars, similar to those observed in straight channels, but interacting with the bed deformation forced by the sinusoidal variation in the channel width.

TABLE 4.1 Channel Characteristics			
Channel	$2B_o{}^*$ (m)	L^* (m)	$b_o{}^*$ (m)
1	0.40	1.6	0.15
2	0.40	1.6	0.06

For sediment, a well-sorted sand with a grain size diameter of $d_s=0.53$ mm and a standard deviation of $\sigma_g=1.25$ was used. The deformation of the sediment bed was measured using a Kenek, model WH-201c, bed profiler. The profiler had a small mechanical head which, when activated, would travel down to the sand bed. The distance measured would then appear on the control box screen. It was possible to take three different readings with the unit: 1) OW, the distance between a reference datum at the profiler and the water surface, 2) OS, the distance between a reference datum at the profiler and the sediment surface, and 3) WS, the distance between the water surface and the sediment surface. Only measurements of OW and OS were taken for the experiments reported herein. Readings could be taken at any point along the length of the channel since the profiler was attached to a trolley which rolled along the length of the channel on the sidewalls of the flume. Also, any point along the width could be measured as the profiler could slide along a flat metal bar positioned perpendicular to the centerline to the channel.

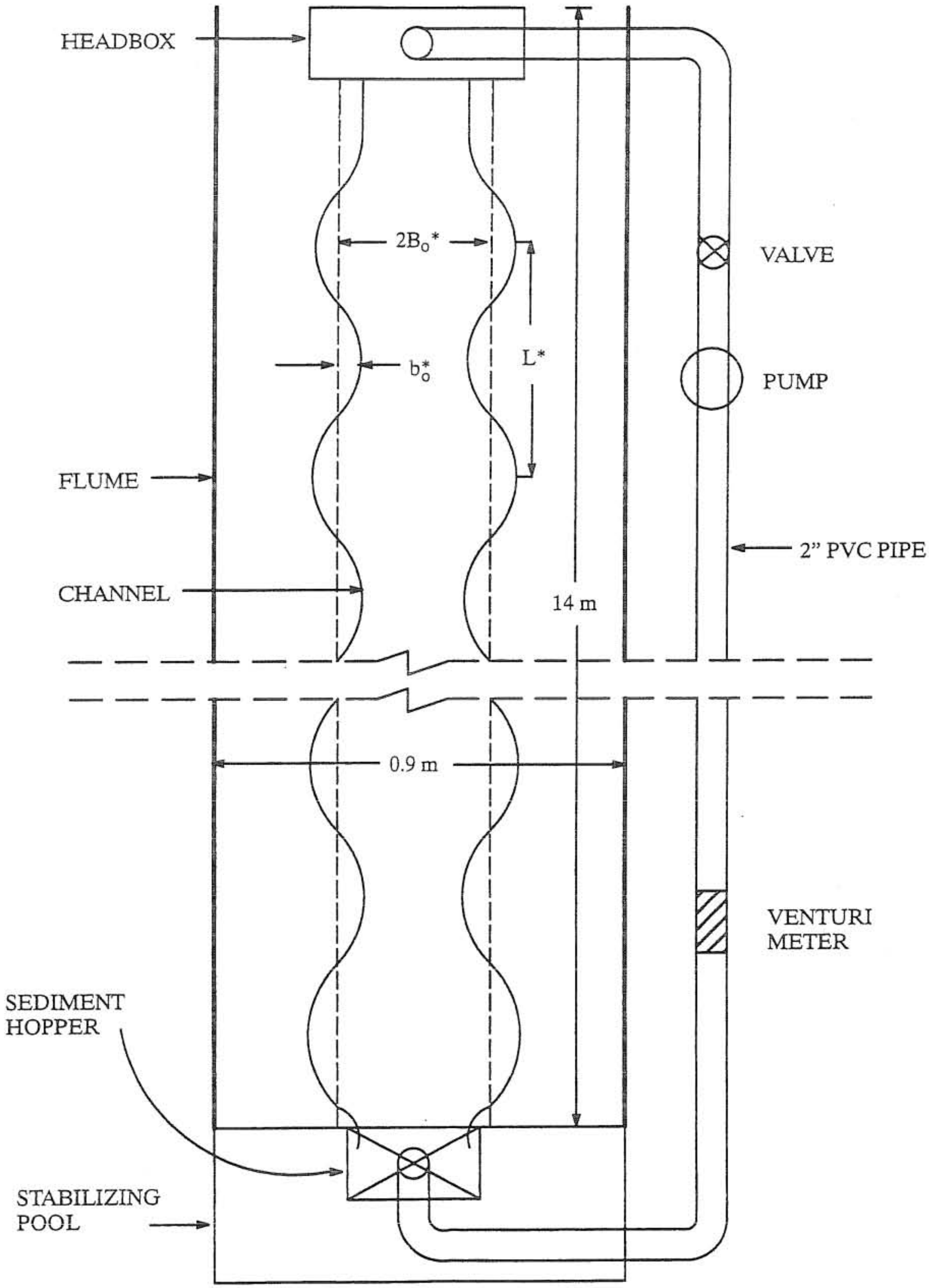


Figure 4.1 Plan view of experimental facilities

4.4 Experimental Procedure

Before the start of an experimental run, the sand bed was flattened by hand using a ruler to approximate a uniform height of about 7.0 cm. This was necessary to ensure that the slope of the bed was the same as the slope of the channel. Then, the pool at the downstream end of the channel was filled with water. The pool was a stabilizing influence on the system during an experimental run and also allowed a certain volume of water to be maintained in the flume. As the pool was filled, the water slowly moved upstream into the channel covering the sediment without disturbing it.

The flow was started by turning on the pump and slowly opening the valve. The flow rate was adjusted with the valve until the predetermined flow rate value was obtained on the venturi meter. Since the flow rate was not very large (1−3 l/s), the downstream pool level needed to be adjusted to be sure that there was no backwater effect and that sand was indeed recirculating.

After the initial stage, the sand bed was allowed to adjust to the flow conditions and obtain an equilibrium deformation. This process took about 6−8 hours. During that time, the

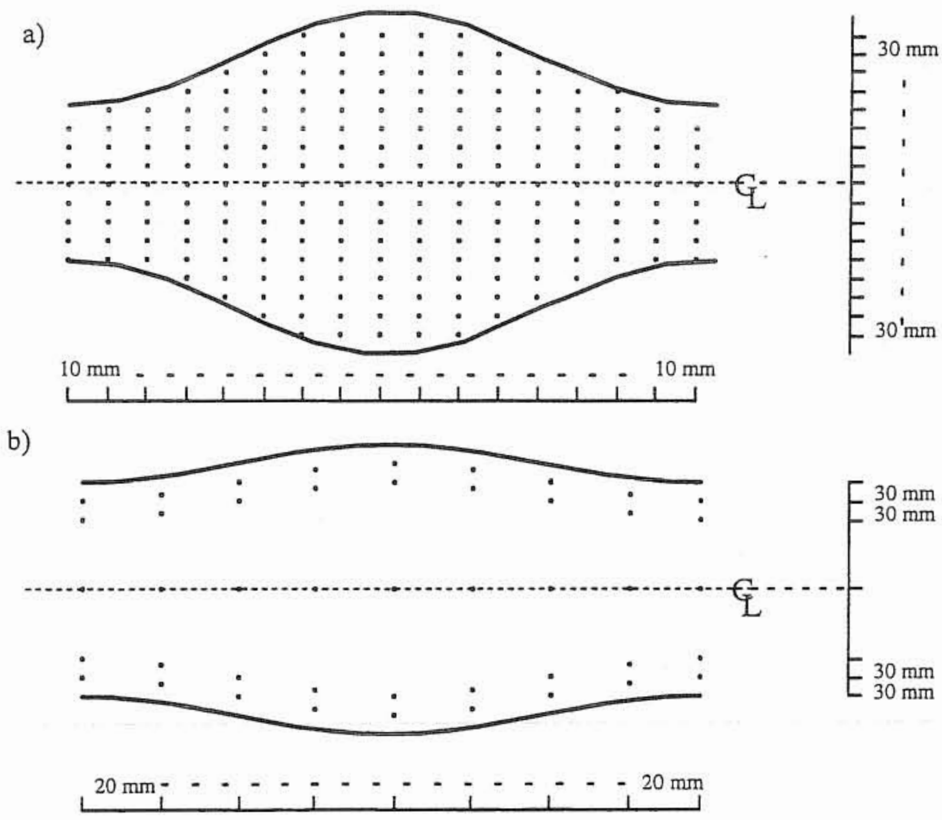


Figure 4.2 Plan view of measurement locations: a) Channel 1 b) Channel 2

bed was observed periodically in order to determine the status of the bedforms. Centerline measurements were taken to help assess whether the bed was in a state of equilibrium. Measurements of the wavelength and celerity of migrating alternate bars were taken in experiments where these bedforms occurred.

When the equilibrium deformation was achieved, water surface level and sediment bed level measurements were taken while the flow was still running. Measurements were taken over a control length of 6 meters along the channel which is equivalent to four wavelengths. The measurement spacing was different for each of the channels constructed. For channel 1, readings were taken along the length of the channel at intervals of 0.10 meters and across the channel at intervals of 0.03 meters. For channel 2, the length interval was 0.20 meters but the interval along the cross sections varied. Each section contained 5 points. One point lay along the centerline with 2 points on either side of it at a spacing of 30 millimeters and 60 millimeters from each of the channel walls. Fewer readings were taken in channel 2 because moving bedforms were observed which could not be accurately captured if too much time was taken at each cross section. The measurement spacing of channels 1 and 2 is shown in Figure 4.2.

5. EXPERIMENTAL RESULTS

5.1 Introduction

A presentation of the results of the experimental study follows. The parameters that were extracted from the raw data correspond to the parameters obtained in the dimensional analysis in Chapter 4. The data obtained are presented such that they are directly comparable with the results of a similar set of experiments in a channel of uniform width by Niño and García (1992). A comparison is made of the parameters for channels of uniform and varying widths.

5.2 Summary of Results

The raw data obtained from the experiments consisted of the water surface and sediment bed elevations from a datum in the plane of the bed profiler for each node in the channel. This data is listed in Appendices I and II. The data was manipulated into the form shown in Tables 5.1, 5.2, 5.3, and 5.4. Each table contains the results for a range of discharges at one particular bed slope. Tables 5.1–5.3 contain results for experiments performed in channel 1 while Table 5.4 presents results for experiments performed in channel 2. The tables show flow discharge, mean flow depth, β, maximum bar height, maximum scour depth, mean velocity, Froude number, and Reynolds number in that order.

The mean depth of flow, D_o*, was calculated by integrating the water and sediment surface measurements over the length and width of the channel. The integration was performed using Simpson's rule for channel 1 because the data points were equally spaced. However, the method of midpoints was used for channel 2 due to the unequal spacing of the measured points in that channel. The results of the integration led to a mean value for the water surface elevation, H_o*, and a mean value for the bed height, η_o*. The mean depth was then calculated using the simple relation: $D_o^* = H_o^* - \eta_o^*$.

TABLE 5.1 Experimental Results For Channel 1 at S_o = 0.0030

Q (l/s)	D_o* (mm)	β	H_{Mb} alternate	H_{Mb} point	S	U_o* (m/s)	F_o	Re
1.54	16.5	12.15	2.48	–	1.99	0.233	0.580	4410
1.57	17.3	11.58	2.48	–	1.96	0.227	0.551	4395
1.78	17.9	11.16	–	1.59	1.08	0.249	0.593	5211
2.11	19.7	10.16	–	1.68	1.13	0.268	0.609	6177
3.08	22.7	8.81	–	1.56	0.96	0.339	0.719	8046

TABLE 5.2 Experimental Results For Channel 1 at S_o = 0.0040								
Q (l/s)	D_o* (mm)	β	H_{Mb} alternate	point	S	U_o* (m/s)	F_o	Re
1.02	13.9	14.36	3.31	–	2.60	0.183	0.497	2357
1.47	15.8	12.62	2.47	–	1.90	0.233	0.591	3660
1.50	16.9	11.86	2.04	–	1.64	0.222	0.545	3558
2.00	18.3	10.90	–	2.62	2.17	0.273	0.645	4621
2.49	20.1	9.94	–	1.42	0.90	0.310	0.697	6200
2.92	22.0	9.09	–	1.23	0.79	0.332	0.714	6747

TABLE 5.3 Experimental Results For Channel 1 at S_o = 0.0054								
Q (l/s)	D_o* (mm)	β	H_{Mb} alternate	point	S	U_o* (m/s)	F_o	Re
0.97	13.7	14.63	2.12	–	1.64	0.176	0.481	2831
1.05	14.6	13.68	3.36	–	2.81	0.180	0.475	3007
1.52	16.4	12.20	–	1.74	1.27	0.232	0.578	4162
2.02	18.4	10.84	–	1.74	1.27	0.274	0.646	5531
2.53	22.8	8.79	–	1.73	1.30	0.277	0.587	6772
3.29	25.2	7.93	–	1.31	0.85	0.326	0.656	8806

TABLE 5.4 Experimental Results For Channel 2 at S_o = 0.0041								
Q (l/s)	D_o* (mm)	β	H_{Mb} alternate	point	S	U_o* (m/s)	F_o	Re
1.03	17.0	11.79	1.41	–	0.91	0.151	0.370	2230
1.51	20.4	9.78	1.79	–	1.21	0.185	0.413	3380
2.02	20.3	9.83	1.65	–	1.21	0.248	0.555	4584
2.02	23.4	8.53	1.22	–	0.84	0.215	0.449	4237
2.50	23.6	8.47	1.40	–	0.92	0.265	0.551	5637
3.06	23.9	8.38	–	0.61	0.41	0.320	0.661	6881

Figure 5.1 shows the definitions of H_{Mb} and S which are shown in the tables. The maximum bar height, H_{Mb}*, is the dimensional distance from the point of maximum deposition to the point of maximum scour where those maximums are not necessarily in the same cross section. In fact, in none of the experiments were the points of maximum deposition and maximum scour in the same cross section. The subheadings in the tables signify that there

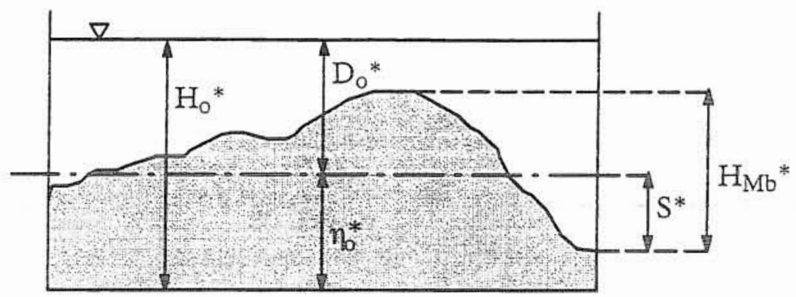


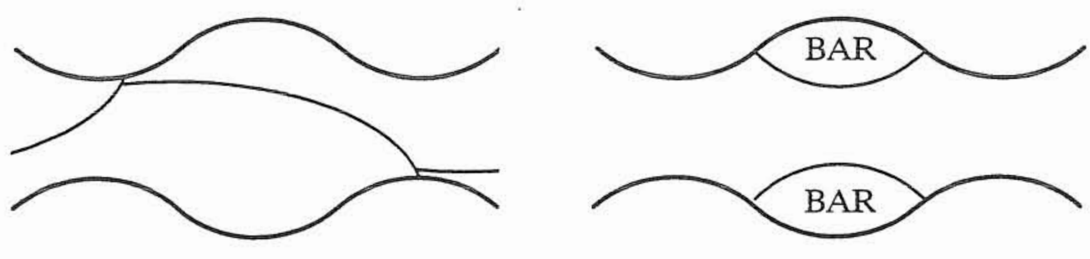
Figure 5.1 Definition of $H_{Mb}{}^*$ and S^*

were two types of bars formed in the channels which are shown schematically in Figure 5.2. Alternate type bars, such as those observed in uniform width channel experiments, were observed for lower flow rates, and point bars were observed for higher flow rates. The dimensionless values of the maximum bar height in the tables are calculated using $H_{Mb} = H_{Mb}{}^*/D_o{}^*$. The maximum scour, S^*, is the distance from the mean sediment height to the point of maximum scour. It is also made dimensionless with the mean depth, $S = S^*/D_o{}^*$.

The Froude numbers listed in the tables vary in the range of 0.4−0.7, thus they correspond to subcritical flow. Therefore, the phenomena which occurred in the channels show no dependence on the Froude number in agreement with (4.5). The Reynolds number is defined as $Re = U_o{}^*D_o{}^*/\nu$ where ν is the kinematic viscosity of water. The Re values are listed in the tables to show that all of the flows were indeed turbulent as assumed in Chapter 3. The values are in the range of 2000−9000 and are large enough to consider viscous effects unimportant.

5.3 General Trends

From the existing body of knowledge about bedforms in uniform width channels, a hypothesis can be generated about the expected behavior of bedforms in varying width



Alternate type bars

Point type bars

Figure 5.2 Schematic of alternate type bars and point type bars channels. As mentioned in Chapter 2, in a channel of uniform width, migrating or free bar formations move through the channel with a speed and wavelength subject only to the flow conditions. In the present experiments, an additional condition is introduced by the perturbation of the channel width which forces the bed deformation. Therefore, there should be a tendency for the system in the present experiments to develop free features of the alternate bar type, however these free bars would interact with the forced bed deformation induced by the channel morphology. Such interaction may result in the suppression of migrating bedforms, however, the final bed pattern may resemble that of alternate bars. This interaction could be analogous to that of free alternate bars and forced fixed bars in a meandering channel of uniform width observed by Kinoshita and Miwa (1974) and Niño and García (1992).

In order to observe the general trends of the sedimentation patterns which occurred in the experiments, contour plots and grayscale images of the measured bed deformations were constructed for each of the experimental runs. In the plots, the variation in bed elevation is shown by the variation in monochromatic color; black represents zero elevation above a certain datum and white corresponds to the highest bed elevation. Therefore, the dark areas represent scour holes while the lighter areas represent deposition or bars. The plots were created with the original measured points but a weighted interpolation process was used for points between those measured, so only general trends of bed deformation can be obtained. Contour plots were not constructed for channel 2 because too few points were measured to obtain meaningful plots.

The plots show that scour occurred at the narrow channel sections as observed in channel width variation experiments in the past such as Straub (1934) and Komura (1966). Two general types of scour patterns were observed in channel 1. The first is a pattern where the scour is concentrated on one side or the other of a narrow section, and the flow alternates from side to side as it moves through the channel. An example of this type of behavior is shown in Figure 5.3 which shows a contour plot and grayscale image for a flow rate of 1.54 l/s and a slope of 0.0030. Generally, the pattern is demonstrated for the lower flow rates of those measured. Of particular interest is the pattern shown for the flow conditions of Q=1.02 l/s and S_o=0.0040 in Figure 5.4. A definite alternating scour pattern is observed which implies a pattern of alternate bar formations. These bars are non-migrating and are suppressed by the sinusoidal channel width perturbation. An approximate bar wavelength of twice the wavelength of the channel width variation can also be observed from Figure 5.4. For higher flow rates, the scour in the narrow sections is more uniform. For example, the flow rate of 3.29 l/s and slope of 0.0054 result in uniform scour in the narrow sections which forms a V-shape

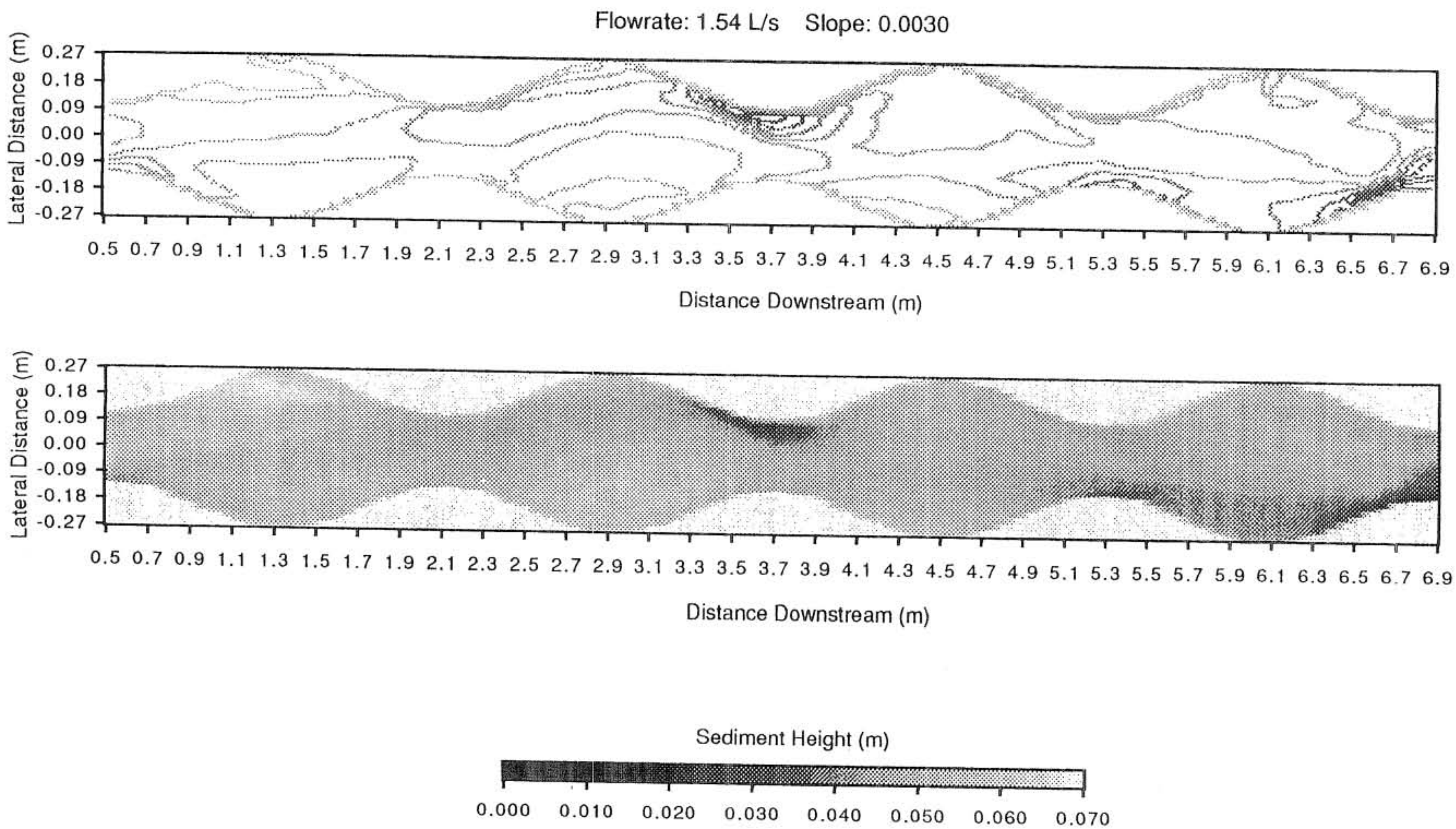


Figure 5.3 Contour plot and grayscale image of bed deformation in channel 1 for a low flow

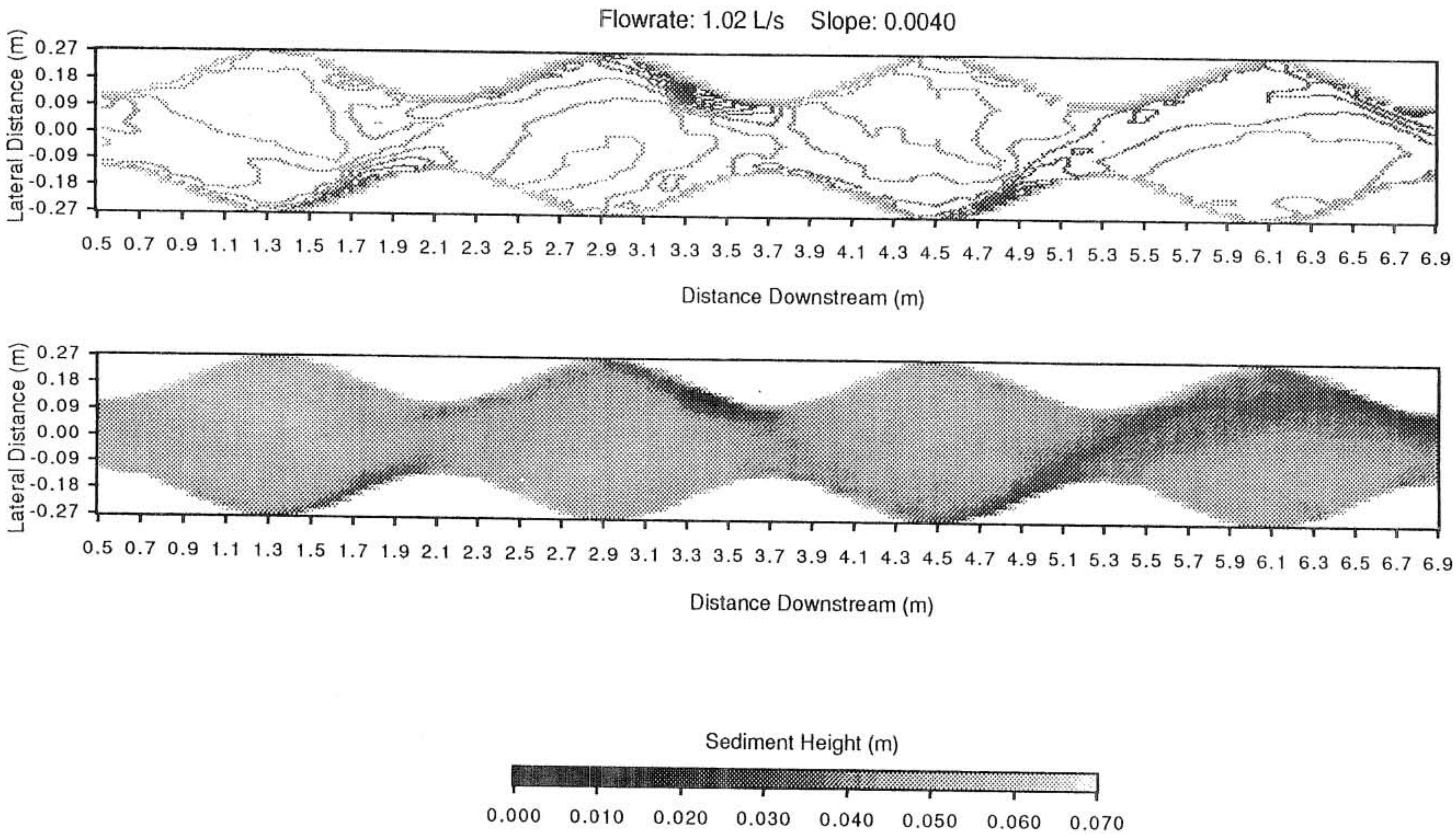


Figure 5.4 Contour plot and grayscale image of bed deformation in channel 1 for a low flow

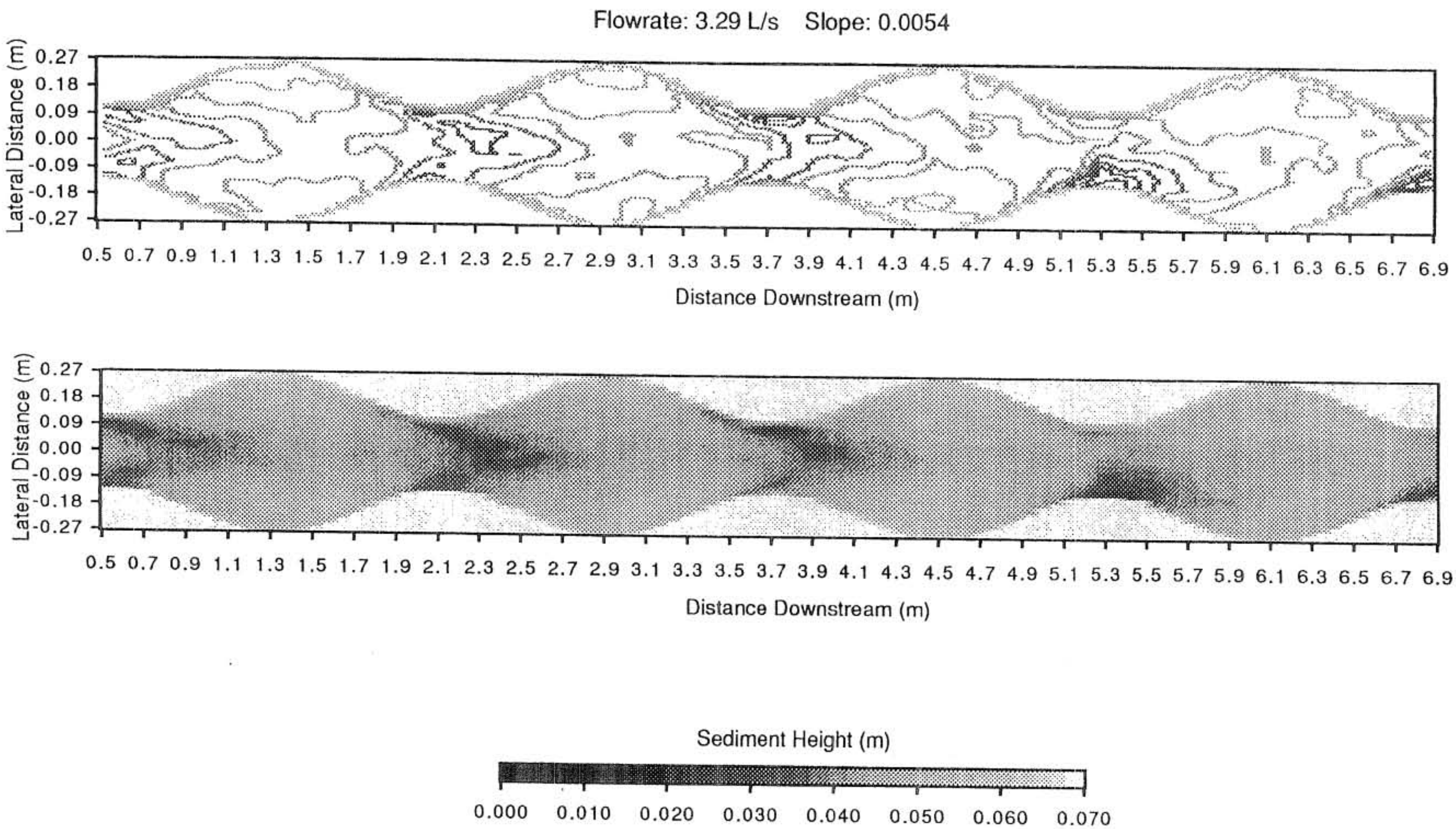


Figure 5.5 Contour plot and grayscale image of bed deformation in channel 1 for a high flow

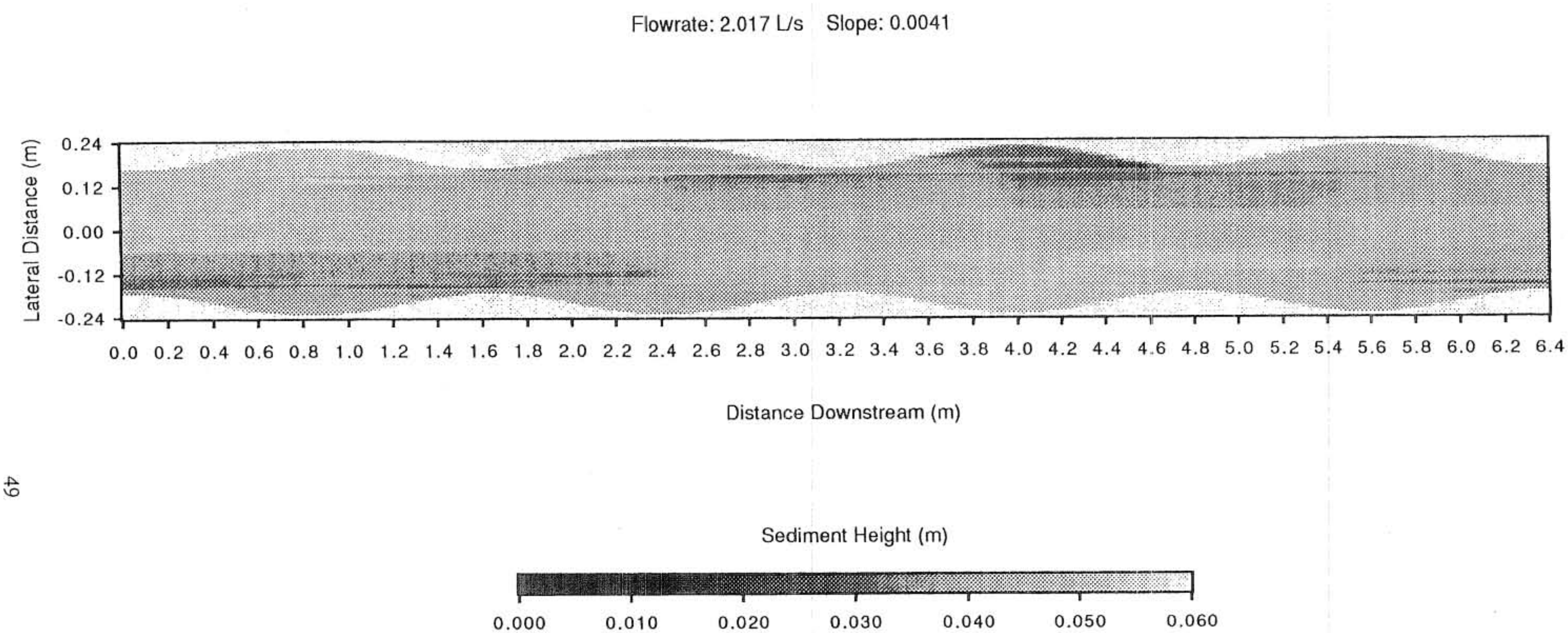


Figure 5.6 Grayscale image of bed deformation in channel 2

pointing in the downstream direction as shown in Figure 5.5. The V-shape corresponds to a lag in the bed response to the flow. Lighter areas resembling point type bars are visible on either side of the channel in the wide sections as the flow pushes through the middle of the channel.

One experiment was performed to investigate the influence of the initial bed deformation on the resulting sedimentation patterns. The flow was initiated at a flow rate of 3.08 l/s and a slope of 0.0030 and allowed to run for a period of time. Then, the flow was reduced to a rate of 1.57 l/s so that the bed deformation created by the first flow served as the initial bed elevation for the slower flow rate. For the high flow rate, the V-shape mentioned above can be distinguished. When the flow rate was lowered, that pattern was transformed to a pattern of alternating scour as observed for other experiments with lower flow rates. Therefore, for non-emergent features, the initial deformation of the bed seems to have no influence on the resulting equilibrium deformation.

In channel 2, because fewer points were measured, the patterns in the plots are more difficult to detect. However, alternate dark areas of scour are noticeable for all but the highest flow implying that there was a tendency for an alternate bar pattern to form. Figure 5.6 shows such alternate dark and light areas corresponding to a flow rate of 2.02 l/s and a slope of 0.0041. In some of these experiments, migrating bars were indeed observed which will be discussed in section 5.6. For the highest flow, a pattern of point bars at the widest sections, similar to high flows in channel 1, can be observed.

Another possible pattern is that of deposition in the central area of a wide section with the flow going around it on either side. Such a central bar pattern was never observed in either of the channels constructed for any tested flow. However, central bars are found in natural settings as demonstrated in Figure 1.1 and were predicted by the two-dimensional model as shown in Figure 3.13.

From this discussion, the sedimentation patterns observed in the varying width channel experiments appear to agree with the hypothesis based on knowledge of uniform width channels. Free bars were observed in channel 2, however only one or two complete free bars were observed at any particular time, and the free bars were not observed for all of the flow conditions. Therefore, there was some interaction in channel 2 between the free bars and the forced bed deformation. In channel 1, where the width perturbation was more than twice that of channel 2, no free bars were observed but an alternating pattern of forced, stable bars formed.

5.4 Analysis of Bar Height

In order to compare the amplitude of the alternate type bars measured in the experiments, a plot of alternate H_{Mb} as a function of β, S_o, and ε is presented in Figure 5.7. The figure demonstrates that as the value of β increases, which implies a decrease in Q, the value of alternate H_{Mb} increases. The slope does not appear to have an effect on the height of the bar formations. However, the alternate H_{Mb} values for channel 2, represented by the filled inverted triangles, are lower than the values for channel 1 implying that a larger perturbation of the channel width causes a larger bar amplitude. A similar plot is constructed for the point type bar heights as shown in Figure 5.8. There is again some tendency for the point bar height to increase as β increases, but the trend is less evident than for the alternate type bars. As in the alternate bar height plot, the slope has little affect on the point H_{Mb} values, and it is observed that the larger width perturbation causes a larger bar height. Comparing the alternate and point type bar heights, it is clear that the range and magnitude of the bar heights are somewhat larger for the alternate bars than for the point bars.

The measured alternate bar heights may also be compared to experimental results from channels of uniform width. As stated previously, the maximum bar height and maximum scour depth are not measured in the same cross section. Ikeda (1984) made a distinction for alternate bars in uniform width channels, denoting H_b as the maximum bar height located in the same section as the maximum scour, and H_{Mb} as the maximum bar height measured over one entire wavelength. The two values can be related by the equation: $H_{Mb} = 1.5H_b$. In order to make a comparison with the bar height data in Ikeda (1984), the measured maximum bar heights were converted from H_{Mb} to H_b. The relation developed by Ikeda (1984) for dimensionless bar height is:

$$H_b = 0.1208\ \beta^{1.9}\ d_s'^{-0.45} \qquad 3 < \beta < 20 \qquad (5.1)$$

where d_s' is defined as the constant, B_o^*/d_s^*, which has a value of 377.4 for the current research. Figure 5.9 shows a plot of (5.1) with the alternate bar height data from the present set of experiments. The solid line represents (5.1), and the dotted lines mark the range of scatter of the data compiled by Ikeda. The plotted data falls within the scatter range demonstrating that the alternate type bar amplitudes measured for flow in a channel of varying width are comparable to those found in a uniform width channel and may be described by (5.1). Since d_s' is a constant, Figure 5.9 demonstrates, as in Figures 5.7, that an increase in β, which signifies a decrease in Q, causes an increase in alternate H_b. This trend also occurs in channels of uniform width as shown in similar plots in Ikeda (1984) and Niño and García (1992).

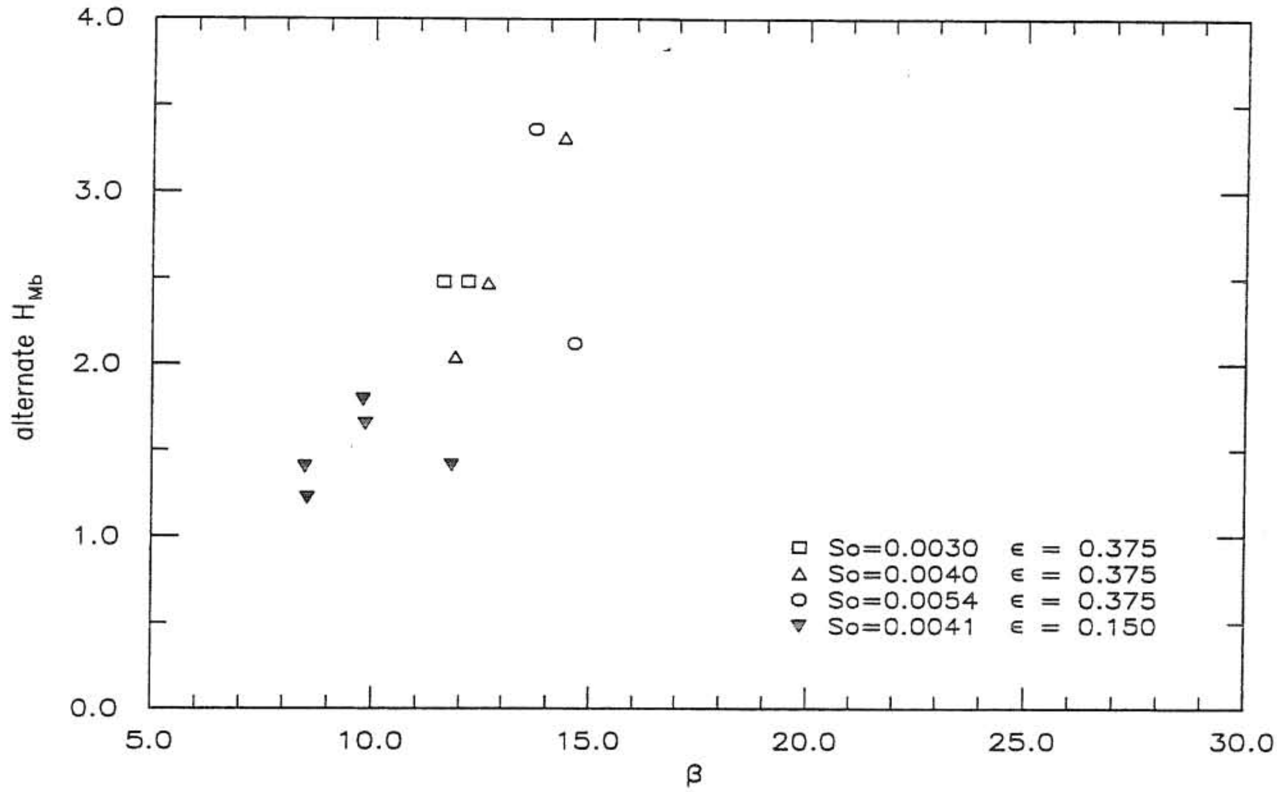


Figure 5.7 Maximum alternate type bar height as a function of β, S_o, and ε

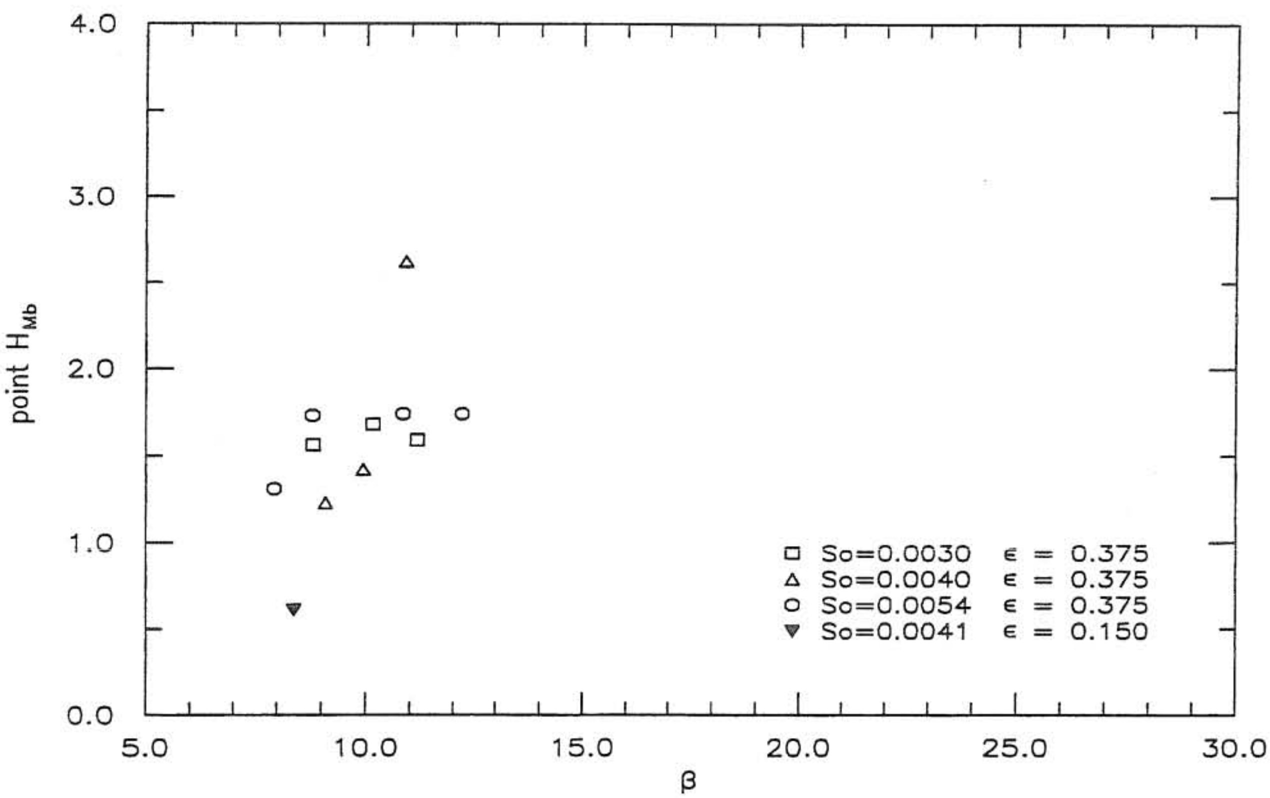


Figure 5.8 Maximum point type bar height as a function of β, S_o, and ε

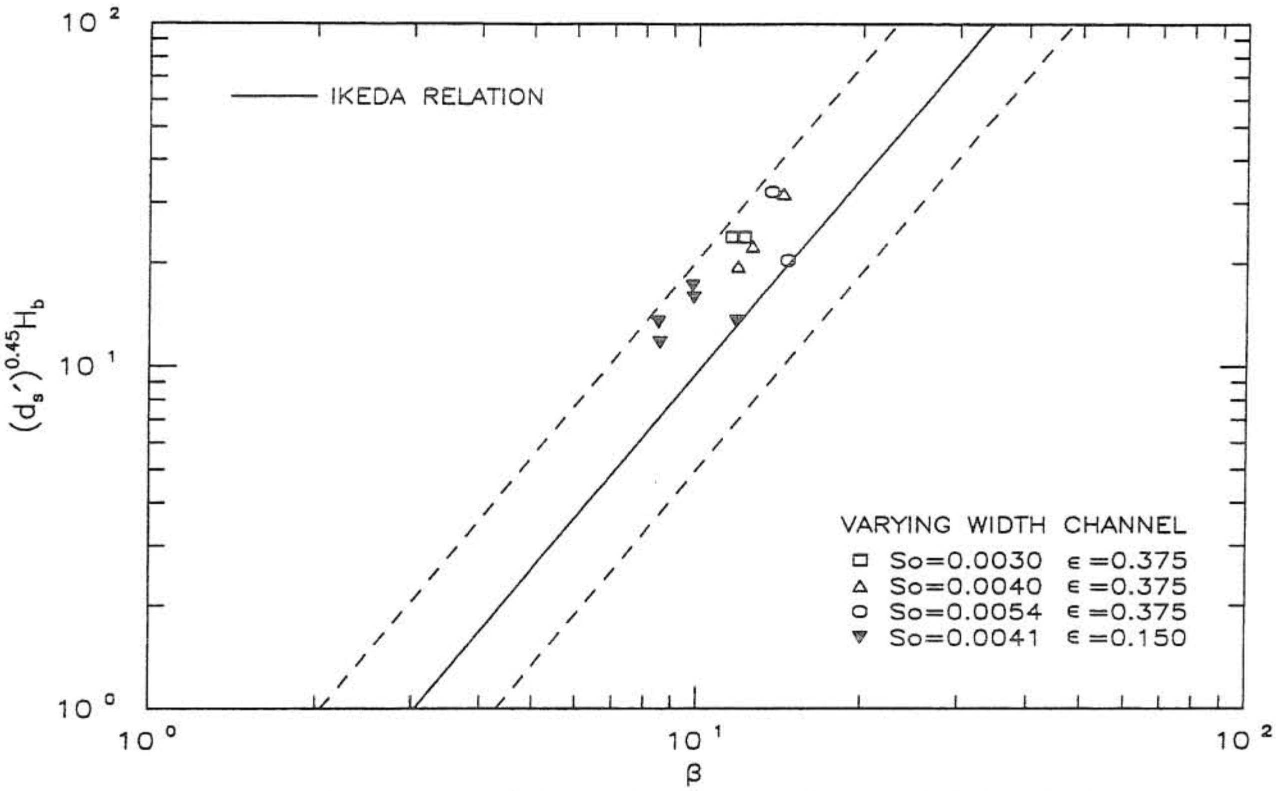


Figure 5.9 Comparison of the Ikeda dimensionless bar height relation with the alternate type bar heights

5.5 Analysis of Scour

The maximum scour, S, has been found to hold a linear relationship with the maximum alternate bar height, H_b, in channels of uniform width. From experimental results, Ikeda (1984) found that:

$$S = 0.75 H_b \tag{5.2}$$

A plot comparing the experimental values of alternate H_{Mb} and S for varying width channels to Ikeda's relationship is shown in Figure 5.10. The experimental values of alternate H_{Mb} were not converted to H_b values as in Figure 5.9 in order to maintain the proportion between the bar height and scour measurements. The figure shows that the slope of the data is larger than 0.75, however for the range of alternate H_{Mb} shown, the relationship fits the data well enough to consider (5.2) accurate for alternate bar type formations in channels of varying width. It is also evident from Figure 5.10 that there is less scour in channel 2 than in channel 1. All of the maximum scour points for channel 2, represented by the inverted triangles, fall below the line representing (5.2), whereas the points for channel 1 fall mostly above the line. Therefore, larger channel width variations result in larger scour depths as found by Colby (1964) from field measurements.

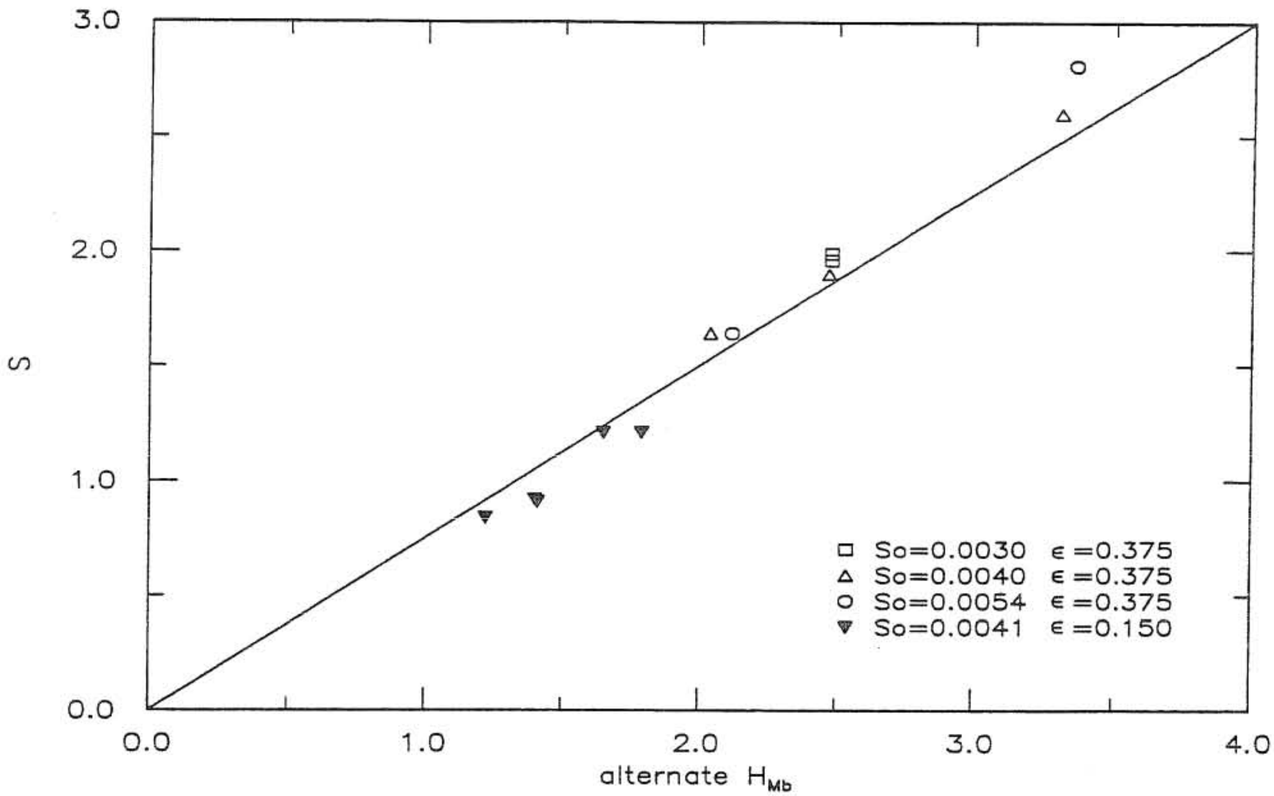


Figure 5.10 Maximum scour as a function of maximum alternate bar height, S_o, and ε

5.6 Analysis of Migrating Bars

No migrating bars were observed in any of the experiments performed in channel 1. However, for some of the flow conditions in channel 2, migrating bars were observed and the maximum bar height, wavelength, and celerity measurements taken are shown in Table 5.5. The definition of the wavelength of an alternate bar is shown in Figure 5.11. Measuring the wavelength was often difficult since there were only 1 or 2 visible fronts in the channel at a given time plus other bedforms were moving on top of the bars. The celerity of the fronts was measured by noting the position of the fronts over a known span of time.

TABLE 5.5 Bar Height, Wavelength, and Celerity Values For Migrating Bars

Q (l/s)	β	H_{Mb}	L* (m)	c* x 10^{-4} (m/s)
1.51	9.78	1.79	–	0.80
2.02	8.53	1.22	3.5	2.50
2.50	8.47	1.40	3.0	1.70

Figure 5.12 shows a comparison of migrating alternate bar heights as a function of β and S_o for the present set of experiments with experiments performed in a straight channel of uniform width (Niño and García (1992)). The unfilled symbols represent bar heights measured in the uniform width channel while the filled inverted triangles represent the heights

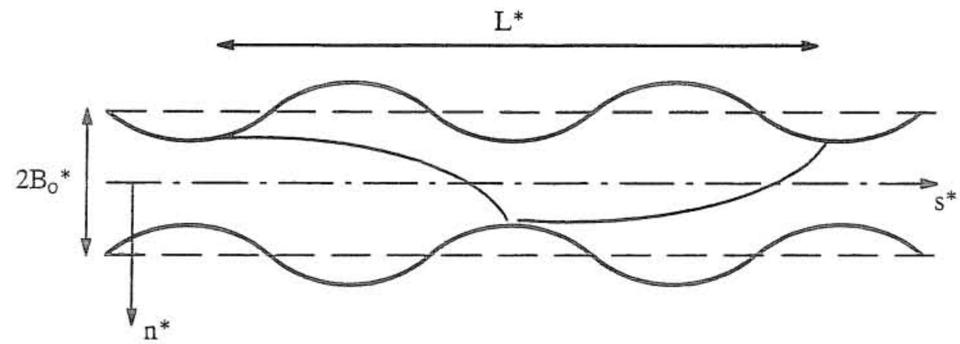


Figure 5.11 Definition sketch of alternate bars in a channel of varying width

of the migrating bars observed in channel 2. The migrating bar heights for the varying width channel are of the same magnitude as those of the uniform width channel. Also, the bar heights for both channel configurations seem to follow the same trend in that they increase with increasing β.

In Figure 5.13, the dimensionless wavelengths of the migrating bars are plotted as a function of β for the experiments of the present research as well as for a channel of uniform width from Niño and García (1992). The wavelength values for the varying width channel are of the same magnitude as those for the uniform width channel, however not enough points

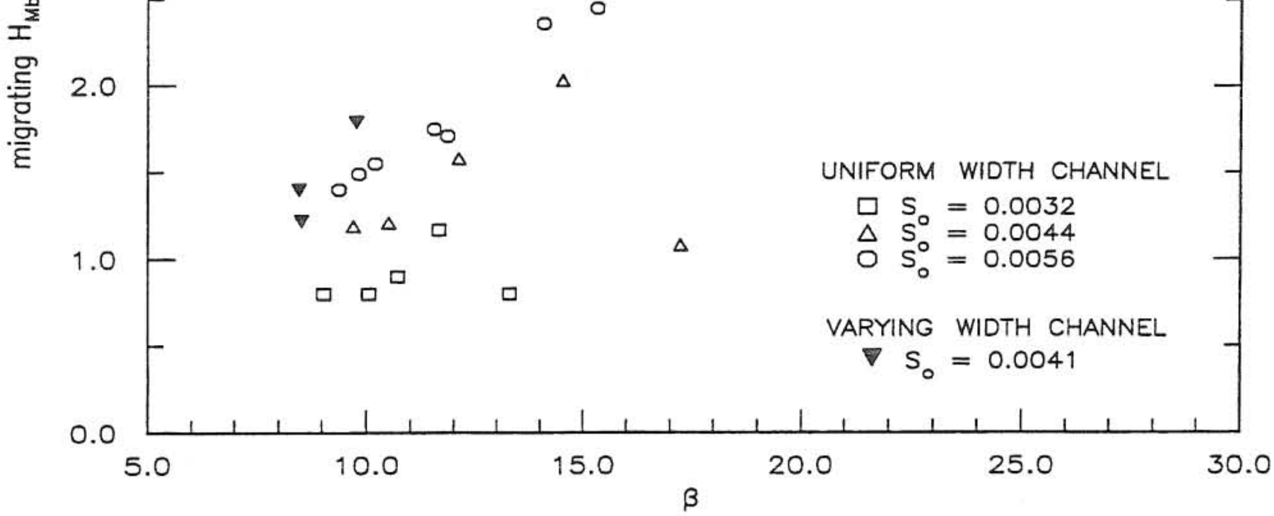


Figure 5.12 Dimensionless bar height of migrating bars as a function of β and S_o

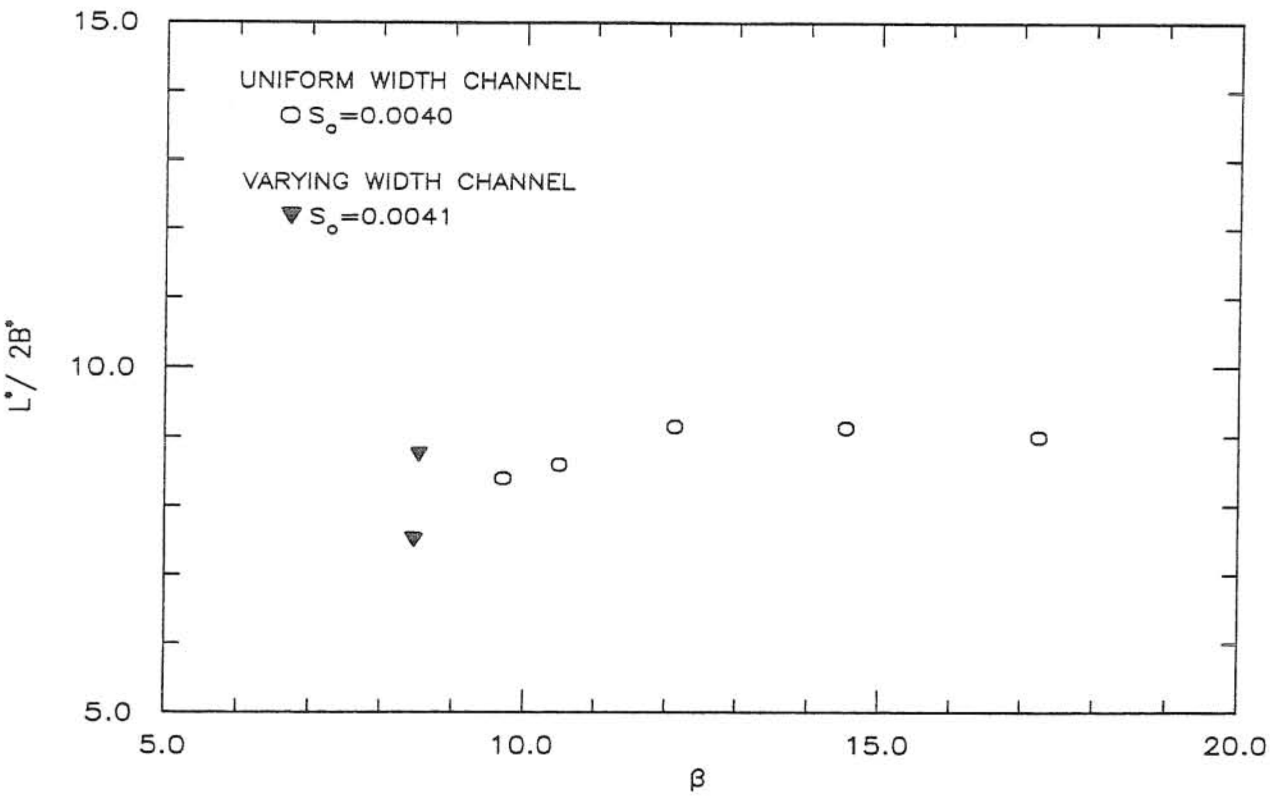


Figure 5.13 Dimensionless wavelength of migrating bars as a function of β

were measured in order to establish a definite trend with respect to β. Of particular interest is the fact that the value of the dimensional wavelength is approximately equal to twice the wavelength of the channel width perturbation which is 1.6 m. This fact is also true for the non-migrating bars in channel 1 as shown in Figure 5.4 and noted in section 5.3.

The dimensionless celerity as a function of β and S_o for the current set of experiments as well as those of Niño and García (1992) are plotted in Figure 5.14. Again, the magnitude of the dimensionless celerity values for the varying and uniform width channels are the same, but the present experimental values cover a larger range of migration speeds. The present values seem to follow a trend similar to the values found in a channel of uniform width which is that the migration speed decreases as β increases.

Since maximum bar height, wavelength, and celerity of the migrating features observed in the set of experiments in channel 2 are of similar magnitude as those observed in an equivalent uniform width channel (Niño and García (1992)), it may be concluded that such bedforms are indeed alternate bars. However, it is also apparent that these bars somehow interact with the forced bed deformation induced by the variable width channel which results in a tendency for the migrating bedforms to be suppressed. In fact, in none of the experiments in channel 2 was a well formed train of alternate bars, similar to those observed in an

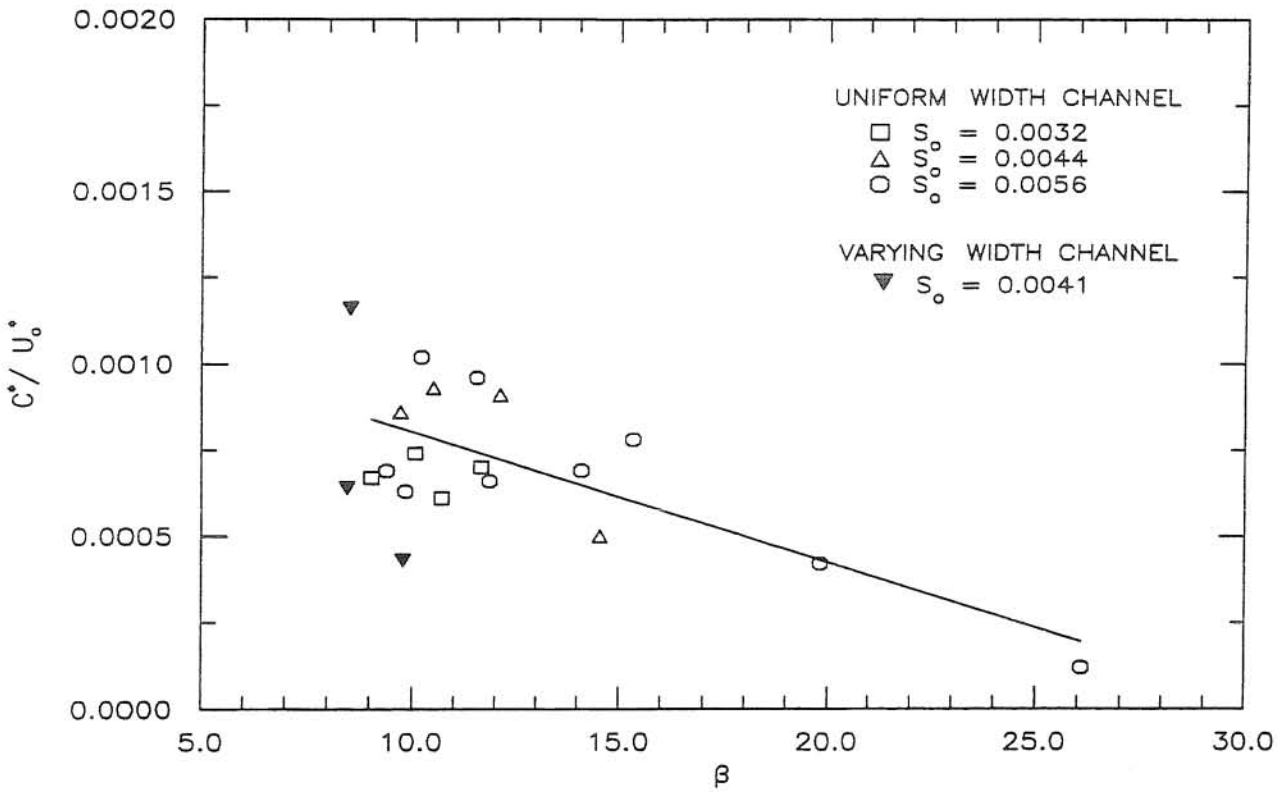


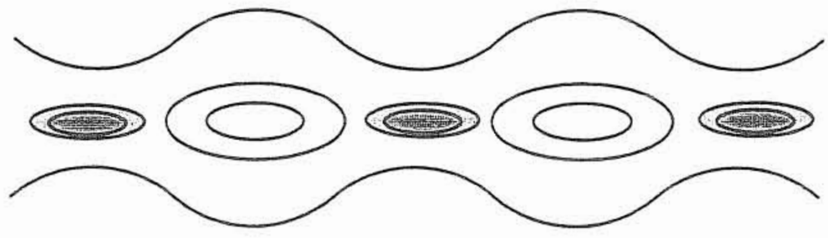
Figure 5.14 Dimensionless migration speed as a function of β and S_o

equivalent uniform width channel, ever observed, and at most, one or two distinct bar fronts developed in the channel. Moreover, as the channel width perturbation was increased, it was found that migrating bedforms were totally suppressed.

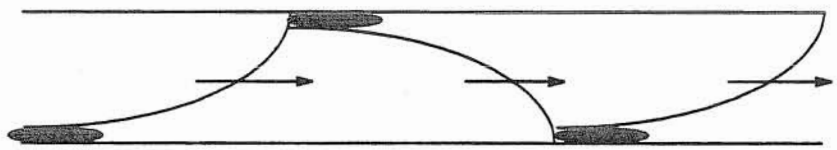
5.7 Suppression of Migrating Bars

Figure 5.15 shows the expected forced bed deformation due to a variation in channel width, the free alternate bar formations found in a straight channel of constant width, and their interaction as found in the present experimental study. In all of the cases, shaded areas represent areas of scour. Case 1 demonstrates the forced bed deformation predicted by the two-dimensional model as shown in Figure 3.13. In the narrow sections, a zone of scour is predicted while in the wide sections, deposition in the central region is expected. Case 2 shows alternate bars in a straight channel of uniform width as observed by Niño and García (1992). The arrows show that the train of alternate bars is moving at some constant speed in the downstream direction. Case 3 shows the findings of the present study for a channel of small width perturbation which corresponds to channel 2. Only one or two alternate bar fronts were observed in the channel at any certain time so that there was not a well formed train of bars as in the uniform width case. However, for some conditions, the bars did migrate. Therefore, the tendency for alternate type bars to develop persists in a channel of small width

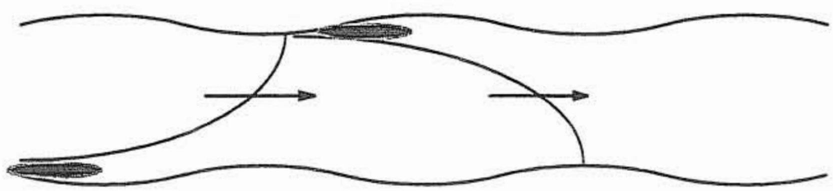
1) Forced bed deformation due to the variable channel width



2) Free alternate bars in a straight channel

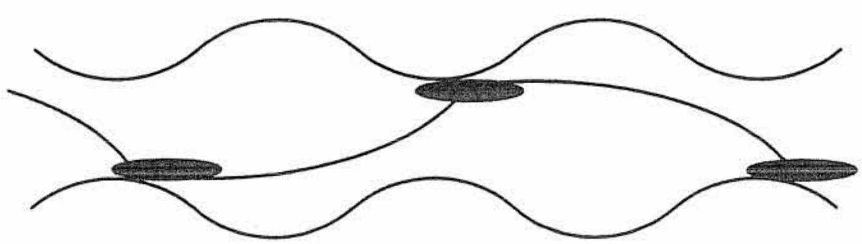


3) Sedimentation pattern found in a channel of small width perturbation (channel 2)



4) Sedimentation pattern found in a channel of larger width perturbation (channel 1)

a) Lower flow rates



b) Higher flow rates

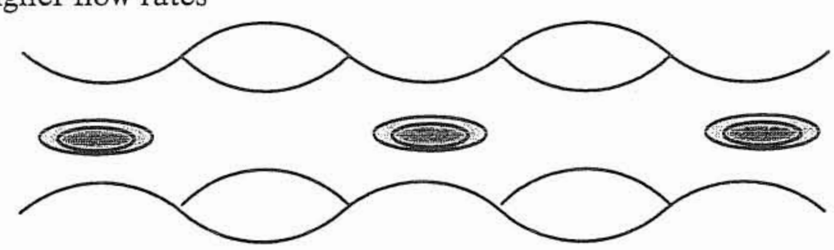


Figure 5.15 Schematic of the interaction between forced bed deformation and free alternate bars

perturbation, but they interact with the forced bed deformation which tends to suppress them. Case 4 displays the results of the present study for a channel of larger width perturbation which corresponds to channel 1. The sedimentation pattern for low flow rates is shown in case 4a. A fixed alternating pattern of deposition was observed with no migrating bedforms. Therefore, some tendency to develop an alternate bed deformation pattern persists, however migrating bedforms are totally suppressed. Case 4b shows the result of high flow rates in channel 1. The alternating pattern of bed deformation is totally suppressed and the resulting sedimentation pattern shows scour in the narrow sections with non-migrating point bar formations within the wide sections. Hence, there is still some tendency for bars to form, but their alternate character has been suppressed, and the scoured areas resemble those observed in case 1 due purely to the forced bed deformation.

The suppression of migrating bars described in cases 3 and 4 above is similar to that observed for uniform width meandering channels in Niño and García (1992). The forced bed deformation due to the curvature of the channel, whether it is curvature due to meanders or due to variable width, tends to suppress the migrating alternate bars. Niño and García (1992) found that an increase in curvature of the channel caused the suppression of alternate bars to be enhanced. In the present experiments, this is also true. For the slightly perturbed channel width, alternate type bars formed for some flow conditions but as the channel perturbation was increased, alternate bars were totally suppressed. In addition, Niño and García (1992) observed that an increase in flow rate also enhanced the suppression of alternate bars. Cases 4a and 4b in the present study lead to the same conclusion. In case 4a, although no migrating bars were observed, an alternating pattern of fixed bars was created, however in case 4b, the alternate pattern was totally suppressed.

6. COMPARISON OF MODELS WITH EXPERIMENTAL DATA

6.1 Analysis of the One-Dimensional Model

Corresponding to each experiment according to its flow conditions, values of the deviation from the mean bed elevation, η', were computed using the one-dimensional theory developed in Chapter 3. In order to make the measured bed elevations comparable to those computed, the measured bed elevations were integrated over each cross section and then regressed to obtain the deviation from the mean along the length of the channel. Plots showing the dimensionless theoretical and experimental values of the deviation from the mean bed elevation as a function of the dimensionless distance along the channel were constructed for all of the experiments performed.

The plots show that the one-dimensional model works better for the higher flows tested than for the lower flows which is to be expected considering low flows show display an associated alternate bar pattern as discussed in Chapter 5. For example, Figure 6.1 shows a comparison of η' as a function of s for two high flow rates at two different slopes in channel 1 and a high flow rate in channel 2. The points represent the experimental measurements and the solid line denotes the theoretical calculation. The broken line signifies the variation in the experimental channel width. The agreement between the measurements and the theory is quite good for all of the cases. The amplitude of the oscillations matches fairly well, although at the narrow channel sections, the measured bed elevations are slightly lower than the predictions. This implies that the depth to the trough of the oscillations at the narrow sections, which is analogous to the scour discussed in Chapter 5, is greater in the experiments than that predicted by the theory. Also, the measured points lag the theoretical prediction by a small amount for channel 1, but lead the predictions in channel 2.

Examples of lower flow rates at the same slopes and channel configurations are shown in Figure 6.2. There is more scatter than in Figure 6.1, but the amplitude of the measurements agrees reasonably well with the theory. The measured points lag the predicted bed elevations, but for both channels 1 and 2. The trough depth at the narrow sections shown by the measurements is greater than shown by the theory and also greater than the trough depth shown by the measurements for the larger flow rates. This is shown more explicitly in Figure 6.3. In the figure, the points represent the depth of the trough of the bed elevation oscillations of the measurements and the solid and dashed lines are the fairly constant one-dimensional model predictions of the trough depth of 0.34 for channel 1 and 0.14 for channel 2, respectively. In comparing the trough depths computed from the measurements, it is clear that a larger width perturbation causes a larger trough depth which is similar to the relationship between width perturbation and scour depth presented in Chapter 5. The model prediction for channel

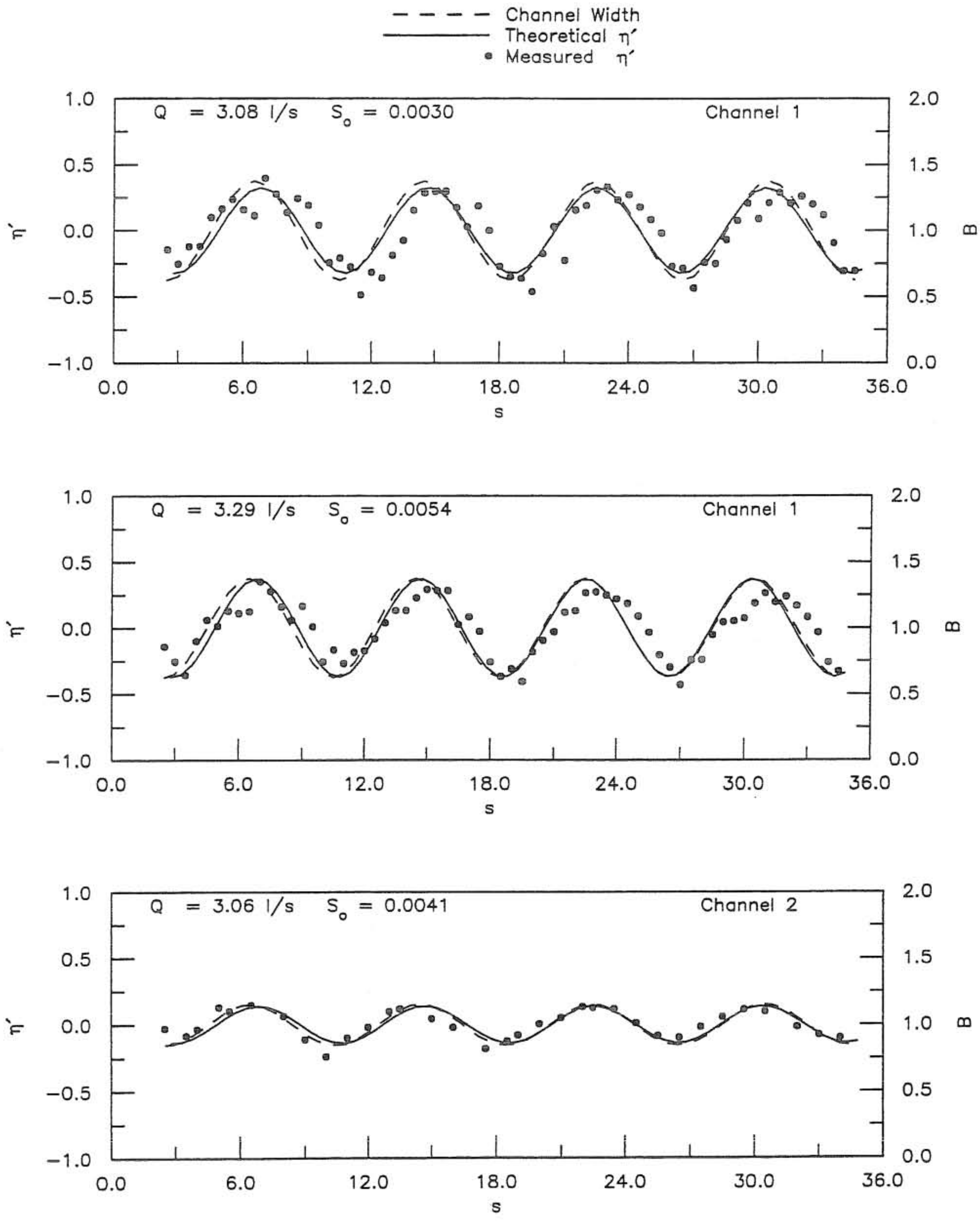


Figure 6.1 Dimensionless deviation from the mean bed elevation as a function of dimensionless distance downstream for a high flow rate

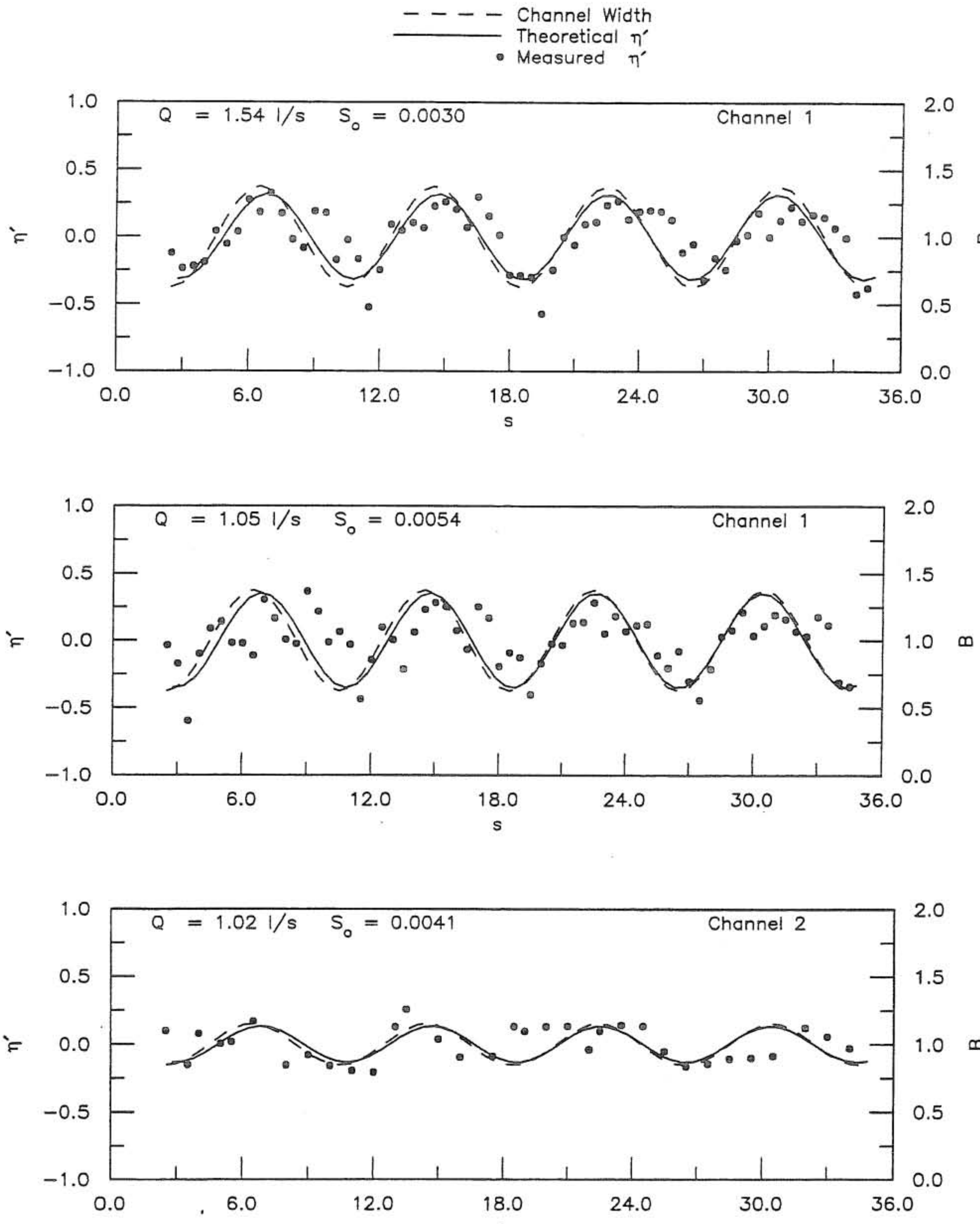


Figure 6.2 Dimensionless deviation from the mean bed elevation as a function of dimensionless distance downstream for a low flow rate

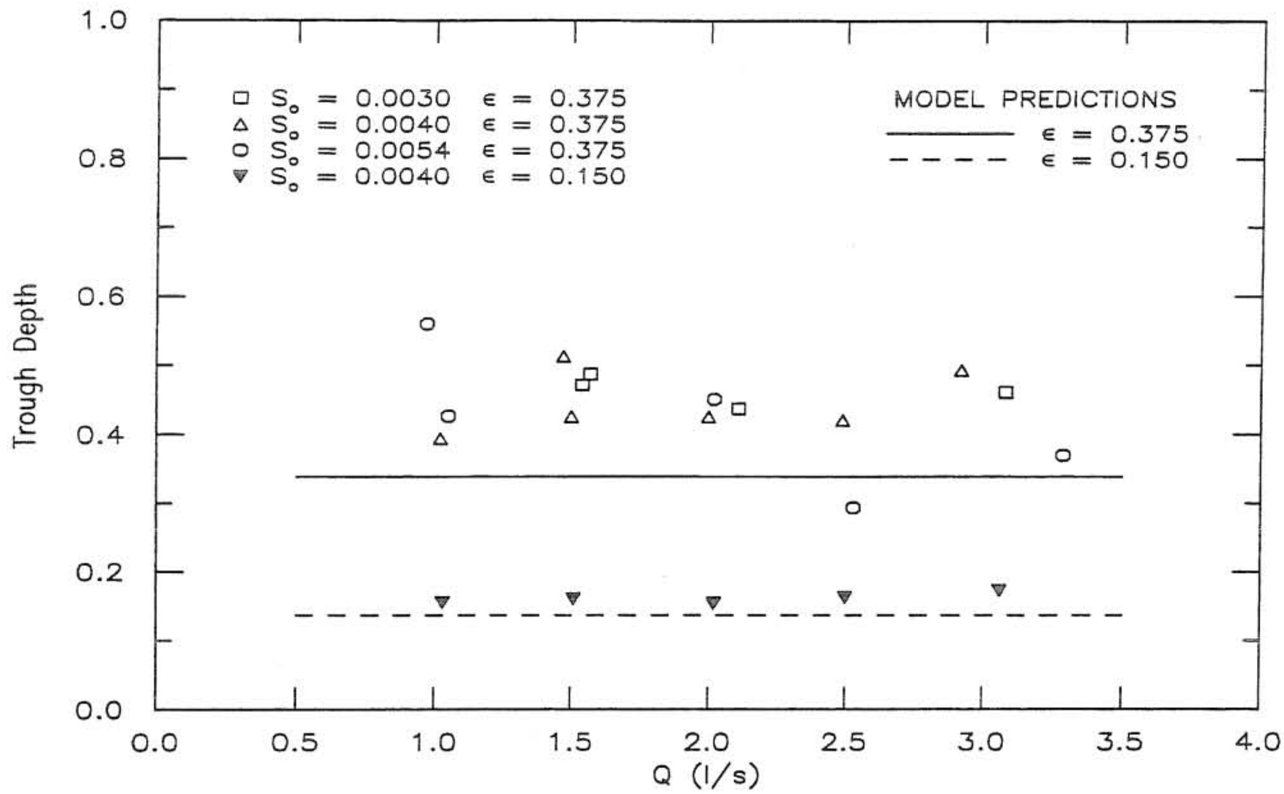


Figure 6.3 Trough depth of the bed elevation oscillations as a function of the flow rate, S_o, and ε

2 is slightly lower than the values computed from the measurements, but the measured values show that the trough depth does not vary greatly with the flow rate in agreement with the model prediction. The measured values in channel 1 show more scatter, but there is a tendency for the trough depth to decrease as the flow rate increases, whereas the model prediction for channel 1 shows a constant value which is again slightly lower than the measured values. Therefore, the measured values in channel 1 show that for lower flow rates, a larger trough depth, which can be interpreted as a larger amount of scour, is observed which is opposed to the conclusions of Colby (1964).

6.1.1 Prediction of the Deposition Amplitude

The deposition amplitude may be predicted by the one-dimensional model by calculating the amplitude of the periodic oscillations of the deviation from the mean bed elevation shown in figures such as those shown in Figures 6.1 and 6.2. Values of the deposition amplitude are calculated from the integrated experimental data for comparison. These values are analogous to the bar height values calculated from the raw data shown in Chapter 5. Figure 6.4 compares the model predictions and the experimental values grouped by slope and perturbation amplitude. The solid line represents a perfect correlation. The model predictions agree fairly well with the data. The agreement is better for the lower values of the

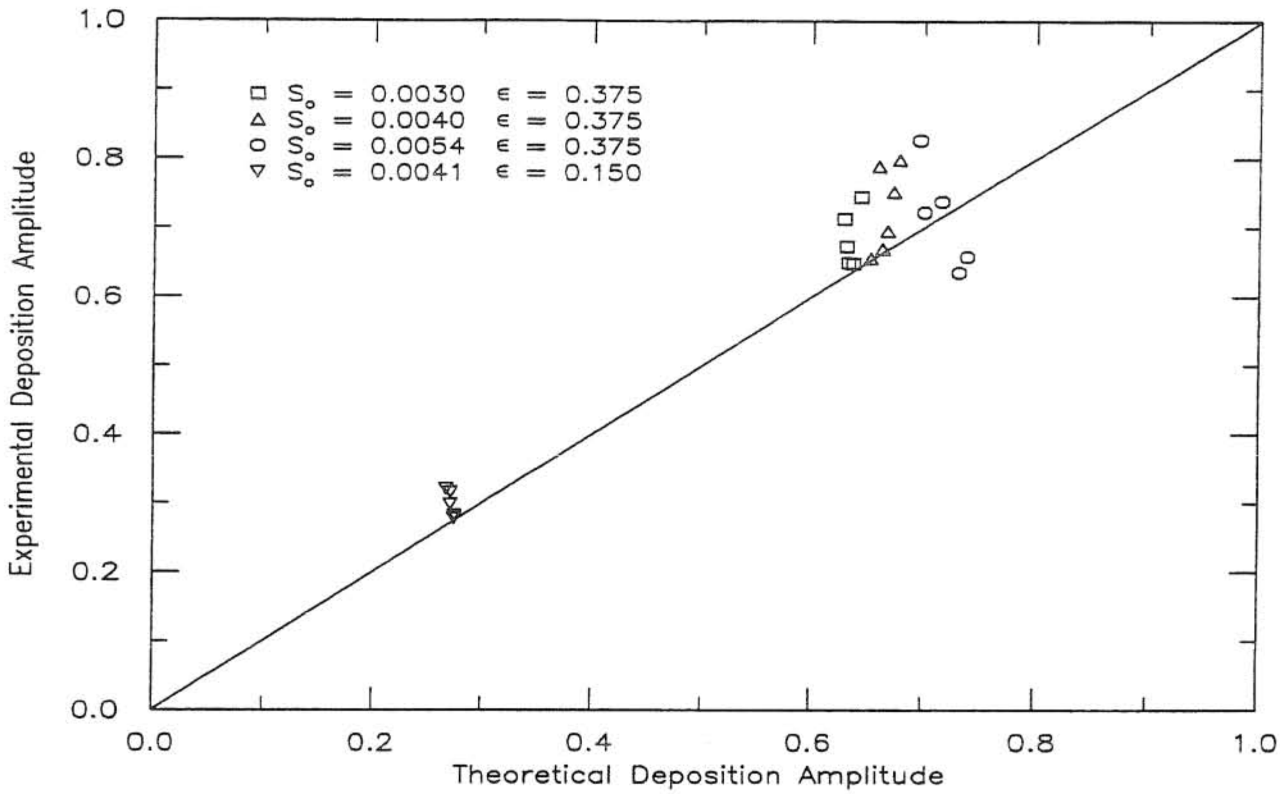


Figure 6.4 Comparison of the deposition amplitude predicted by the model and measured in the experiments

experimental deposition amplitude, but this is expected since from Figures 5.7 and 5.8, a lower bar height implies a smaller value of β and a higher value of the flow rate, for which the model agreement is generally better as shown in Figures 6.1 and 6.2.

The inverted triangles in Figure 6.4 correspond to the deposition amplitude found for channel 2. These values are much less than the deposition amplitude values found for channel 1. Therefore, larger channel width variations cause larger deposition amplitudes. This same conclusion was reached from the bar height analysis in Figures 5.7 and 5.8, however the calculation of the deposition amplitude from the integrated experimental data causes the effect of the width variation to be much more evident as observed in Figure 6.4.

6.1.2 Prediction of the Lag

As seen in the Figures 6.1 and 6.2, the lowest bed elevations of the measurements and of the one-dimensional theory occur downstream of the narrowest channel section. The lag found in the experiments can be computed by measuring the dimensionless distance, s, between the position of the lowest η' value and the position of the narrowest channel section in a given wavelength. The theoretical value of the lag can be determined by using (3.18c). Figure 6.5 shows the theoretical and experimental lag of the minimum bed elevation as a

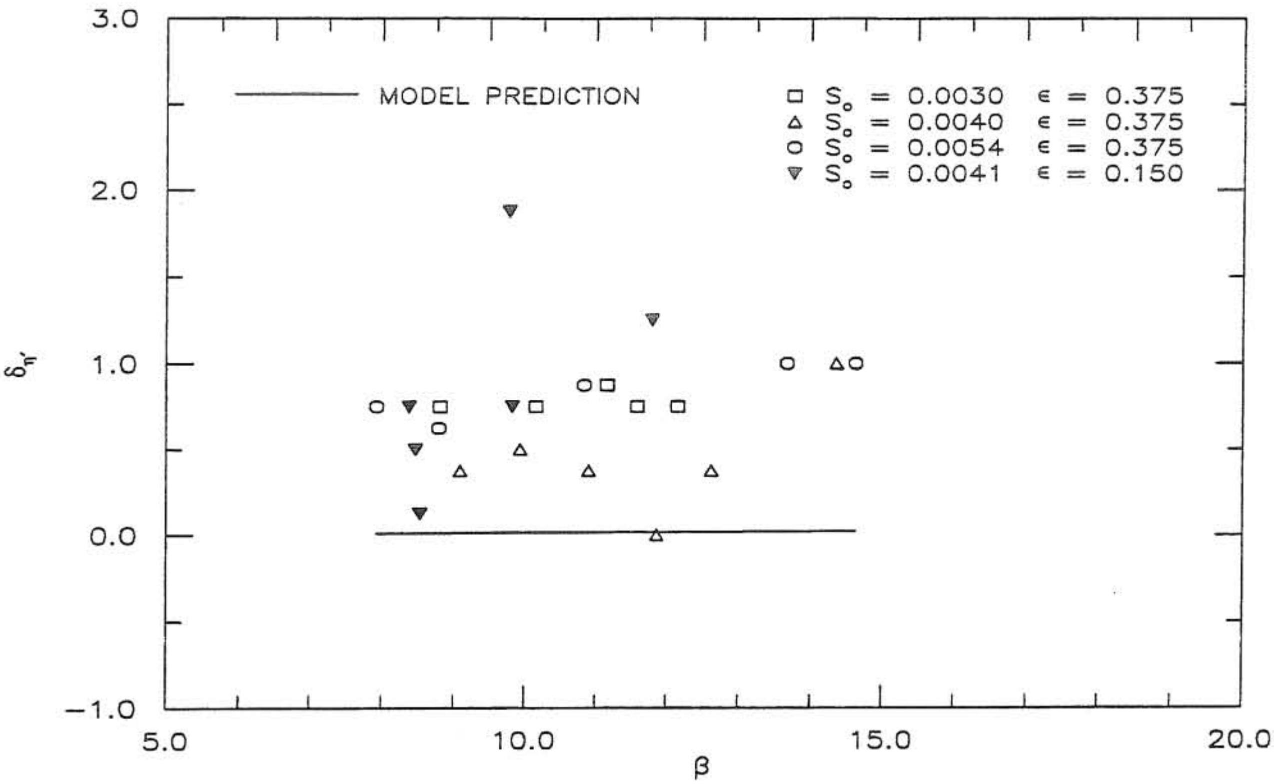


Figure 6.5 Lag of the point of minimum bed elevation as a function of β, S_o, and ε

function of β, the bed slope, and the dimensionless width perturbation. For all values of β, the theoretical lag has approximately the same value of 0.015 which is represented in Figure 6.5 by the solid line. The experimental lag shows no discernable relationship with β, the bed slope, or the width perturbation and does not compare well with the theoretical predictions.

6.2 Analysis of the Two-Dimensional Model

Values for the deviation from the mean bed elevation, η', along the centerline of the channel and along the widest and narrowest cross sections were computed for flow conditions tested in the experiments using the two-dimensional model developed in Chapter 3. Similar values were extracted from the data by subtracting the global mean bed elevation, η_o, from the raw bed elevation data. The global mean bed elevation was found by integrating the raw data in both the transverse and streamwise directions. Plots comparing the theoretical predictions of the centerline and cross sections to the experimental data were constructed for all of the flows tested.

Centerline plots of the dimensionless deviation from the mean bed elevation as a function of the dimensionless streamwise distance for two high flows at two different slopes in channel 1 and a high flow in channel 2 are shown in Figure 6.6. The solid line represents the values computed using the two-dimensional model and the points represent the

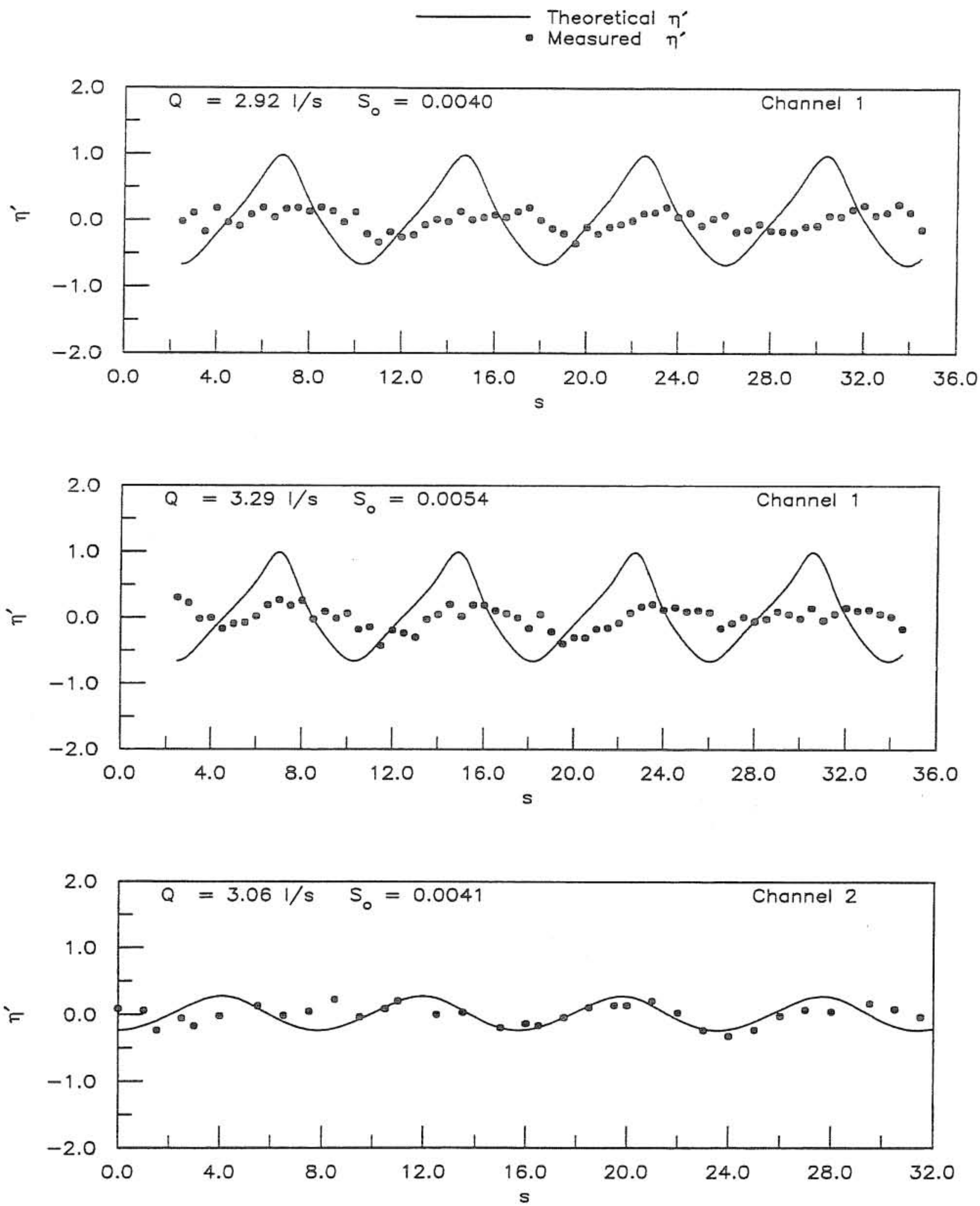


Figure 6.6 Dimensionless deviation from the mean bed elevation as a function of dimensionless streamwise distance for the channel centerline at a high flow rate

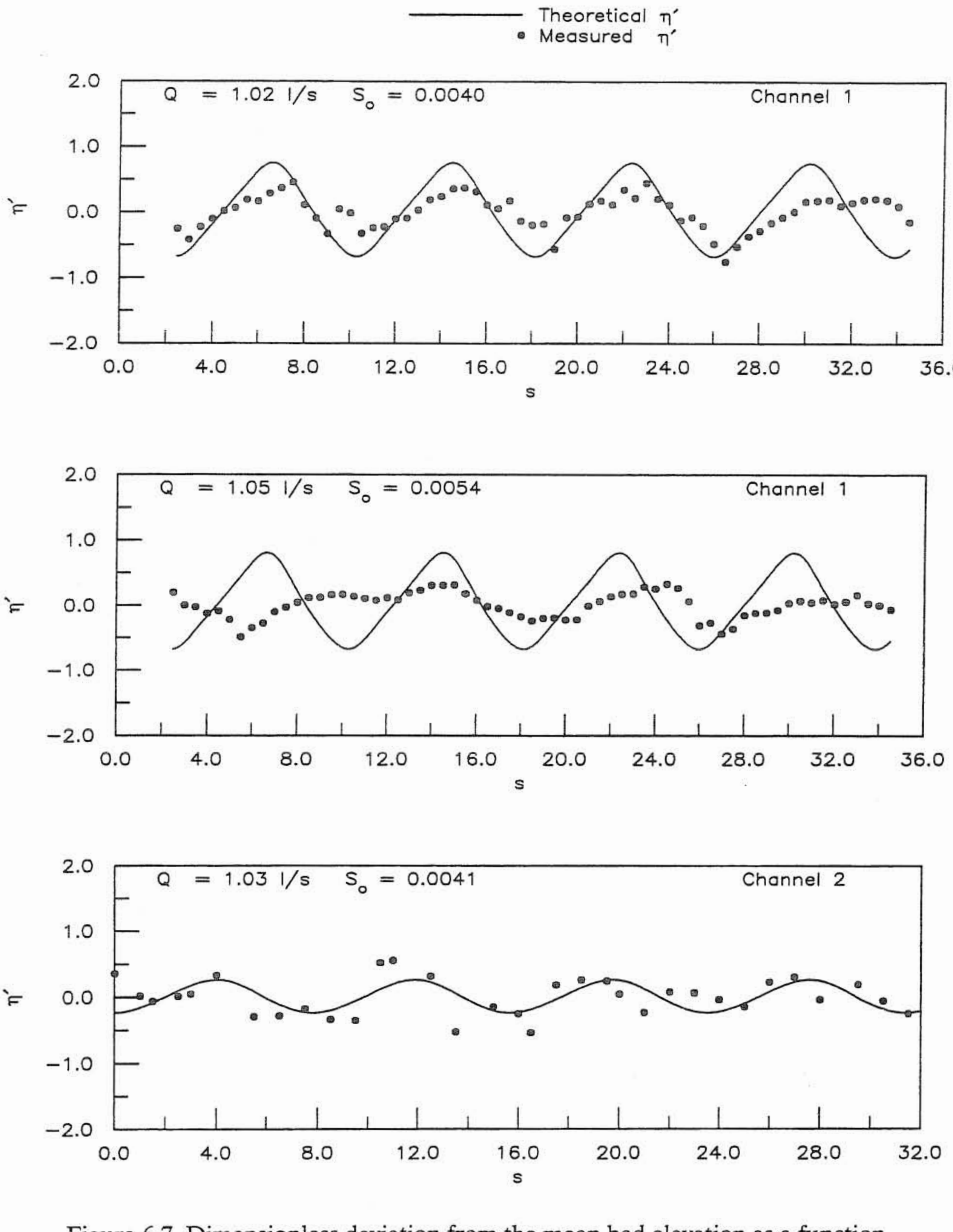


Figure 6.7 Dimensionless deviation from the mean bed elevation as a function of dimensionless streamwise distance for the channel centerline at a low flow rate

measurements. Comparing the results for a high flow in channel 1, it is clear that the theoretical predictions do not coincide with the measured values. The measurements do show an oscillating trend as predicted by the model but the amplitude is much less. Also, the measurements show a lag downstream of the theoretical values. By contrast, the plot of channel 2 in Figure 6.6 shows that the results from the experiments and the model agree quite well.

Figure 6.7 depicts lower flow rates for the same slopes and conditions shown in Figure 6.6. For channel 1, the results show better agreement with the measurements than the results for the higher flows. The theoretical calculation for a flow rate of 1.02 l/s and a slope of 0.0040 shows an amplitude which is very close to that of the measurements. A tendency for the measurements to oscillate in the same manner as the model prediction is apparent in both of the plots for channel 1. However, the measurements do lag the computation for both flows just as in Figure 6.6. The measurements for a low flow in channel 2 show some trend of oscillation, and the range of their scatter matches well with the amplitude of the oscillations shown by the model.

The ability of the model to predict transverse variation in bed elevation was also tested. In the following figures, the solid line represents the model calculation at the widest channel section, but the points represent the measured data at a cross section which is 0.2 m downstream from one of the widest channel sections in order to compensate for the effects of the sediment lag shown in the previous figures. Plots showing the transverse variation for wide channel sections for two high flow rates at two different slopes in channel 1 and a high flow rate in channel 2 are shown in Figure 6.8. The measurements for all of the cases form a concave shape whereas the model prediction shows a convex shape. That is, the flow pushes through the center of the wide sections instead of moving around each side of a central bar as predicted by the model. Much better results are shown in Figure 6.9 for low flows in wide channel sections. The shapes and magnitudes of the model computations match very well with the measured points.

Plots of the model predictions as compared to the measurements for narrow channel sections are shown in Figures 6.10 and 6.11. The measured points correspond to a cross section that is 0.2 m downstream from one of the narrowest channel sections, whereas the model bed elevations are calculated at the narrowest channel cross section exactly. Figure 6.10 shows two high flows for two different slopes in channel 1 and a high flow in channel 2. The concave shape of the theoretical computation agrees well with the experimental data for all of the cases. Figure 6.11 shows low flows for the same slopes and channel configurations. Again, the model predicts a concave bed elevation variation. The data shows a convex shape for both of the cases

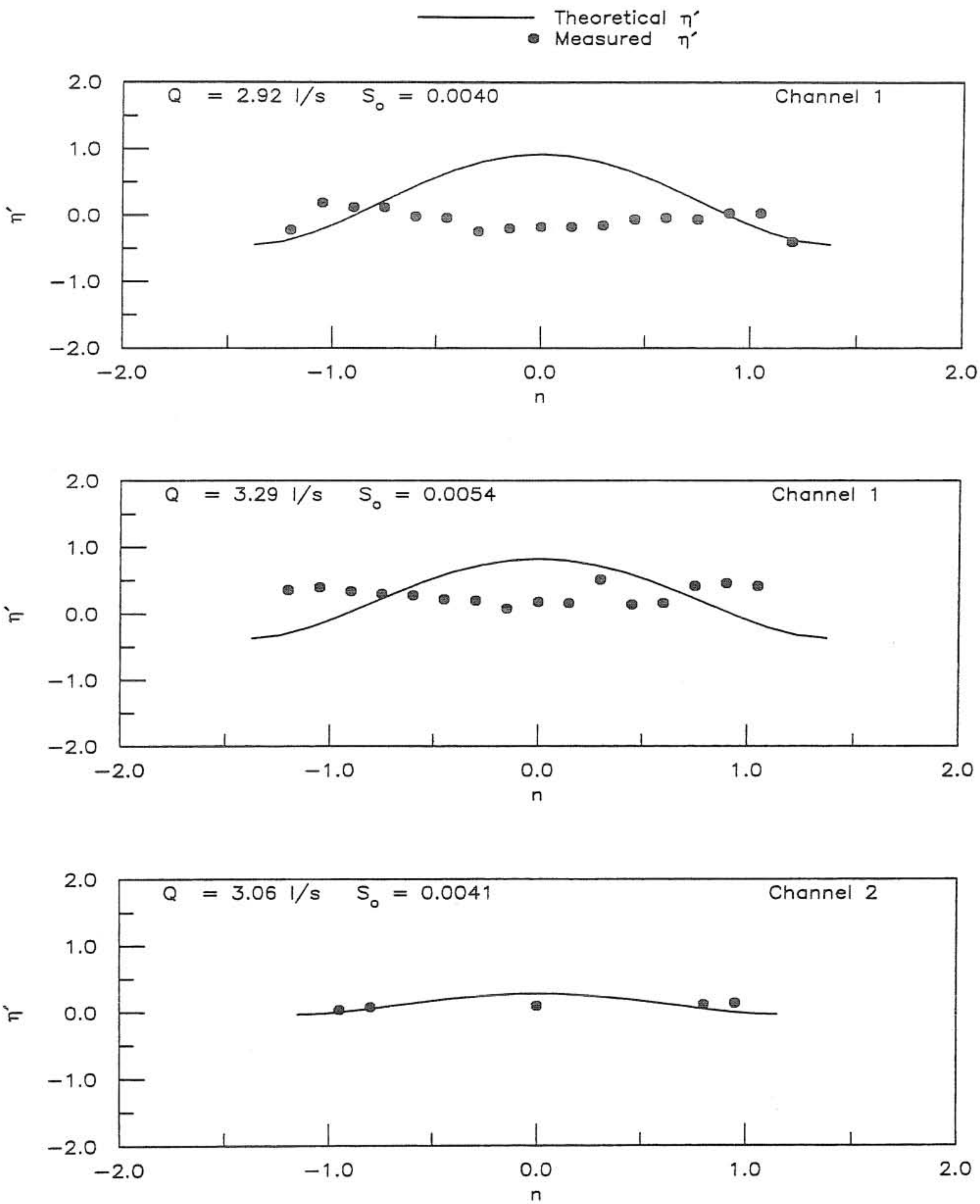


Figure 6.8 Dimensionless deviation from the mean bed elevation as a function of dimensionless transverse distance for a wide channel section at a high flow rate

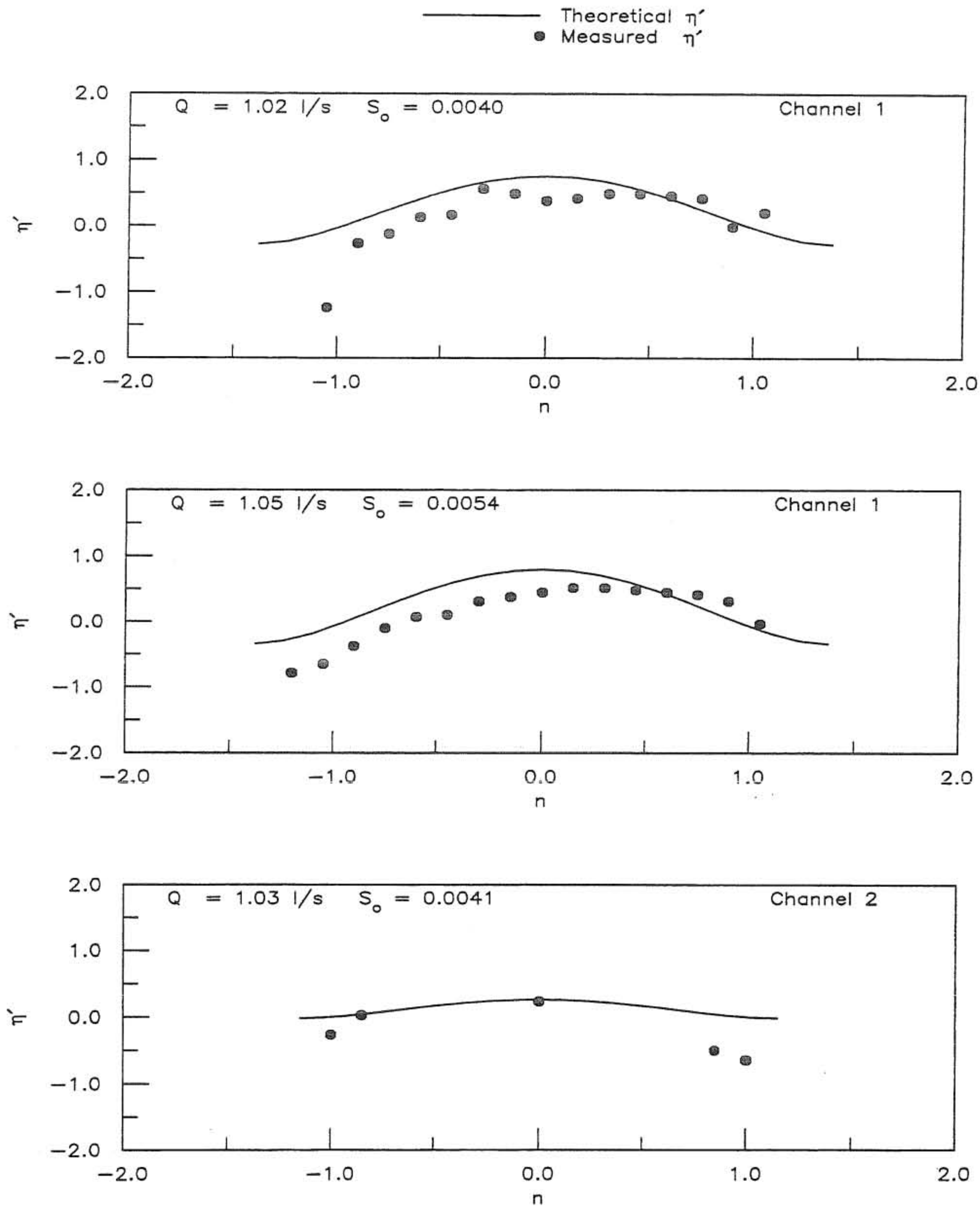


Figure 6.9 Dimensionless deviation from the mean bed elevation as a function of dimensionless transverse distance for a wide channel section at a low flow rate

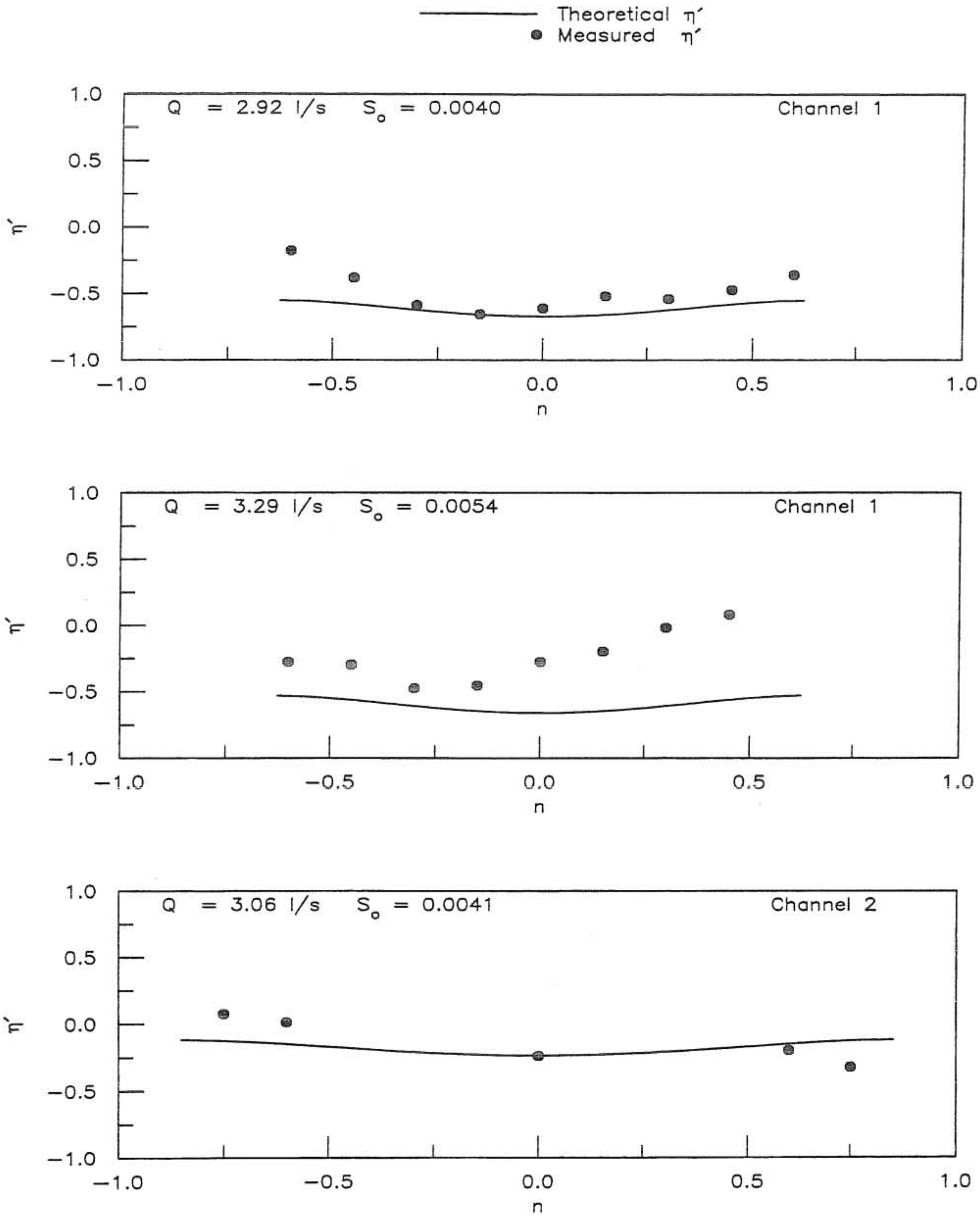


Figure 6.10 Dimensionless deviation from the mean bed elevation as a function of dimensionless transverse distance for a narrow channel section at a high flow rate

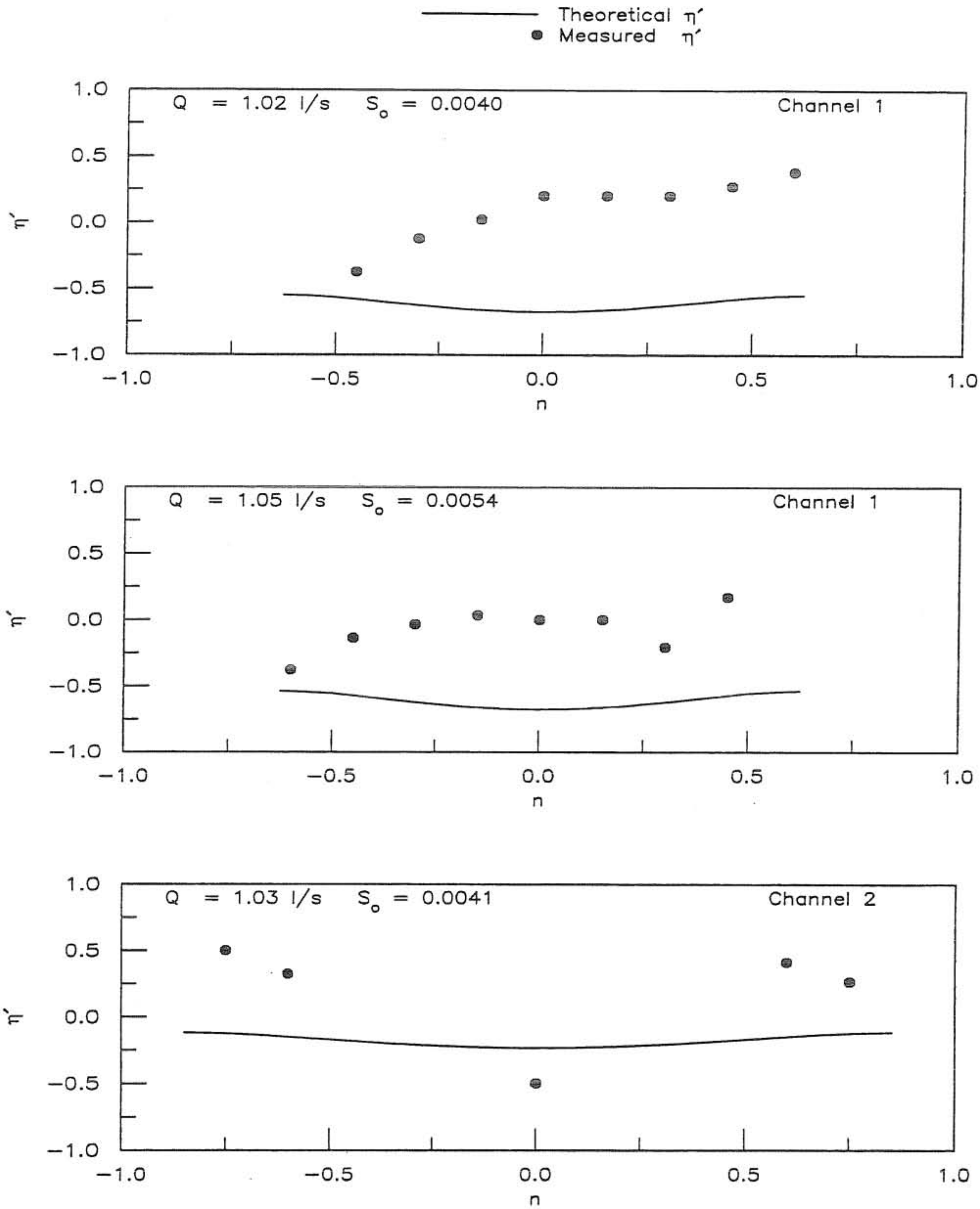


Figure 6.11 Dimensionless deviation from the mean bed elevation as a function of dimensionless transverse distance for a narrow channel section at a low flow rate

in channel 1 and a concave shape for channel 2. However, even though the shape of the transverse profile is the same for the low flow in channel 2, the magnitude of the measurements is much greater.

In summary, the two-dimensional model gives better bed elevation results along the centerline for lower flows in channel 1 and for higher flows in channel 2. For the transverse variation, the model shows better agreement in wide sections for lower flows and in narrow sections for higher flows in both channels 1 and 2.

The two-dimensional model can only predict the forced bed deformation due to the channel width perturbation as observed in Figure 3.13. However, Figure 5.15 shows that the effect of free alternate bars is also present in the system causing bar formations that can not be predicted with the model. During the experiments at low flows, the water moved from one side of the channel to the other, creating bar formations which are apparent in the plots of the channel cross sections in Figures 6.9 and 6.11. In some cases, the bars would emerge from the water or the flow depth would be so shallow on the bars as to not allow sediment transport which can not be explained by the model. The existence of the bar formations causes the model to show better results in the wide sections where a central bar is predicted in the model than in the narrow sections where the model predicts scouring. On the other hand, for higher flows in the channels, no bar formations were observed. For the most part, the water moved straight through the channel center. Scouring is observed in the narrow sections as predicted by the model, but some scour also occurs in the central area of the wide sections where the model predicts a central bar. Therefore, for higher flows, the model gives better results for narrow sections than wide sections.

It is likely that the problems with the two-dimensional model come from the fact that it is based on the linear theory of alternate bar formation. As stated in Chapter 2, the linear theory is unable to describe certain phenomena observed in experimental studies in channels of uniform width. As discussed by Blondeaux and Seminara (1985) and Seminara and Tubino (1992), the flow and bed deformation in a meandering channel exhibit a resonance phenomenon, which corresponds to a peak in the flow and bed response associated with a certain range of meander wavelengths. As shown by Seminara and Tubino (1992), a linear theory tends to highly over-estimate the flow and bed response near resonance compared to the results of a nonlinear theory, which is expected to better represent the actual behavior of the system. The two-dimensional linear theory developed herein also predicts the existence of resonance for the flow and bed deformation in a variable width channel, and based on the discussion of Seminara and Tubino (1992), it is expected that near resonance, the linear model would over-estimate the bed response. Plots of the deviation from the mean bed elevation as

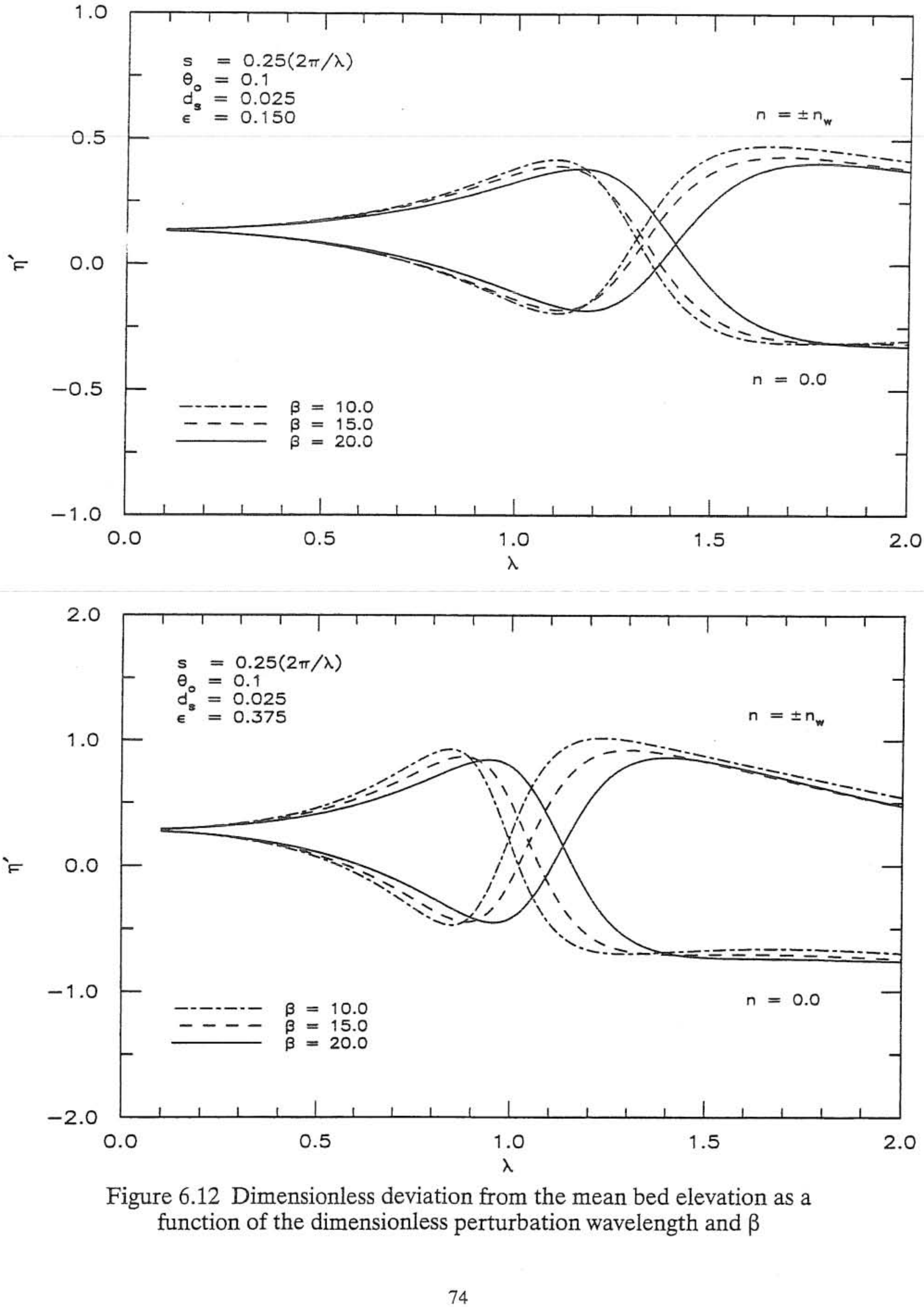


Figure 6.12 Dimensionless deviation from the mean bed elevation as a function of the dimensionless perturbation wavelength and β

a function of the dimensionless channel perturbation wavelength and β for the conditions used in the experimental study for both channels 1 and 2 are shown in Figure 6.12. The plots correspond to three specific points in the widest channel section. One point is on the channel centerline, n=0.0, and the others are at the channel walls, $n=\pm n_w$. The resonance effect occurs at wavelengths between 1.2 and 1.6 for $\varepsilon=0.150$ and 0.9 and 1.2 for $\varepsilon=0.375$. The wavelength of the varying width channels in the experimental study was 0.8. This value is fairly close to the the resonance range for both channels so that the model results may be affected, where the effects on channel 1 are stronger than channel 2, such that they do not concur with the measurements. Another problem is that the linear theory can not account for the coexistence of free and forced bars. From the discussion in Chapter 5, it is clear that some interaction of migrating and non-migrating bars did occur in the varying width experiments in channel 2, and only non-migrating bars occurred in channel 1. The analysis of the coexistence and interaction of free bars and forced bed deformation would require the development of nonlinear theories such as that of Tubino and Seminara (1990), who analyzed the interaction between free and forced bars in meandering channels.

The occurrence of resonance in the varying width channels leads to a few speculations. The suppression of migrating bedforms is observed in the present study for conditions under which resonance must occur according to the linear theory. In meandering channels, suppression of migrating bars also occurs near resonance as discussed by Niño and García (1992). Therefore, it is possible that this idea is true in the general sense, that is, that migrating bedforms are suppressed near resonance regardless of the configuration of the channel. In order to prove this, experiments with channel wavelengths which are not near resonance conditions are necessary to observe whether or not migrating bedforms are suppressed. Another point of interest is the possibility that resonance may lead to the formation of braids in a channel of variable width. Since the two-dimensional model predicts a central bar in the wide channel sections, and the bed response is over-estimated near resonance, the conditions may be sufficient to cause central bar emergence. Thus, the flow must split into two reaches around the central bar which may initiate braiding.

7. CONCLUSIONS

The aim of this research has been to investigate the effects of a variation in the width of a channel on the bed elevation in the channel. To accomplish this, several methods of analysis of the problem were employed including the examination of the results of previous studies related to this phenomenon, the development of theoretical models to calculate the variation in streamwise and transverse velocities, flow depth, and bed deformation, and the measurement of the water surface and bed elevation variation through experiments.

As discussed in Chapter 2, the emphasis of early research on the effects of channel contractions on bed deformation centered on the determination of the flow depth, slope, and bed elevation at equilibrium. Through calculations and experiments, Exner (1925), Straub (1934), Laursen and Toch (1954), and Komura (1966) developed relations to compute these values and concluded that sediment moves faster in channel contractions than in uncontracted sections meaning scour occurs in narrow channel sections. Field measurements analyzed by Colby (1964) yielded the results that scour increases with increasing discharge, scour is proportional to width reduction at a certain flow rate, and scour is independent of the length of a stream reach. Hotchkiss (1990), by extending the work of Garde and Range Raju (1985), developed relationships for the equilibrium depth, slope, and bed elevation based on the width alone where the width is any function of the distance in the streamwise direction. Tsujimoto (1987) developed a model to predict the equilibrium transverse bed profile for a channel with a sinusoidal width variation and reached the conclusion that in narrow channel sections, the bed profile has a convex shape and in wide sections, the bed profile shape is concave. One of the goals of this work has been to compare the above relations and conclusions to the results obtained from the theoretical and experimental study.

The effect of bedforms in a channel of varying width has not previously been studied, however a great deal of research has been conducted on bedforms in channels of uniform width. Relationships between the wavelength, celerity, and height of alternate bars and flow and sediment parameters are obtained using the two-dimensional linear model developed by Blondeaux and Seminara (1985). The model yields good results, but some problems exist including the prediction of exponential bar amplitude growth where in reality, a finite amplitude is maintained, the failure to obtain meaningful results near resonance, and the inability to account for the coexistence of forced and free bars. Weakly nonlinear theories such as those of Colombini et al. (1987), Tubino and Seminara (1990), and Seminara and Tubino (1992) have been developed to improve the analysis. The analysis of bedform effects in varying width channels and their relationship to those in uniform width channels has been another goal of the present work.

The linear theory is used as a basis for the one- and two- dimensional models used to obtain the values of the equilibrium velocity, flow depth, and bed elevation in a channel of sinusoidally varying width as developed in Chapter 3. The final form of the equations for the one-dimensional model imply that there is a phase shift between the channel width and the calculated parameters. The streamwise velocity and the flow depth are 180° out of phase with the channel width meaning that the highest velocity and flow depth occur in the narrowest channel sections and the lowest occur in the widest sections. The bed elevation lags downstream of the channel width by a small amount that depends on β, the dimensionless wavelength, the dimensionless sediment diameter, and the Shields parameter. The value of the lag of the bed elevation increases with increasing β, d_s, and θ but decreases as λ increases. This means that as the flow rate increases, the point of maximum scour moves upstream which is contrary to the results of Hotchkiss (1990). The two-dimensional model describes a similar situation in which the point of maximum scour occurs just downstream of the narrowest section. The shape of the bed profile in that section is concave and the flow depth profile is convex in shape. The streamwise velocity is slowest in the narrowest sections and the transverse velocity has no influence on the flow. The transverse velocity has an effect as the flow moves into the wider sections and spreads out around a central area of deposition or central bar. Just downstream of the widest channel section, the bed elevation reaches its largest value and the profile is convex. The profile of the flow depth in that section is concave. The bed elevation profiles are exactly opposite to the results found by Tsujimoto (1987).

The analysis of the experimental study in Chapter 5 shows that for some conditions, an interaction between forced bed deformation and free alternate bars occurred in the channels. Non-migrating alternate bar formations were observed in channel 1 for lower flow rates. Higher flow rates in channel 1 yielded scour along the centerline creating non-migrating point bars on both sides of the channel in the widest sections. The scour occurring in the narrowest sections formed a V-shape for the highest flows. In channel 2, migrating alternate bars were observed for some flow conditions and non-migrating bars could be distinguished for all but the highest flowrate. Both fixed and free bars had wavelengths that were approximately twice the wavelength of the channel.

The analysis of both alternate and point bar heights show that the dimensionless bar heights increase with increasing β and the perturbation magnitude. The channel slope, however, has no distinguishable effect on either type of the bar height. Comparing the two types of bars, it is clear that the magnitude and range of values of the alternate bar heights are larger than those of the point bars. The alternate type bar heights may be compared with the heights of free bars in channels of uniform width. That comparison shows that alternate type bar heights in varying width channels show values similar to those of uniform width channels and may be described by the bar height relationship developed by Ikeda (1984).

The analysis of the maximum scour depth in Chapter 5 demonstrates that an increase in the perturbation of the channel width increases the amount of scour as observed in field measurements by Colby (1964). Also, the maximum scour in the varying width channel follows the scour relationship found by Ikeda (1984) for channels of uniform width.

The analysis of the migrating bars indicates that the free bars observed in the varying width channel have the same character as those observed in channels of uniform width. A comparison of migrating bar heights and wavelengths shows that the magnitudes are the same for the present set of experiments as those found in a uniform width channel by Niño and García (1992). The migrating bar heights, like the data from Niño and García (1992), also increase with increasing β. Additionally, in the varying width experiments, the bar celerities tend to decrease with an increase in β and have a magnitude close to those observed by Niño and García (1992).

In summary, the effect of the channel width on bedforms can be described as follows. A channel of uniform width produces a sequence of free bars with a certain wavelength and speed which depend upon the flow conditions. If the width is slightly perturbed from the uniform value, free bars exist, but not in the continuous sequence observed in a uniform channel, due to the bed deformation forced by the width perturbation which tends to suppress them. A larger perturbation in width shows increased suppression of alternate bars since for low flow rates, only a non-migrating alternating pattern of bar formations exist and for higher flow rates, bars form but they are fixed and have no alternate pattern. Migrating alternate bars in channels of varying width are therefore affected by the magnitude of the width perturbation and the magnitude of the flow rate. An increase in either of these will increase the degree of suppression of the migrating alternate bars. The same conclusions were reached by Niño and García (1992) in their discussion of migrating bars in meandering channels of uniform width.

Chapter 6 gives a comparison between the bed elevations measured in the experimental study and those calculated with the one- and two- dimensional models. The one-dimensional model yields bed elevations which compare well with the data from all of the experiments. Better results are obtained for the higher flow rates of those tested. The model does, however, slightly underestimate the magnitude of the depth of the trough of the bed elevation oscillations at the narrowest channel sections. The one-dimensional model may also be used to predict the deposition amplitude and the lag of the bed elevation. The predicted deposition amplitudes match reasonably well with the data, although better agreement is obtained for lower values of the deposition amplitude which correspond to higher flow rates.

The model concurs with the measurements on the point that an increase in the width perturbation causes an increase in deposition amplitude. The lag of the bed elevation predicted by the model maintains a constant value of 0.015 for all of the flow conditions tested in the experimental study. The measured values vary quite a bit and show no relationship with β, the bed slope, or the width perturbation. The two-dimensional model is used to obtain the values of the bed elevations along the channel centerline and along the transverse sections in the widest and narrowest channel sections. The centerline predictions for channel 1 have higher values than obtained with the measurements and show better results for lower flow rates. For channel 2, the centerline predictions are better for higher flow rates. For the transverse profiles, the two-dimensional model yields closer results in both channels 1 and 2 in wide sections at lower flow rates because the profile of the bar formations agree with the predicted convex profile and in narrow sections at higher flow rates because the profile of the scouring along the channel centerline agrees with the predicted concave profile.

The problems of the two-dimensional model are most likely due to problems which are inherent in the linear theory used to develop the model. As described by Blondeaux and Seminara (1985) and Seminara and Tubino (1992), the linear theory does not generate accurate results near resonance, and the dimensionless wavelength used in the experimental study herein is close to the resonance range found for the experimental conditions. Also, the linear theory can not describe the effects of the interaction of forced bed deformation and free bars which occurred in the experiments. Therefore, the model may not be able to give accurate results for this set of experiments. Some progress has been made in using nonlinear theories to analyze resonance effects and free and forced bar interaction in channels of uniform width such as those of Tubino and Seminara (1990) and Seminara and Tubino (1992). Perhaps those methods would yield better results than the linear theory in the case of a varying width channel as well.

There are a few possibilities to consider due to the occurrence of resonance in the varying width channels. The first stems from the facts that the suppression of migrating bars was observed by Niño and García (1992) in meandering channels near resonance and that the same phenomenon occurred in the experimental study herein. Therefore, it may be that resonance causes the suppression of migrating bars in general, however proof of this may only be gained by studying the behavior of alternate bars in channels where conditions are not within the range of resonance. Another speculation comes from the possibility that resonance may provide a mechanism for the emergence of the central bar predicted by the two-dimensional model. If this is true, then resonance may lead to the formation of braids in channels of variable width.

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APPENDIX I

Raw Measurements of the Water Surface and Bed Elevation for the Experiments Performed in Channel 1

Water Surface Elevation Measurements (mm)

Q = 1.54 l/s S = 0.0030 beta = 12.15 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	146.5	148.0	144.5	147.5	144.0	146.0	144.0	152.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	150.0	146.0	148.5	144.0	144.0	144.0	146.5	145.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	144.5	145.0	145.0	144.5	144.5	146.0	145.0	144.5	145.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	145.5	145.0	145.0	144.0	144.5	144.5	144.0	144.0	147.0	146.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	146.0	146.5	144.5	145.0	145.0	145.0	145.0	145.0	145.5	146.5	147.0	146.0	0.0	0.0
1.0	0.0	0.0	143.0	145.5	146.0	145.5	145.5	145.5	145.5	145.0	145.5	146.0	146.5	146.5	149.0	0.0	0.0
1.1	0.0	144.0	142.0	143.5	146.5	145.5	146.0	146.0	145.5	145.5	145.5	146.5	146.5	147.5	148.0	149.0	0.0
1.2	150.5	144.0	142.0	143.5	148.0	146.5	146.0	146.0	146.5	146.0	146.0	146.0	147.0	146.5	148.5	148.5	148.5
1.3	152.0	145.5	142.5	142.5	148.0	147.5	146.5	147.0	146.0	146.0	146.5	146.0	146.0	146.0	147.0	148.0	148.0
1.4	148.5	146.0	143.0	143.0	147.5	147.0	147.0	146.5	146.0	146.0	146.0	145.5	146.5	146.5	146.5	147.5	147.0
1.5	0.0	150.5	145.5	144.0	148.0	147.5	146.5	146.5	146.0	147.5	146.5	145.5	146.0	146.0	146.5	148.0	148.0
1.6	0.0	0.0	150.0	145.5	148.0	147.0	146.5	146.0	145.5	145.5	146.0	146.0	146.5	146.5	147.0	147.0	0.0
1.7	0.0	0.0	0.0	149.0	147.5	147.0	146.5	146.5	145.5	146.0	147.5	147.0	146.5	147.5	147.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	148.0	147.0	147.0	145.5	146.0	146.0	146.5	146.5	147.0	148.0	147.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	148.5	147.5	147.5	146.5	146.0	147.0	146.5	147.5	147.5	148.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	148.0	147.5	148.0	147.5	147.5	147.5	148.0	148.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	148.0	148.0	147.5	148.5	149.0	148.0	149.5	149.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	148.5	148.5	148.5	148.0	147.5	150.0	148.5	149.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	149.5	148.5	148.5	149.0	148.5	149.5	150.0	151.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	150.5	150.0	149.5	150.0	149.0	149.0	149.5	149.5	151.0	150.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	152.0	150.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	151.0	0.0	0.0
2.6	0.0	0.0	150.5	151.5	150.0	149.5	148.5	149.0	149.0	150.5	148.5	149.0	149.5	149.5	149.0	0.0	0.0
2.7	0.0	150.0	152.0	150.0	149.5	149.0	149.0	148.5	148.5	149.0	149.0	149.5	149.5	149.5	148.5	152.0	0.0
2.8	0.0	150.5	150.5	149.5	149.5	148.5	149.0	148.5	148.5	148.5	148.5	149.5	149.0	148.5	148.5	150.5	151.5
2.9	152.5	151.5	150.5	150.0	149.5	149.0	148.5	149.0	149.0	149.0	148.5	149.0	149.0	149.0	148.5	150.0	152.0
3.0	153.5	152.5	151.5	149.5	150.0	149.5	149.0	149.0	149.5	149.0	149.0	149.5	149.5	149.0	149.5	151.0	153.5
3.1	0.0	151.0	150.5	150.5	150.5	149.5	149.5	150.0	149.0	149.5	149.5	150.0	149.5	149.5	151.5	150.5	154.5
3.2	0.0	0.0	151.0	151.0	150.0	149.5	149.5	149.5	149.5	150.0	150.0	150.0	149.0	149.0	151.0	153.0	0.0
3.3	0.0	0.0	151.0	152.5	151.5	151.5	151.0	150.5	151.0	150.5	151.0	151.0	149.5	149.0	155.0	156.0	0.0
3.4	0.0	0.0	0.0	151.5	152.0	152.5	152.0	151.0	151.0	151.0	151.5	151.0	152.5	154.5	154.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	153.5	152.0	151.5	151.5	152.0	152.0	152.0	153.0	154.0	155.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	154.5	153.5	153.0	152.0	152.5	153.5	154.5	155.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	157.0	155.5	153.5	154.0	153.5	153.5	155.0	156.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	157.0	155.0	153.5	152.5	153.0	154.0	154.5	155.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	153.0	155.0	154.0	152.5	153.0	153.5	154.0	155.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	153.0	153.0	152.0	153.0	152.5	152.0	152.5	153.5	154.0	154.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	154.0	152.5	152.0	150.5	151.5	151.5	151.5	152.0	153.5	153.5	154.0	153.5	0.0	0.0
4.2	0.0	0.0	154.5	153.5	153.0	151.5	151.0	151.0	151.0	151.0	152.0	152.0	152.5	153.0	153.0	0.0	0.0
4.3	0.0	155.0	154.0	153.0	153.0	152.0	152.0	151.5	151.0	151.0	152.0	152.0	152.0	153.0	153.0	153.0	0.0
4.4	0.0	155.5	154.5	153.5	152.5	152.5	152.0	151.5	151.5	151.5	151.5	152.0	152.0	153.0	153.5	153.0	154.5
4.5	155.5	155.0	154.0	153.5	153.0	153.0	152.0	151.5	152.0	152.0	152.0	152.5	152.5	153.0	153.5	152.5	155.0
4.6	156.5	155.5	154.5	154.0	153.5	153.5	152.5	153.0	152.5	153.0	152.5	152.5	153.0	154.0	154.0	154.5	156.0
4.7	0.0	156.0	155.5	154.5	154.0	154.0	153.5	153.0	154.0	153.5	153.5	152.5	153.5	154.0	154.5	156.5	156.5
4.8	0.0	155.0	156.0	155.5	155.0	154.5	154.0	154.0	153.5	154.5	154.0	154.0	154.0	154.5	155.5	157.5	0.0
4.9	0.0	0.0	156.5	156.0	155.5	155.5	155.0	154.5	154.5	154.5	155.0	154.0	154.0	155.0	156.0	157.0	0.0
5.0	0.0	0.0	0.0	157.5	156.0	156.0	156.5	154.5	154.5	154.0	154.0	154.0	154.0	155.0	157.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	157.0	155.5	155.5	155.0	155.0	156.0	155.5	154.0	154.0	154.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	157.0	156.0	156.0	156.0	156.0	154.5	155.5	155.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	156.5	157.0	155.0	156.0	156.0	155.5	155.5	155.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	156.0	157.0	156.5	156.5	157.0	156.5	157.0	155.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	156.0	157.0	156.0	155.5	156.0	156.5	157.0	157.5	156.5	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	157.5	155.0	155.5	156.0	157.0	155.5	155.5	156.0	157.5	157.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	156.0	157.0	156.0	157.0	156.0	155.5	155.5	156.0	156.5	157.5	157.5	157.0	0.0	0.0
5.8	0.0	0.0	157.0	156.0	157.0	156.0	156.0	155.5	156.5	156.0	156.5	157.5	158.0	157.5	158.5	157.5	0.0
5.9	0.0	155.5	157.5	156.5	157.5	156.5	156.0	156.0	156.5	158.0	157.0	158.5	158.5	157.0	159.5	158.5	159.0
6.0	0.0	155.0	158.0	156.5	157.5	157.5	157.0	156.5	157.0	156.5	158.0	157.0	157.0	158.5	158.5	159.0	159.0
6.1	160.5	162.0	159.5	159.5	157.0	157.0	158.0	158.0	157.5	158.0	157.5	157.5	158.5	158.5	158.0	159.0	160.0
6.2	162.0	158.0	156.0	162.0	157.0	157.0	157.5	158.0	158.0	158.0	158.0	158.0	159.0	158.0	159.5	159.0	159.5
6.3	0.0	158.5	156.5	159.5	158.0	156.5	156.5	157.5	158.5	158.0	157.5	159.5	157.5	157.5	158.5	159.0	159.0
6.4	0.0	161.0	158.5	159.0	158.0	159.5	158.0	156.5	157.5	158.0	158.5	157.5	158.5	159.5	158.5	158.5	0.0
6.5	0.0	0.0	161.5	156.5	158.0	158.5	156.5	156.5	157.0	157.5	158.0	158.5	157.5	158.0	158.0	0.0	0.0
6.6	0.0	0.0	0.0	161.0	159.5	160.5	157.0	157.0	157.5	158.0	158.0	158.0	159.0	158.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	160.0	161.0	159.0	159.0	158.5	158.5	158.5	158.5	158.0	158.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	160.5	160.0	160.0	160.0	159.5	159.0	158.0	158.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	160.0	159.5	159.5	159.0	159.5	158.5	158.0	158.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.57 l/s S = 0.0030 beta = 11.58 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	142.5	142.5	143.5	143.5	143.0	142.0	143.0	142.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	143.0	144.5	144.5	144.0	144.5	143.5	144.0	145.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	144.0	143.5	144.0	143.5	142.0	145.5	143.5	145.0	144.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	144.5	143.5	144.5	144.0	145.0	144.5	145.0	145.0	145.5	144.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	145.5	145.0	144.5	144.0	143.5	145.5	144.0	145.0	145.0	143.5	146.0	145.5	0.0	0.0
1.0	0.0	0.0	144.5	146.0	144.5	144.5	144.0	144.5	144.0	144.5	143.0	145.5	147.5	145.5	146.5	147.0	0.0
1.1	0.0	146.5	144.5	146.5	146.0	145.5	144.5	144.0	144.5	145.5	146.0	145.5	146.5	146.0	146.5	146.5	148.0
1.2	0.0	144.5	145.0	146.5	147.0	145.5	145.0	145.0	144.5	145.5	145.0	146.5	145.0	145.5	148.0	147.5	148.5
1.3	147.5	144.5	144.5	145.5	147.0	146.0	145.0	145.5	146.0	146.5	147.5	148.0	145.5	147.0	149.0	149.0	148.0
1.4	149.0	145.5	144.0	145.0	145.5	145.5	145.5	145.5	145.5	147.0	147.0	146.5	145.5	146.5	148.0	147.5	147.5
1.5	0.0	150.5	145.0	144.0	145.0	147.0	146.0	145.5	146.0	146.5	146.5	147.5	145.5	146.5	146.5	147.5	148.0
1.6	0.0	0.0	149.5	148.0	146.0	147.0	147.0	146.0	145.0	146.0	147.0	147.0	146.0	145.5	146.5	147.5	0.0
1.7	0.0	0.0	0.0	146.5	146.5	149.0	147.0	147.0	146.0	147.0	147.5	146.0	147.0	146.5	146.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	150.0	149.5	147.0	146.5	146.5	147.5	146.5	146.5	146.5	147.0	147.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	149.5	149.0	148.0	147.0	148.0	149.0	148.5	146.0	149.0	147.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	148.0	147.0	148.0	148.0	148.5	149.5	149.0	149.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	149.0	148.5	148.0	149.5	149.5	150.5	150.5	150.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	150.0	149.0	148.0	149.5	149.5	149.5	149.5	150.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	151.5	150.0	148.5	150.0	149.5	149.0	150.5	151.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	152.5	151.0	149.5	149.5	150.5	151.0	151.5	150.0	151.0	152.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	152.0	152.0	150.5	150.0	149.5	150.5	150.0	150.0	149.5	150.0	151.5	152.0	0.0	0.0
2.6	0.0	0.0	152.5	152.0	150.5	150.0	149.5	149.0	150.0	151.5	151.0	151.5	152.0	150.0	150.5	150.5	0.0
2.7	0.0	153.5	152.5	151.5	151.0	150.0	149.0	149.0	150.0	148.5	149.0	150.0	149.0	150.0	150.0	150.0	0.0
2.8	0.0	156.0	151.5	151.0	150.5	149.5	149.0	149.0	149.5	149.5	149.0	149.5	151.5	148.0	149.0	149.5	152.5
2.9	153.5	152.5	152.0	152.0	151.0	149.5	149.5	151.0	150.0	149.5	149.5	149.5	149.0	150.0	150.0	149.5	150.0
3.0	153.5	153.0	152.5	152.0	150.0	150.0	149.0	149.5	150.0	150.5	148.0	149.0	149.5	149.5	150.0	150.5	153.0
3.1	0.0	153.0	153.0	152.5	151.0	150.0	149.5	149.5	150.5	148.5	151.0	153.5	149.5	150.0	151.0	150.0	153.5
3.2	0.0	0.0	153.5	152.0	151.5	150.0	149.5	149.5	149.5	149.5	148.5	150.0	151.5	150.5	151.0	151.0	0.0
3.3	0.0	0.0	153.0	152.5	151.5	150.5	151.0	150.5	148.5	151.0	153.0	150.5	151.0	151.5	152.5	0.0	0.0
3.4	0.0	0.0	0.0	152.5	152.0	151.5	151.0	150.5	151.5	156.0	152.5	151.0	151.0	152.0	152.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	152.5	152.0	152.0	151.5	151.5	151.0	153.0	151.0	152.0	153.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	154.0	153.0	152.0	154.5	154.5	155.0	155.5	153.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	153.0	153.5	153.5	152.0	154.0	153.5	154.5	152.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	153.0	153.0	155.0	152.0	151.0	151.5	153.5	153.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	153.0	153.5	153.0	151.0	153.0	152.5	152.0	152.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	154.0	152.5	152.5	152.5	151.0	152.0	152.0	151.5	153.0	153.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	155.0	154.0	154.5	153.5	151.5	152.5	152.0	152.0	152.5	152.5	152.5	152.5	0.0	0.0
4.2	0.0	0.0	156.5	155.5	153.0	153.5	153.5	156.0	156.0	154.5	153.0	154.0	152.5	153.0	152.5	0.0	0.0
4.3	0.0	157.0	155.0	154.5	154.5	155.5	154.0	153.0	152.5	152.5	153.5	152.5	152.0	153.5	153.5	152.5	0.0
4.4	0.0	156.0	155.5	154.5	154.5	155.5	154.5	154.0	153.5	152.5	153.0	152.5	153.5	153.5	153.0	152.5	156.5
4.5	157.0	156.5	156.5	155.5	155.0	154.0	155.0	154.5	153.0	153.5	153.5	153.5	154.0	154.0	153.5	153.0	157.5
4.6	157.0	157.5	156.0	155.0	155.0	156.0	154.0	155.0	153.5	154.0	155.0	155.0	154.5	154.5	154.0	153.5	158.5
4.7	0.0	157.0	157.5	156.5	155.5	157.5	155.0	155.0	154.0	155.0	156.5	154.0	155.0	155.0	154.0	154.5	159.0
4.8	0.0	161.0	158.0	156.5	157.0	157.5	157.5	156.0	155.5	155.5	155.5	156.0	155.5	155.0	155.0	159.0	0.0
4.9	0.0	0.0	157.0	157.5	156.5	156.0	154.5	155.0	156.0	156.0	156.0	156.5	156.0	156.5	159.5	160.0	0.0
5.0	0.0	0.0	0.0	157.0	158.0	157.5	157.5	155.5	156.0	155.5	156.0	155.5	156.5	157.0	157.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	157.5	156.0	157.0	155.5	155.5	155.5	156.0	155.5	156.5	157.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	158.0	158.0	157.0	156.0	155.0	156.0	155.5	156.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	157.5	155.5	156.5	156.0	156.5	156.0	156.0	156.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	157.0	155.5	155.5	154.5	156.0	157.0	156.5	156.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	156.5	156.5	156.5	156.5	156.5	157.0	157.0	157.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	157.0	156.5	155.5	157.5	157.0	156.5	158.0	156.0	157.0	157.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	157.0	156.5	157.0	157.0	156.5	156.0	156.5	156.5	158.0	158.5	158.0	158.5	0.0	0.0
5.8	0.0	0.0	159.5	157.5	158.0	157.0	157.0	156.5	157.0	157.0	158.0	157.0	157.5	158.5	158.5	159.5	0.0
5.9	0.0	160.5	160.0	159.0	157.5	157.5	157.0	156.5	157.5	157.5	157.0	158.0	158.5	158.0	158.5	160.0	0.0
6.0	0.0	161.0	160.0	159.0	158.5	158.5	157.5	157.5	157.5	158.0	158.0	158.0	159.5	159.0	159.5	160.0	161.0
6.1	163.0	161.5	160.5	160.0	158.5	158.0	158.0	158.0	157.5	158.0	158.0	159.5	158.0	159.0	159.5	160.5	161.5
6.2	163.0	161.5	160.0	158.5	158.5	158.0	157.5	158.0	157.5	157.0	158.0	158.0	157.5	158.5	160.0	160.0	160.5
6.3	0.0	161.5	160.5	159.0	158.5	157.5	157.5	158.0	157.5	158.0	157.5	157.5	156.5	158.5	158.5	159.5	160.5
6.4	0.0	0.0	160.5	159.0	158.5	158.5	158.0	157.5	157.5	157.5	157.5	157.5	157.5	159.5	159.0	159.0	0.0
6.5	0.0	0.0	160.5	159.0	158.5	158.0	158.0	158.0	158.5	158.0	158.0	157.5	158.5	159.0	159.0	0.0	0.0
6.6	0.0	0.0	0.0	159.5	159.0	159.0	158.5	158.0	159.0	158.0	158.5	159.5	158.0	159.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	159.5	159.0	159.5	159.5	158.5	159.0	158.5	158.0	158.5	159.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	161.5	160.5	159.5	160.5	160.5	159.0	160.5	159.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	160.0	161.0	160.0	160.5	160.5	161.0	161.5	161.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.78 l/s S = 0.0030 beta = 11.16 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	144.0	144.0	144.0	142.5	143.0	144.0	143.5	143.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	143.5	144.5	144.5	143.0	145.0	145.0	144.0	144.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	143.5	143.5	144.0	143.0	145.5	145.5	145.5	145.5	144.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	145.0	144.5	144.0	144.5	143.5	144.5	144.5	145.5	145.5	147.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	146.0	145.5	144.5	145.0	144.0	145.5	144.5	144.0	145.5	146.5	147.0	147.5	0.0	0.0
1.0	0.0	0.0	144.0	146.5	145.5	145.0	144.5	144.5	144.5	145.0	146.0	146.0	147.0	147.5	148.0	147.5	0.0
1.1	0.0	145.0	144.5	145.5	146.5	146.0	145.0	145.0	145.5	146.5	146.5	147.5	149.5	147.0	148.0	148.0	147.5
1.2	0.0	144.0	143.5	145.0	147.0	146.5	146.0	145.5	145.5	145.0	146.5	147.5	148.0	147.0	146.5	149.5	148.0
1.3	152.0	144.5	144.0	145.5	146.0	146.5	146.5	146.5	146.5	146.5	147.5	148.0	146.5	146.5	147.0	148.5	149.0
1.4	0.0	145.0	143.5	145.0	146.0	147.0	146.5	146.0	145.5	146.5	147.0	147.5	146.5	146.5	146.0	150.0	149.0
1.5	0.0	151.0	144.5	144.0	146.5	147.0	146.5	146.5	146.5	146.5	147.5	146.0	147.5	146.5	147.0	147.0	149.5
1.6	0.0	0.0	146.5	146.0	148.5	147.0	146.5	146.5	148.0	147.5	147.0	147.5	147.0	148.0	148.0	148.5	0.0
1.7	0.0	0.0	0.0	146.5	149.5	147.5	147.0	146.5	146.5	146.5	147.5	148.0	147.5	148.0	148.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	148.0	147.0	147.0	148.0	147.5	148.0	148.5	148.0	148.0	148.5	148.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	149.5	149.0	148.5	147.0	148.5	148.5	149.0	148.0	148.5	150.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	149.0	149.0	149.0	149.0	149.0	149.5	149.5	150.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	149.5	149.0	149.5	150.0	149.5	149.0	150.0	150.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	149.5	149.5	150.0	150.0	149.5	150.5	151.0	151.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	150.5	150.0	150.0	150.5	150.5	151.0	150.5	151.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	152.0	151.0	150.0	149.5	149.5	151.5	150.0	152.0	151.0	152.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	152.0	151.5	150.0	150.0	150.5	150.5	149.5	150.5	151.0	151.0	151.5	151.0	0.0	0.0
2.6	0.0	0.0	151.5	152.0	151.0	150.0	149.5	149.0	150.5	150.5	150.0	150.5	150.0	151.0	152.5	152.0	0.0
2.7	0.0	0.0	150.0	151.0	149.5	149.5	149.0	149.0	150.0	149.5	149.0	150.0	149.0	149.5	152.0	150.5	0.0
2.8	0.0	153.0	150.5	151.0	149.5	149.0	149.0	149.5	148.0	149.5	149.5	149.5	150.0	150.0	151.0	152.0	150.5
2.9	153.0	150.5	150.5	150.5	149.5	149.0	148.5	149.0	148.0	148.0	148.5	149.5	149.0	150.0	150.5	151.5	151.5
3.0	151.5	151.0	151.5	150.5	149.5	148.5	148.5	148.0	148.0	149.0	151.0	149.0	150.0	150.5	150.5	151.0	152.0
3.1	0.0	152.5	151.5	150.5	150.0	149.0	148.5	149.0	149.0	148.5	150.0	149.5	149.0	150.0	151.0	151.5	152.5
3.2	0.0	0.0	151.0	150.5	148.5	149.0	149.0	148.5	149.0	148.5	150.0	150.5	149.5	150.0	151.0	152.0	0.0
3.3	0.0	0.0	0.0	151.5	151.0	150.5	150.5	149.5	150.0	151.0	150.5	150.0	150.5	151.0	151.0	152.0	0.0
3.4	0.0	0.0	0.0	151.5	151.0	150.5	150.0	150.5	151.5	151.0	151.0	151.0	152.0	151.5	152.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	151.5	153.5	151.5	152.5	152.5	151.5	152.5	151.0	151.5	152.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	152.5	151.0	151.5	153.0	152.5	153.0	152.5	152.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	155.0	154.0	152.0	152.5	154.0	153.5	154.0	153.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	153.5	154.0	152.5	153.0	152.5	152.0	152.5	154.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	153.0	152.5	152.5	152.5	152.0	153.0	153.0	153.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	153.0	152.5	153.0	152.5	152.5	152.5	152.5	153.0	152.5	151.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	154.0	154.0	152.0	152.0	151.5	151.5	150.5	152.5	152.5	151.0	152.5	152.5	0.0	0.0
4.2	0.0	0.0	155.0	153.5	154.0	152.5	152.0	152.0	153.5	152.5	151.0	151.0	150.5	152.5	152.0	0.0	0.0
4.3	0.0	155.0	154.0	153.5	153.5	152.0	153.5	151.5	151.5	151.0	151.0	151.5	151.5	151.0	152.0	150.0	0.0
4.4	0.0	156.0	154.5	154.0	153.0	152.5	152.0	151.0	152.0	152.5	152.5	152.0	151.5	152.0	152.0	150.0	154.5
4.5	154.0	156.0	155.5	153.5	153.0	152.0	152.5	153.0	151.5	152.0	151.5	151.5	151.5	151.5	153.0	150.0	155.5
4.6	156.0	157.0	155.5	155.0	152.5	154.5	154.0	153.5	151.5	152.5	152.0	151.5	152.5	152.5	152.5	153.0	154.0
4.7	0.0	156.5	156.0	155.5	154.5	153.5	153.0	152.5	153.5	152.0	152.5	151.0	152.5	153.0	153.0	153.0	156.5
4.8	0.0	157.0	157.0	156.0	155.0	154.0	156.0	154.0	153.0	154.0	153.0	153.5	153.0	154.0	154.0	156.0	0.0
4.9	0.0	0.0	155.5	156.0	155.5	155.0	155.5	154.5	152.5	153.0	153.5	153.5	153.5	154.0	155.0	156.5	0.0
5.0	0.0	0.0	0.0	155.0	154.5	154.0	154.0	152.0	154.0	153.5	154.0	154.0	153.0	154.0	154.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	154.5	154.5	153.5	151.5	154.0	155.0	153.5	153.0	154.5	154.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	154.0	156.0	154.0	154.0	154.0	154.5	153.5	154.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	155.5	154.5	155.0	154.5	153.5	153.5	153.5	154.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	154.5	154.0	155.5	154.5	155.5	154.5	155.0	155.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	155.0	155.5	155.5	155.5	154.5	157.0	156.0	155.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	155.0	154.5	155.5	153.0	156.0	155.0	155.0	156.5	155.0	155.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	157.0	155.0	156.5	156.0	155.5	154.0	155.0	154.0	151.5	155.0	155.5	155.5	0.0	0.0
5.8	0.0	0.0	158.5	155.0	155.5	155.5	156.5	157.5	153.5	155.0	156.0	154.0	154.5	156.0	155.5	157.5	0.0
5.9	0.0	159.5	158.5	157.0	156.5	156.0	155.0	155.0	157.0	154.5	155.5	155.5	155.5	155.5	156.0	156.0	159.5
6.0	0.0	159.5	157.5	157.0	156.5	156.5	155.5	156.0	156.5	155.0	155.0	156.0	156.0	156.5	156.5	156.0	159.5
6.1	160.0	160.5	158.0	157.5	157.0	156.5	156.0	158.0	156.5	157.0	156.5	157.0	156.0	157.5	157.0	157.0	160.0
6.2	159.5	159.5	158.5	157.5	156.5	157.0	156.0	156.0	156.0	156.5	155.5	156.5	156.5	157.0	157.0	157.0	160.0
6.3	0.0	159.0	158.0	157.5	156.0	157.0	156.5	155.5	155.0	158.0	156.0	155.0	156.0	157.0	157.0	156.5	160.0
6.4	0.0	158.0	157.5	158.0	156.0	156.0	156.0	153.0	156.0	155.5	155.5	157.0	156.0	156.5	157.0	158.5	0.0
6.5	0.0	0.0	157.5	157.5	156.0	155.0	155.5	156.5	157.0	155.5	155.5	155.0	156.5	157.0	157.5	0.0	0.0
6.6	0.0	0.0	0.0	157.0	156.0	156.5	155.5	155.5	156.5	156.0	156.5	155.0	156.0	157.0	157.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	157.0	156.5	155.5	156.5	156.0	156.5	155.5	159.5	156.5	158.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	157.0	153.5	156.5	157.0	156.5	156.5	157.0	157.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	157.5	157.5	157.0	157.0	157.5	157.0	157.5	157.5	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 2.11 l/s S = 0.0030 beta = 10.16 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	145.0	141.5	142.0	143.0	143.5	142.0	142.5	143.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	144.0	143.5	144.5	142.0	142.0	142.0	142.0	145.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	144.0	144.5	144.5	144.5	143.5	144.0	144.5	144.0	143.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	143.5	144.5	145.0	144.5	144.5	142.5	145.5	144.5	142.5	145.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	145.0	144.0	144.0	144.5	144.5	143.5	143.5	144.0	142.5	144.0	144.0	144.0	0.0	0.0
1.0	0.0	0.0	145.0	145.0	144.5	144.0	145.0	144.5	144.0	143.5	142.5	143.0	144.5	145.0	145.5	145.5	0.0
1.1	0.0	144.0	145.5	145.5	145.0	144.5	144.5	144.5	143.0	144.5	143.0	144.5	146.0	146.5	147.5	145.5	146.5
1.2	0.0	144.0	146.5	145.5	145.5	145.5	144.5	144.0	144.5	145.0	144.5	144.5	146.0	145.0	146.0	146.5	146.5
1.3	149.0	144.0	146.0	146.0	146.0	145.0	145.0	145.5	145.0	146.5	144.5	144.5	145.0	144.5	146.0	146.0	146.5
1.4	148.5	144.0	145.5	145.0	145.5	145.0	144.5	145.5	145.0	144.0	144.5	144.0	145.5	144.5	145.0	145.5	146.0
1.5	0.0	144.0	143.5	144.5	145.5	145.0	145.0	144.5	146.0	143.0	145.0	147.5	144.5	144.0	144.5	146.0	145.0
1.6	0.0	0.0	144.0	143.5	145.5	145.5	145.5	145.0	145.5	146.0	145.0	144.5	145.0	144.0	145.5	146.5	0.0
1.7	0.0	0.0	143.0	143.5	146.0	146.0	146.0	145.5	146.0	145.5	146.5	146.0	146.0	145.0	146.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	147.5	146.0	147.0	146.5	145.5	144.5	144.5	146.5	145.5	146.0	146.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	146.0	147.0	146.0	145.5	147.5	147.5	147.5	147.0	145.5	145.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	146.5	146.5	147.5	146.5	147.0	147.0	147.5	146.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	146.5	148.0	146.5	148.0	147.5	147.5	148.0	147.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	149.5	147.0	148.0	146.0	148.5	147.0	147.5	148.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	148.0	148.0	148.0	146.5	147.5	147.5	148.5	150.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	150.0	147.5	149.0	148.0	148.0	149.0	149.0	149.5	149.0	148.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	150.5	150.0	148.0	148.5	148.0	148.5	147.5	147.5	149.0	149.0	148.5	149.0	0.0	0.0
2.6	0.0	0.0	150.5	150.5	148.5	147.5	147.5	147.0	148.0	147.0	147.0	148.5	148.0	148.0	148.5	150.0	0.0
2.7	0.0	0.0	149.0	148.5	148.0	147.0	147.0	145.5	147.0	148.0	147.5	147.5	148.5	148.5	148.0	148.5	0.0
2.8	0.0	149.0	148.5	148.5	147.5	147.0	147.5	146.5	147.5	147.5	147.5	146.0	147.5	146.0	147.0	148.5	150.5
2.9	152.0	147.5	148.5	148.0	147.5	146.5	145.5	146.0	146.0	146.0	144.0	145.5	146.5	147.5	147.5	148.5	149.5
3.0	151.0	147.5	148.0	148.0	147.0	147.5	146.5	147.0	147.5	144.5	143.0	145.5	145.5	147.0	147.0	148.0	149.0
3.1	0.0	150.5	148.5	148.5	148.0	147.5	147.0	146.5	147.0	147.5	146.5	147.5	146.5	147.5	147.5	147.5	149.0
3.2	0.0	0.0	149.5	149.0	148.0	147.0	147.0	147.0	148.5	147.0	147.0	147.5	147.5	146.5	147.5	149.5	0.0
3.3	0.0	0.0	0.0	148.0	148.0	147.5	147.0	148.0	147.5	149.5	148.0	148.5	147.5	148.0	148.0	149.5	0.0
3.4	0.0	0.0	0.0	148.5	148.0	147.5	148.0	148.0	149.5	149.5	147.5	147.5	147.5	148.0	149.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	149.0	148.5	148.0	149.5	149.5	148.0	149.0	147.5	148.0	148.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	151.0	149.5	149.5	151.5	152.0	148.0	148.0	149.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	150.0	150.5	149.0	148.0	150.0	150.5	150.5	149.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	149.5	149.5	150.0	150.0	149.0	151.0	149.5	149.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	149.5	150.5	150.0	150.5	148.5	148.0	150.0	149.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	149.0	149.0	149.5	149.0	150.0	148.5	148.5	149.0	150.5	149.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	150.5	151.0	150.0	150.5	149.0	149.5	148.0	149.0	149.0	148.5	149.5	148.5	0.0	0.0
4.2	0.0	0.0	151.5	150.0	149.0	149.0	151.5	149.5	150.5	150.0	150.0	148.0	147.5	149.0	149.5	0.0	0.0
4.3	0.0	152.0	150.5	149.5	148.5	149.5	150.0	149.5	149.5	146.5	151.5	150.0	148.0	148.0	148.5	148.5	0.0
4.4	0.0	151.5	150.5	149.5	149.5	149.0	147.5	148.0	147.5	147.5	146.5	148.0	148.5	148.5	149.0	149.5	149.5
4.5	152.5	152.5	151.5	149.5	149.0	149.0	148.5	148.0	151.0	150.5	147.5	148.5	148.5	148.5	149.0	149.0	147.5
4.6	152.5	152.0	151.0	149.5	149.5	149.0	149.5	149.0	148.5	148.5	150.0	148.5	149.0	149.5	150.0	151.0	150.5
4.7	0.0	152.0	151.0	150.5	150.0	149.5	150.0	150.0	149.5	149.0	149.0	149.5	149.5	149.5	150.0	150.5	153.5
4.8	0.0	152.0	152.0	151.5	151.5	150.0	151.0	151.5	151.0	150.0	149.5	151.5	150.5	150.5	152.0	152.0	0.0
4.9	0.0	0.0	152.0	151.5	152.5	152.0	152.0	150.3	151.0	150.0	150.0	151.5	151.0	152.0	152.0	153.0	0.0
5.0	0.0	0.0	0.0	151.5	151.0	151.0	151.5	151.5	151.0	151.5	151.0	151.0	150.5	151.0	152.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	151.0	152.5	150.0	150.0	151.5	151.0	150.5	151.5	151.0	151.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	150.5	151.0	152.5	151.0	150.5	151.0	152.5	150.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	152.5	151.5	152.0	151.5	151.0	152.5	151.5	151.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	152.0	151.5	151.5	152.5	151.5	152.0	152.5	152.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	152.5	153.0	152.5	151.0	152.0	152.5	152.5	151.5	151.5	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	151.5	150.5	152.5	153.0	152.5	152.5	152.5	153.0	152.0	152.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	153.0	152.0	151.5	150.0	151.5	152.0	151.0	151.5	152.0	152.5	152.5	152.0	0.0	0.0
5.8	0.0	0.0	154.5	154.0	152.0	153.0	152.0	151.5	152.5	152.0	152.5	151.5	151.5	152.0	152.5	153.0	0.0
5.9	0.0	155.5	153.5	152.5	151.5	152.0	151.0	150.5	152.0	151.0	151.0	151.5	151.5	152.0	152.5	151.5	155.5
6.0	0.0	155.0	154.5	156.0	154.0	152.0	152.5	153.5	152.5	154.0	152.0	151.5	152.0	152.5	152.5	151.5	155.5
6.1	157.0	154.5	154.5	154.0	153.0	152.0	152.0	154.0	153.0	153.0	153.5	151.5	153.0	153.0	153.0	152.5	155.0
6.2	156.0	155.0	153.0	152.0	152.0	152.0	152.0	152.5	152.5	152.5	152.5	152.0	152.0	153.0	153.5	152.0	156.5
6.3	0.0	154.0	153.0	152.5	152.5	153.5	153.5	153.5	150.5	151.0	151.0	151.0	152.0	152.5	153.5	152.5	156.0
6.4	0.0	153.0	153.5	152.5	153.0	152.5	153.0	153.0	153.5	152.0	152.0	152.0	152.5	152.5	153.5	155.5	0.0
6.5	0.0	0.0	152.5	152.5	153.0	153.5	152.0	151.0	152.0	153.0	152.0	151.0	151.5	152.5	154.5	0.0	0.0
6.6	0.0	0.0	0.0	154.0	154.0	153.0	152.5	153.5	152.5	152.5	153.5	151.5	152.0	154.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	155.0	154.5	153.0	152.5	152.5	151.0	151.5	150.5	152.5	153.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	154.5	155.0	155.0	156.0	153.0	153.5	152.5	153.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	155.0	153.5	154.0	154.5	153.5	151.0	152.5	153.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 3.08 l/s   S = 0.0030   beta = 8.81   epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	138.5	141.0	142.5	137.0	137.5	139.0	139.5	145.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	139.5	144.5	144.0	144.5	143.0	143.5	139.0	146.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	142.0	144.0	147.5	144.0	138.0	137.5	139.0	138.5	144.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	144.5	143.0	144.5	144.0	142.0	136.5	139.5	141.5	139.5	143.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	143.0	146.0	144.5	145.0	144.5	141.5	144.0	144.5	143.0	143.5	143.0	144.0	0.0	0.0
1.0	0.0	0.0	146.5	145.0	144.0	144.5	147.0	146.5	143.0	142.0	144.0	145.5	141.0	145.5	146.5	145.5	0.0
1.1	0.0	144.5	146.5	146.5	147.0	147.5	147.0	145.5	145.0	146.0	144.5	145.0	149.0	145.0	145.5	145.0	143.5
1.2	0.0	145.0	146.0	145.5	146.5	146.5	145.5	146.0	142.5	146.5	147.0	146.0	145.5	146.0	148.5	146.5	143.5
1.3	0.0	145.0	145.0	146.5	145.5	145.5	145.0	146.0	143.0	148.0	147.0	145.5	145.0	147.5	146.5	143.5	144.0
1.4	151.5	144.0	144.5	145.5	143.5	146.0	146.0	146.5	145.0	146.0	145.0	148.0	145.5	148.0	144.5	145.5	145.0
1.5	0.0	146.0	146.0	146.0	139.5	144.5	143.0	141.5	140.5	144.0	145.5	148.0	147.0	147.5	146.5	145.5	146.5
1.6	0.0	0.0	144.0	147.0	146.0	144.5	145.0	140.0	137.0	138.0	138.0	144.0	142.5	145.0	145.5	147.0	0.0
1.7	0.0	0.0	0.0	144.5	140.0	146.5	146.5	146.0	146.0	146.0	147.0	147.0	146.0	146.0	142.5	146.0	0.0
1.8	0.0	0.0	0.0	0.0	141.5	145.5	146.0	147.0	144.5	144.5	145.5	148.5	148.0	146.5	148.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	137.5	145.0	145.0	140.5	147.5	148.5	147.0	147.5	148.0	145.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	143.0	143.5	141.0	141.0	148.0	142.5	146.0	146.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	143.5	147.0	147.0	151.0	146.5	145.5	148.5	148.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	145.5	141.0	140.0	141.0	148.5	140.0	141.5	142.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	142.5	142.0	142.0	143.5	142.5	142.5	142.0	143.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	146.5	145.5	142.5	141.0	147.5	149.0	149.5	146.5	142.5	151.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	144.5	143.5	142.5	141.5	142.5	143.0	140.5	141.5	145.0	144.0	143.0	0.0	0.0	0.0
2.6	0.0	0.0	0.0	146.5	142.0	142.5	143.5	142.5	140.0	140.5	140.0	144.0	142.0	141.5	143.5	0.0	0.0
2.7	0.0	0.0	144.5	141.5	140.0	144.0	149.0	145.5	145.5	141.5	143.5	143.5	142.5	144.0	144.5	144.5	0.0
2.8	0.0	147.0	144.0	144.5	142.0	142.5	143.5	141.5	141.5	144.5	143.0	144.0	142.5	148.5	144.5	145.0	143.0
2.9	148.0	146.5	146.0	144.0	143.5	143.5	142.5	142.5	142.5	145.0	143.0	144.5	145.5	145.0	145.5	145.0	144.0
3.0	148.5	147.0	144.5	143.0	146.0	141.0	142.5	142.5	142.0	141.0	145.0	146.5	146.5	146.0	147.0	147.0	145.0
3.1	0.0	142.5	142.5	143.5	143.5	141.0	139.5	140.5	137.5	139.5	145.0	143.5	145.5	146.0	146.0	145.5	147.0
3.2	0.0	0.0	147.0	145.0	144.0	143.5	146.0	143.5	141.0	140.5	144.0	144.0	146.5	147.5	145.0	147.0	0.0
3.3	0.0	0.0	0.0	143.5	147.0	148.0	146.5	148.0	147.0	149.5	143.0	145.0	143.0	141.0	143.5	0.0	0.0
3.4	0.0	0.0	0.0	142.0	142.5	144.0	141.0	141.0	143.5	138.0	142.5	143.0	147.0	144.0	144.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	145.5	152.0	150.5	142.0	144.5	149.5	146.5	144.5	144.5	147.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	144.5	142.5	142.5	140.5	142.0	143.5	141.0	143.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	143.5	143.0	141.0	141.0	142.5	143.5	143.0	145.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	145.5	145.0	145.5	145.0	145.5	144.5	144.5	143.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	142.0	145.0	140.5	146.5	142.0	150.0	148.5	148.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	144.0	143.5	140.5	137.5	141.5	142.0	141.5	140.5	141.5	139.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	140.0	142.0	141.0	141.5	141.0	142.5	137.0	140.0	142.5	141.0	142.0	141.0	0.0	0.0
4.2	0.0	0.0	0.0	142.5	141.5	142.0	139.0	140.0	143.0	141.0	142.5	142.5	140.0	142.0	142.0	0.0	0.0
4.3	0.0	143.5	141.5	142.5	141.5	139.5	139.5	141.0	141.5	140.0	140.5	139.5	142.0	141.0	142.0	142.0	0.0
4.4	0.0	144.0	142.0	141.0	139.5	141.0	138.0	139.5	139.0	138.0	140.0	138.5	142.5	140.5	141.5	141.0	142.5
4.5	145.5	142.5	143.5	141.0	141.0	141.5	141.5	140.0	136.5	140.0	141.5	139.5	140.0	140.5	141.5	142.0	141.5
4.6	142.0	142.5	142.5	142.5	140.0	141.5	141.0	141.0	141.5	141.5	138.5	140.5	141.0	140.5	141.5	143.0	142.5
4.7	0.0	142.5	143.5	142.0	143.5	142.5	141.5	140.0	145.0	139.5	141.0	140.0	142.0	141.0	141.5	142.5	143.0
4.8	0.0	143.5	145.5	144.0	143.5	143.0	142.5	143.0	141.5	141.0	137.5	139.0	142.5	142.5	143.0	143.0	0.0
4.9	0.0	0.0	143.0	143.5	143.0	142.0	142.5	143.5	143.0	143.5	139.5	144.0	143.5	142.0	144.0	143.0	0.0
5.0	0.0	0.0	0.0	142.5	144.0	143.5	143.0	142.5	141.0	142.0	143.5	142.5	142.5	141.0	140.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	143.0	142.5	142.5	140.5	141.5	144.5	141.5	141.0	143.0	142.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	143.0	141.0	144.0	143.0	144.5	144.0	143.5	141.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	144.5	143.5	143.5	142.0	144.0	144.0	143.0	143.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	144.0	143.5	141.5	143.5	143.0	146.0	144.5	144.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	144.5	143.0	144.0	142.5	143.5	143.5	142.5	142.0	142.5	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	144.0	145.0	144.5	143.5	141.5	140.5	143.5	139.5	142.0	142.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	146.5	144.0	143.0	142.5	145.0	143.5	144.0	143.5	144.0	143.5	142.0	144.5	0.0	0.0
5.8	0.0	0.0	146.5	144.0	144.0	143.5	142.5	142.0	140.0	139.5	144.5	143.0	141.5	143.0	144.5	143.5	0.0
5.9	0.0	146.0	147.0	143.5	142.5	143.0	143.0	143.0	143.0	145.0	143.5	142.0	142.0	143.5	144.0	144.0	146.0
6.0	0.0	146.5	145.5	144.0	144.0	142.0	148.5	145.5	143.0	146.5	146.5	143.5	146.0	144.5	143.0	144.0	144.0
6.1	147.5	147.5	144.0	144.0	144.0	143.0	143.5	145.5	144.5	142.5	143.5	144.0	144.5	143.5	144.5	146.0	146.5
6.2	145.5	146.0	144.0	144.0	143.5	143.0	142.5	143.0	142.5	143.0	138.5	140.5	143.0	142.5	142.5	142.5	144.5
6.3	0.0	145.5	143.5	143.0	142.5	143.5	142.5	142.5	143.5	141.0	142.5	142.0	143.5	143.5	142.5	153.5	144.0
6.4	0.0	145.0	144.0	144.0	143.5	144.0	144.0	141.0	140.0	140.0	146.5	143.0	142.0	142.5	141.0	142.5	0.0
6.5	0.0	0.0	144.0	143.5	143.5	142.5	143.5	142.5	142.5	142.0	140.5	143.0	143.0	143.5	143.0	0.0	0.0
6.6	0.0	0.0	0.0	143.5	144.0	144.5	142.0	138.5	140.5	141.5	143.5	144.0	142.0	142.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	0.0	144.0	144.5	144.5	144.0	142.5	142.0	146.5	145.0	141.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	143.5	143.0	143.5	145.0	144.0	143.5	142.5	142.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	144.0	143.5	144.5	145.5	143.0	144.0	144.5	142.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.02 l/s S = 0.0040 beta = 14.36 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	152.5	153.0	152.5	153.0	152.0	153.0	153.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	154.0	153.0	153.5	152.5	153.0	152.0	152.5	153.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	153.5	153.5	153.0	152.5	152.5	153.0	152.5	152.5	153.0	154.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	152.0	152.0	153.5	152.5	153.0	153.0	153.0	152.5	153.5	153.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	150.5	151.0	152.0	152.0	152.5	152.0	152.0	153.0	153.5	154.0	154.0	154.5	0.0	0.0
1.0	0.0	0.0	156.5	151.0	150.0	152.0	152.5	152.0	153.0	153.0	154.0	154.0	154.5	154.0	155.0	155.0	0.0
1.1	0.0	157.0	154.5	152.0	152.0	151.0	150.0	151.5	152.5	154.0	154.5	155.5	155.0	155.5	156.0	157.0	0.0
1.2	158.0	156.5	154.5	153.0	152.0	151.5	151.0	152.0	153.5	155.0	155.0	156.5	156.5	156.5	156.5	158.5	158.0
1.3	160.0	156.5	155.0	152.5	151.5	150.5	150.0	151.0	152.5	154.5	156.5	155.5	156.5	156.0	157.0	158.0	159.5
1.4	159.5	155.5	154.0	153.5	152.0	152.0	150.0	150.5	152.0	152.5	155.0	156.5	156.0	157.0	157.0	158.5	159.0
1.5	159.0	159.0	157.0	155.5	155.5	154.0	151.5	150.0	151.0	152.0	153.5	156.0	156.5	157.0	157.5	157.5	157.5
1.6	0.0	0.0	160.0	160.0	155.0	156.5	156.0	155.5	155.5	151.5	152.0	154.5	157.0	158.5	159.5	160.0	0.0
1.7	0.0	0.0	0.0	160.0	159.0	161.0	158.0	159.5	158.5	158.0	158.0	159.0	160.0	158.0	160.0	0.0	0.0
1.8	0.0	0.0	0.0	158.5	156.0	156.0	159.0	158.5	158.0	157.5	158.0	159.0	158.5	159.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	158.5	158.0	157.5	157.5	156.5	157.0	157.5	157.5	156.5	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	158.0	157.0	157.5	157.0	156.5	156.0	155.0	157.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	157.5	157.5	156.0	156.0	156.0	156.0	156.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	158.0	156.5	156.0	156.5	156.0	156.5	157.0	158.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	158.5	157.5	156.5	156.0	157.0	157.0	156.5	157.5	157.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	158.5	157.5	157.5	157.0	157.0	157.0	157.5	157.5	158.5	156.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	159.0	158.5	158.0	157.5	157.0	157.0	157.5	157.0	157.0	157.0	154.5	0.0	0.0	0.0
2.6	0.0	0.0	159.0	158.5	157.5	157.0	157.0	157.0	157.0	157.0	156.5	155.5	156.0	154.0	155.5	0.0	0.0
2.7	0.0	158.5	159.0	158.5	158.5	157.5	157.0	156.5	157.0	156.5	154.5	155.0	154.0	154.0	156.0	161.0	0.0
2.8	0.0	159.0	159.0	158.5	158.0	158.0	157.0	157.0	156.5	155.5	154.0	152.0	153.5	155.0	158.5	156.5	162.0
2.9	159.5	159.5	159.5	158.5	158.5	158.0	157.0	156.5	155.0	155.0	153.0	155.0	154.0	156.0	159.0	160.0	159.5
3.0	160.0	161.0	160.5	159.5	159.0	158.0	158.0	157.5	155.0	153.0	154.0	154.0	156.0	157.0	161.5	162.0	159.0
3.1	0.0	161.0	161.5	160.5	160.0	159.5	155.0	154.5	155.5	155.5	155.5	157.0	157.5	160.0	160.5	161.5	161.5
3.2	0.0	0.0	159.0	160.5	160.5	157.0	155.5	158.0	159.0	157.5	157.0	157.0	165.0	161.0	161.5	163.0	0.0
3.3	0.0	0.0	0.0	160.5	161.5	162.0	161.0	160.0	160.0	157.5	158.5	160.0	161.0	160.0	159.0	0.0	0.0
3.4	0.0	0.0	0.0	158.5	161.0	160.5	159.5	160.0	158.5	159.0	160.0	160.5	161.0	160.5	0.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	159.5	160.0	159.0	158.5	159.0	159.0	160.0	160.5	160.5	161.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	159.0	160.0	159.0	158.5	159.5	159.0	160.0	161.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	159.5	159.0	160.0	159.5	160.0	160.5	159.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	160.5	161.0	161.0	161.0	160.5	160.5	161.0	160.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	160.5	159.0	160.0	159.5	160.5	159.5	159.5	159.0	160.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	158.5	158.5	159.0	159.0	160.0	160.0	159.5	160.0	159.5	160.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	156.5	157.0	158.0	159.5	159.0	159.0	159.5	160.0	159.5	159.5	161.0	0.0	0.0	0.0
4.2	0.0	0.0	158.0	157.0	156.0	157.5	158.0	159.0	160.0	159.5	159.5	160.0	160.5	160.5	162.0	0.0	0.0
4.3	0.0	162.5	159.0	158.5	158.5	156.0	157.5	160.0	159.0	160.0	159.0	159.5	161.5	161.0	161.0	162.5	0.0
4.4	165.0	164.5	157.5	159.5	159.5	158.5	156.5	158.0	158.0	159.5	160.0	160.0	161.5	162.0	162.5	162.5	163.5
4.5	165.5	165.0	161.0	160.0	160.0	159.0	156.5	158.0	159.0	160.0	160.0	161.0	162.0	162.5	162.5	163.0	163.5
4.6	165.5	167.0	159.5	159.5	158.5	159.0	158.0	157.5	157.0	158.5	160.5	161.5	163.0	164.0	163.5	164.0	164.0
4.7	0.0	163.0	165.0	160.0	159.5	159.0	159.0	160.0	160.0	159.0	158.0	163.0	163.5	163.5	164.5	165.5	165.0
4.8	0.0	0.0	166.5	162.5	161.5	160.0	161.5	161.5	162.0	162.0	159.0	159.5	164.5	164.5	165.0	164.0	0.0
4.9	0.0	0.0	166.0	162.0	162.0	161.0	160.5	161.5	164.0	164.0	164.5	163.5	165.0	165.5	166.0	0.0	0.0
5.0	0.0	0.0	0.0	165.5	163.5	164.5	162.0	161.0	163.0	164.5	164.5	164.5	164.0	164.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	163.5	163.0	163.0	162.5	163.0	162.5	162.0	162.5	163.0	162.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	163.5	163.0	162.5	162.5	161.5	162.0	162.0	163.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	163.0	163.5	162.5	162.0	162.0	162.0	163.0	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	163.0	162.5	161.5	162.0	162.0	162.0	161.0	162.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	162.0	163.5	162.5	162.0	162.0	162.0	162.0	162.0	163.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	164.0	162.5	163.0	161.5	161.5	162.0	161.5	162.0	161.0	161.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	165.0	163.5	162.0	162.0	162.0	162.0	161.5	162.0	161.0	160.0	160.0	163.5	0.0	0.0
5.8	0.0	0.0	166.0	164.5	164.0	163.0	162.5	163.0	163.0	163.0	162.0	162.0	162.0	160.0	164.5	162.0	0.0
5.9	0.0	166.0	165.0	164.5	164.5	163.5	163.0	163.5	163.5	162.5	161.0	161.5	161.0	162.0	166.0	162.0	0.0
6.0	0.0	166.5	165.5	165.5	165.0	164.5	164.5	164.0	163.0	161.5	161.0	160.5	161.0	160.5	162.5	162.0	165.0
6.1	166.5	168.0	167.5	166.0	165.0	165.0	164.5	163.5	163.5	163.0	162.0	162.0	161.5	162.5	163.0	160.0	166.5
6.2	166.0	168.0	167.5	167.5	165.5	164.5	165.5	164.0	163.0	163.5	163.0	162.0	162.0	163.0	168.5	163.0	168.0
6.3	0.0	168.0	167.5	167.0	166.0	165.0	165.0	165.0	165.0	164.0	162.5	160.5	161.5	163.5	168.5	165.0	166.0
6.4	0.0	0.0	167.0	167.0	166.5	165.5	165.5	166.0	164.5	163.0	161.0	161.0	161.5	162.0	163.5	170.0	0.0
6.5	0.0	0.0	166.5	167.0	167.0	165.0	165.0	165.5	164.0	164.0	162.0	160.5	162.0	162.5	169.0	0.0	0.0
6.6	0.0	0.0	0.0	167.0	165.0	167.0	165.0	165.0	164.0	164.0	163.5	163.5	165.0	167.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	167.0	166.0	165.0	164.5	164.5	164.5	164.5	166.0	167.0	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	166.0	166.5	165.0	164.5	165.0	165.5	166.5	167.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	167.0	165.0	166.0	165.0	165.0	165.5	166.5	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.47 l/s S = 0.0040 beta = 12.62 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	145.0	146.5	145.0	146.0	146.5	147.5	147.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	144.5	146.0	146.0	145.5	145.0	146.0	147.0	148.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	143.0	145.5	144.5	144.5	146.0	145.0	145.5	145.5	147.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	146.5	145.5	145.5	145.5	144.5	145.5	146.0	146.0	147.0	148.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	146.0	146.0	144.5	145.5	146.5	144.0	145.0	146.0	147.0	146.5	147.5	148.5	0.0	0.0
1.0	0.0	0.0	147.0	148.0	148.5	146.5	145.0	145.5	147.0	146.5	146.0	147.0	147.5	147.5	148.5	149.0	0.0
1.1	0.0	148.5	147.5	147.0	145.0	145.0	145.0	145.0	145.5	146.0	147.5	146.0	146.5	151.0	148.0	149.5	0.0
1.2	148.5	149.0	149.0	144.0	147.0	147.0	146.0	147.0	147.5	147.5	146.5	147.0	148.0	148.0	149.0	149.5	150.5
1.3	148.0	148.0	146.5	149.0	147.5	147.5	147.0	146.5	146.0	147.0	147.5	148.0	148.0	149.0	148.5	150.0	150.5
1.4	149.0	148.0	148.0	147.0	146.5	146.5	148.0	146.5	147.0	147.0	152.5	146.5	151.5	148.0	148.0	149.5	151.0
1.5	0.0	148.0	146.0	147.0	147.0	147.5	147.0	147.5	147.0	147.5	147.5	147.5	148.0	148.5	148.5	149.5	149.5
1.6	0.0	0.0	149.0	149.0	148.5	147.5	147.5	147.5	147.5	148.5	148.0	148.0	149.0	149.0	150.5	151.0	0.0
1.7	0.0	0.0	0.0	150.5	149.0	148.5	148.5	148.5	148.5	148.5	148.5	148.5	149.0	149.5	150.0	0.0	0.0
1.8	0.0	0.0	0.0	151.5	149.0	149.0	149.0	149.5	149.5	149.0	149.5	150.5	150.5	150.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	151.0	150.0	149.5	149.0	151.0	149.5	150.0	149.5	149.5	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	151.5	151.0	150.5	151.0	151.0	152.0	151.0	151.5	150.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	152.0	151.5	151.0	152.0	152.0	152.0	153.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	153.0	152.5	152.0	153.0	152.0	151.0	152.5	0.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	154.0	152.0	152.0	152.5	151.5	152.0	152.0	153.5	151.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	153.5	152.0	152.5	152.0	152.5	152.5	152.5	152.5	154.0	155.0	155.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	150.5	151.5	152.5	152.0	152.0	152.5	152.0	152.5	153.5	154.5	154.0	0.0	0.0	0.0
2.6	0.0	0.0	151.5	150.0	151.0	152.0	152.5	152.0	152.5	152.5	153.0	153.0	154.0	154.0	154.5	0.0	0.0
2.7	0.0	155.5	151.5	151.0	151.0	151.5	151.5	151.5	152.5	152.5	151.5	152.0	154.0	153.0	154.0	155.0	0.0
2.8	159.5	153.0	151.0	151.0	151.5	152.5	152.0	151.5	152.0	151.0	152.0	152.5	153.5	153.0	153.0	153.5	154.0
2.9	159.5	152.5	152.0	152.0	152.0	153.5	153.0	152.5	152.5	152.0	152.0	152.0	153.0	152.5	152.0	152.0	154.0
3.0	159.0	153.0	155.0	152.0	152.5	152.0	152.5	153.0	152.5	152.0	152.5	152.0	152.5	152.0	153.0	153.5	154.0
3.1	0.0	158.0	156.0	152.5	153.0	152.0	153.5	153.0	152.5	152.5	152.0	153.0	152.5	152.5	153.5	153.5	154.0
3.2	0.0	157.0	157.0	154.0	152.0	153.5	154.0	153.0	152.0	152.5	152.5	154.0	153.0	151.5	155.0	152.5	0.0
3.3	0.0	157.0	157.0	153.5	154.0	154.0	154.0	153.5	152.5	153.5	154.5	153.5	152.0	156.5	0.0	0.0	0.0
3.4	0.0	0.0	0.0	157.0	157.0	154.5	153.5	153.5	153.5	153.0	155.0	154.5	154.0	154.0	0.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	157.0	154.5	154.5	154.0	155.0	154.5	154.0	154.5	159.5	154.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	155.0	154.5	156.0	155.5	157.0	158.5	156.5	156.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	155.0	154.5	156.5	155.5	156.0	155.0	156.0	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	155.0	155.0	154.5	154.0	156.0	158.5	155.0	155.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	154.5	155.5	155.0	153.5	154.5	154.5	154.0	153.0	155.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	156.5	153.5	153.0	152.5	152.0	152.5	149.5	151.0	154.0	151.5	154.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	156.0	155.0	153.5	152.0	150.5	155.0	155.0	153.0	156.5	152.5	153.5	0.0	0.0	0.0
4.2	0.0	0.0	157.5	155.0	163.5	153.0	161.5	152.5	152.0	153.0	154.5	154.5	152.5	154.0	153.0	0.0	0.0
4.3	0.0	157.0	157.5	155.5	154.0	153.0	152.0	151.0	152.0	152.0	153.5	152.5	155.5	153.0	153.0	154.0	0.0
4.4	157.5	156.0	155.5	155.5	154.5	153.5	153.0	151.5	153.0	151.5	152.5	151.0	151.5	153.0	153.0	152.5	152.0
4.5	0.0	158.0	157.5	155.5	154.5	152.5	152.5	154.5	153.0	153.0	154.0	152.0	151.5	152.5	152.5	153.5	157.0
4.6	159.0	158.0	158.0	157.5	156.5	155.5	154.5	157.0	154.5	154.0	154.5	155.5	155.0	155.0	155.0	156.5	158.0
4.7	0.0	159.0	158.5	158.5	158.0	160.0	156.0	155.0	156.0	156.0	156.5	155.5	155.5	156.0	156.0	157.5	160.0
4.8	0.0	160.0	159.0	158.0	157.5	159.0	158.5	155.5	157.0	157.0	156.0	156.5	156.5	156.0	155.5	158.5	0.0
4.9	0.0	0.0	159.0	159.5	160.5	156.5	159.0	158.0	158.0	158.5	157.0	157.0	156.5	156.5	160.0	0.0	0.0
5.0	0.0	0.0	0.0	156.0	161.5	159.0	160.0	158.5	158.0	158.0	157.5	157.0	156.0	160.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	159.0	160.5	159.5	158.5	158.5	157.5	157.5	157.5	160.5	159.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	159.5	161.5	161.0	159.0	159.0	158.0	157.0	158.0	159.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	159.5	161.5	159.5	160.0	159.0	156.0	159.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	159.5	160.0	159.5	158.5	159.5	160.5	159.0	0.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	160.5	158.5	160.0	159.5	158.0	158.5	159.0	159.0	158.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	160.5	160.5	160.0	159.5	160.0	160.0	159.0	158.5	158.5	159.0	159.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	159.5	160.0	159.5	159.0	159.5	160.0	159.5	159.0	159.0	161.0	160.5	0.0	0.0	0.0
5.8	0.0	0.0	160.5	160.0	160.0	160.0	159.0	159.0	159.5	159.5	160.5	160.0	161.0	160.5	161.0	0.0	0.0
5.9	0.0	161.5	161.0	161.0	160.0	159.5	160.0	160.0	160.0	159.0	160.0	160.5	161.0	161.5	162.0	162.0	0.0
6.0	162.0	161.5	161.0	160.5	160.5	160.0	160.5	160.0	160.5	159.5	161.0	161.5	161.0	161.0	161.5	162.0	162.5
6.1	162.0	161.0	162.5	161.0	160.0	160.5	160.5	161.0	160.5	160.0	161.5	160.0	162.0	161.0	161.5	162.0	164.0
6.2	162.0	161.0	161.5	161.0	161.0	161.0	160.5	160.0	160.0	160.5	161.0	161.0	161.0	162.0	162.0	162.0	162.5
6.3	0.0	162.0	161.5	161.0	160.5	160.0	160.5	161.0	161.0	160.0	160.5	160.5	161.5	162.0	162.0	162.5	162.5
6.4	0.0	161.5	161.5	161.0	160.5	160.5	161.0	160.0	161.0	161.0	161.0	161.0	161.0	162.0	162.0	162.5	0.0
6.5	0.0	0.0	161.5	161.5	160.5	160.0	161.0	160.0	161.0	161.0	161.0	161.0	161.5	162.0	161.5	0.0	0.0
6.6	0.0	0.0	0.0	163.0	161.0	161.0	162.0	162.0	161.0	161.5	161.0	161.5	161.0	161.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	160.5	161.5	161.5	161.0	161.0	160.5	161.0	161.5	162.0	161.5	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	163.5	162.0	161.5	162.5	162.0	162.5	162.5	163.0	161.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	163.0	162.5	162.0	162.5	163.0	163.5	163.0	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.50 l/s S = 0.0040 beta = 11.86 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	147.0	148.0	147.0	147.0	146.0	146.0	145.0	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	148.0	148.5	148.0	147.5	148.5	146.0	147.0	147.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	147.0	148.5	147.5	148.0	147.5	147.0	146.5	147.5	147.0	145.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	147.5	148.0	148.0	147.0	148.0	147.0	146.5	147.0	148.0	148.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	148.5	147.5	148.0	148.0	147.0	147.5	146.5	147.0	147.0	148.5	148.0	147.0	0.0	0.0
1.0	0.0	0.0	148.0	148.5	147.0	147.5	147.5	147.5	148.5	146.5	147.5	147.0	148.5	148.5	148.0	147.5	0.0
1.1	0.0	149.0	148.0	148.0	149.0	148.0	148.5	148.5	148.0	147.5	148.0	148.0	148.5	149.5	149.0	149.0	0.0
1.2	150.0	151.0	148.0	149.0	148.5	149.0	148.5	148.5	148.0	148.0	149.0	149.0	149.0	149.5	150.5	150.0	150.5
1.3	149.0	151.0	148.5	148.0	149.0	148.0	149.5	149.0	148.0	149.0	148.5	149.5	149.5	149.0	149.0	150.5	149.5
1.4	0.0	151.0	149.0	149.0	149.0	148.5	149.0	148.0	147.5	148.0	149.0	149.5	150.0	148.5	149.5	149.5	150.0
1.5	0.0	152.5	150.0	149.0	150.0	149.0	148.5	148.0	147.5	148.0	149.0	149.5	149.0	150.0	149.5	149.5	149.5
1.6	0.0	0.0	153.0	149.0	149.0	148.5	148.0	148.0	148.0	148.0	148.0	149.0	149.5	149.0	149.5	149.5	0.0
1.7	0.0	0.0	0.0	152.5	149.5	150.0	148.5	149.0	149.0	148.5	149.0	149.5	150.0	150.0	150.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	151.5	150.5	149.0	149.0	149.0	149.0	149.0	150.5	151.0	150.5	151.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	150.0	150.0	149.5	149.0	149.5	150.0	150.5	150.5	151.5	151.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	149.5	149.0	149.5	150.0	149.0	151.0	151.0	152.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	150.0	150.5	150.0	151.0	150.0	151.5	152.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	151.0	149.0	151.0	151.0	151.0	151.5	152.5	151.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	152.0	151.5	151.5	151.5	152.0	151.0	151.5	151.5	152.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	152.5	152.0	152.0	151.5	152.5	151.5	152.0	152.0	152.5	151.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	153.5	152.5	151.0	151.0	151.0	152.0	150.5	150.5	151.5	152.5	150.5	0.0	0.0	0.0
2.6	0.0	0.0	153.0	152.5	151.5	150.5	150.5	151.0	151.0	151.0	150.5	150.0	152.0	151.0	149.0	0.0	0.0
2.7	0.0	153.5	153.0	151.5	150.5	150.5	150.0	150.0	150.0	149.5	148.5	150.0	151.0	150.0	149.0	150.0	0.0
2.8	0.0	152.5	152.0	151.0	150.5	150.0	150.0	149.5	152.0	149.0	151.0	148.0	150.0	149.0	148.0	148.5	153.5
2.9	153.5	152.5	152.0	151.0	150.5	150.0	149.0	149.0	149.5	149.0	149.5	149.0	149.0	150.0	149.0	151.0	154.0
3.0	153.0	152.5	151.5	151.5	150.5	151.0	150.0	150.0	150.0	149.5	150.0	150.0	150.0	150.5	150.0	150.0	154.5
3.1	0.0	153.5	152.0	151.5	151.5	151.0	151.0	151.0	151.0	150.0	149.5	150.0	150.5	150.0	150.0	150.0	154.5
3.2	0.0	153.0	154.0	152.5	152.0	151.5	151.0	150.5	150.0	150.5	150.0	150.0	149.0	150.0	150.0	153.0	0.0
3.3	0.0	0.0	152.5	152.0	152.5	152.0	151.5	151.0	151.5	151.0	150.5	149.0	149.5	150.5	153.0	0.0	0.0
3.4	0.0	0.0	0.0	152.0	152.5	152.0	151.5	151.0	151.0	151.0	149.5	149.5	150.0	152.0	154.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	153.0	153.0	153.0	153.0	151.5	150.5	150.0	150.0	153.0	155.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	151.5	151.5	152.5	153.5	154.5	150.0	151.5	155.0	155.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	155.5	153.5	155.5	155.0	154.5	155.0	155.5	155.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	152.0	151.0	152.5	152.5	152.5	152.5	153.5	154.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	154.0	152.5	151.5	153.0	151.5	151.0	153.0	152.0	153.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	153.0	152.0	153.0	152.5	151.0	152.0	153.5	153.0	152.5	153.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	153.0	153.0	152.5	151.5	152.0	152.0	152.5	153.0	153.0	154.0	153.5	0.0	0.0	0.0
4.2	0.0	0.0	154.0	154.0	153.0	153.0	152.0	152.0	151.0	152.5	153.0	153.5	154.0	154.5	153.5	0.0	0.0
4.3	0.0	155.0	154.0	154.0	153.5	152.0	152.5	151.5	151.5	153.0	153.0	152.0	153.0	153.5	153.5	154.5	0.0
4.4	0.0	154.5	155.0	154.5	153.0	152.5	152.5	152.0	153.5	154.0	153.0	153.0	153.0	153.5	154.5	155.0	155.0
4.5	154.5	154.5	155.0	154.0	154.0	153.0	153.0	153.5	153.0	153.5	153.0	153.5	153.5	153.0	154.0	155.0	156.0
4.6	155.0	155.0	155.5	154.5	154.0	153.0	152.0	153.0	153.5	154.0	153.0	154.0	154.5	155.0	154.5	155.5	156.0
4.7	155.0	156.0	155.0	155.0	156.0	154.5	155.0	154.5	154.0	154.5	153.0	152.0	154.0	154.5	155.0	155.5	156.5
4.8	0.0	155.5	156.5	155.5	155.0	155.0	155.5	155.0	155.0	156.0	154.5	155.0	155.0	155.0	156.5	157.0	0.0
4.9	0.0	0.0	157.5	157.0	156.5	156.5	156.0	156.5	156.0	156.0	156.0	156.0	155.5	155.0	157.0	0.0	0.0
5.0	0.0	0.0	0.0	156.5	157.0	155.5	156.0	155.5	155.5	155.0	155.5	156.5	157.5	157.5	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	157.0	156.0	156.0	155.5	155.0	155.5	156.0	156.0	156.0	154.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	154.0	156.0	155.0	155.0	155.0	155.0	156.0	156.0	156.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	156.5	155.0	155.5	155.5	155.5	156.5	154.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	156.0	156.5	155.5	154.5	156.0	154.5	156.0	157.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	156.0	156.5	155.5	156.0	156.0	156.0	155.5	155.5	157.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	155.0	157.0	154.5	156.5	154.5	157.0	156.0	155.5	157.0	158.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	156.5	156.5	156.5	156.0	156.0	156.5	157.0	156.0	157.0	158.0	157.5	157.0	0.0	0.0
5.8	0.0	0.0	157.5	158.0	157.0	157.0	156.5	156.0	156.5	156.0	156.0	157.5	158.0	159.0	159.5	0.0	0.0
5.9	0.0	156.0	157.5	158.5	157.5	157.5	156.0	157.0	157.0	157.0	156.0	157.0	158.5	160.0	160.5	159.0	0.0
6.0	0.0	156.0	158.5	159.0	158.0	158.5	157.5	158.0	158.5	158.0	158.5	158.5	159.0	160.0	160.0	160.0	160.0
6.1	159.5	159.0	159.0	159.0	158.0	158.0	158.0	157.5	158.0	158.0	157.0	158.0	158.0	159.0	161.5	160.0	161.0
6.2	160.5	159.5	160.0	158.5	157.0	157.5	157.5	158.0	158.0	158.0	158.0	158.5	159.0	159.0	159.5	160.5	162.0
6.3	0.0	158.5	158.0	158.0	158.5	156.5	157.0	157.0	158.0	157.5	157.5	157.0	158.5	159.5	160.0	159.5	0.0
6.4	0.0	0.0	158.0	158.0	158.0	157.5	157.5	157.0	158.0	158.0	158.5	158.5	159.0	159.0	160.0	160.5	0.0
6.5	0.0	0.0	158.5	158.0	158.0	158.0	159.0	158.5	158.0	157.5	158.0	159.0	159.0	160.0	160.0	0.0	0.0
6.6	0.0	0.0	0.0	158.5	158.0	157.0	155.0	157.0	157.5	158.0	155.0	158.0	158.0	159.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	158.5	159.5	158.0	159.5	158.0	157.5	157.5	158.5	159.0	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	157.5	158.5	159.5	160.0	158.5	157.5	158.5	158.5	158.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	158.0	158.0	155.5	160.0	158.0	159.5	160.0	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 2.00 l/s S = 0.0040 beta = 10.90 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	148.0	147.0	145.0	148.5	150.0	147.0	148.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	150.0	148.0	149.5	148.0	149.0	145.5	145.5	148.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	147.5	148.0	147.0	148.0	146.0	150.0	142.5	147.5	146.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	148.5	147.5	149.0	149.5	146.5	147.0	146.5	147.5	150.5	149.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	148.5	146.5	147.0	148.5	147.0	149.5	146.0	146.5	144.5	148.0	149.5	149.5	0.0	0.0
1.0	0.0	0.0	148.5	148.5	150.5	147.0	147.0	150.0	150.0	146.5	152.0	146.0	150.0	150.0	150.5	150.5	0.0
1.1	0.0	147.5	149.0	150.0	150.5	149.0	147.0	147.0	149.5	150.0	149.0	149.0	146.5	149.5	149.5	151.5	0.0
1.2	152.0	148.0	149.0	150.0	150.0	148.0	151.0	147.0	150.0	152.5	152.0	153.0	149.5	151.0	150.5	152.5	152.5
1.3	152.5	148.5	150.0	151.5	151.0	150.5	151.5	150.5	151.5	147.5	151.0	151.5	149.5	152.5	151.5	154.5	152.5
1.4	153.0	148.5	150.0	149.0	149.5	149.0	149.5	150.0	150.5	151.0	152.5	152.5	150.5	151.5	151.0	151.0	153.0
1.5	0.0	149.5	151.5	151.0	149.5	150.0	148.5	149.5	149.5	151.0	150.5	148.0	150.0	152.0	152.0	152.5	152.0
1.6	0.0	149.5	149.5	149.0	150.0	149.5	149.0	149.0	147.0	145.0	147.0	150.0	151.0	152.0	151.5	151.5	0.0
1.7	0.0	0.0	0.0	149.0	150.5	149.5	150.0	152.0	150.5	152.0	149.0	150.5	149.0	153.0	152.5	0.0	0.0
1.8	0.0	0.0	0.0	150.5	151.0	150.5	149.0	150.5	146.0	151.0	150.5	155.0	153.0	152.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	151.0	150.5	150.0	149.5	150.5	153.0	148.5	148.0	151.0	150.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	152.0	149.0	151.5	153.0	153.5	153.0	153.0	153.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	152.0	153.0	154.0	149.5	153.0	152.0	151.5	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	148.5	152.0	152.0	147.5	149.5	150.5	153.0	155.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	150.5	153.5	154.5	148.5	156.0	152.5	154.0	153.5	153.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	152.5	153.0	154.0	157.0	150.5	155.0	154.5	155.0	155.0	156.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	154.0	154.0	153.5	157.0	156.0	152.0	151.5	150.0	157.0	153.0	154.5	0.0	0.0	0.0
2.6	0.0	0.0	153.5	153.0	153.5	151.5	154.5	148.0	151.0	151.0	152.0	151.5	154.5	152.0	155.5	155.0	0.0
2.7	0.0	153.0	154.0	152.5	152.5	153.5	151.0	151.0	148.5	154.5	151.5	152.5	153.5	154.5	153.0	155.5	0.0
2.8	0.0	153.0	152.5	152.0	150.5	150.5	148.5	155.0	154.0	153.5	155.5	153.0	152.0	152.0	155.5	154.0	154.5
2.9	154.0	153.0	153.0	152.5	152.0	149.5	153.5	154.0	154.5	151.0	152.0	155.0	153.0	154.5	153.0	155.0	154.5
3.0	154.0	152.5	152.5	152.0	152.0	152.0	154.0	153.0	153.5	152.5	152.5	152.5	154.0	153.0	154.5	154.0	157.0
3.1	0.0	153.5	151.5	153.0	153.5	153.0	154.5	149.0	153.5	155.0	153.0	154.0	153.5	152.5	154.0	157.0	155.5
3.2	0.0	152.5	153.5	154.5	154.0	153.0	151.0	154.0	151.0	152.0	153.5	152.5	152.0	154.0	154.5	156.0	0.0
3.3	0.0	0.0	154.0	152.5	154.0	154.5	154.0	154.5	156.0	151.5	154.0	155.5	153.5	156.0	157.5	0.0	0.0
3.4	0.0	0.0	0.0	154.5	154.0	155.5	156.5	151.5	153.0	155.0	155.0	155.0	155.5	154.0	154.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	154.5	154.5	155.0	156.0	157.0	154.5	156.5	156.5	156.0	155.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	158.5	155.5	154.5	155.0	154.5	157.5	156.5	155.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	158.0	156.5	158.0	157.0	155.5	156.5	156.0	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	155.5	156.5	155.0	155.0	154.0	157.0	156.5	155.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	156.0	156.0	156.0	156.0	156.0	155.5	155.5	156.5	156.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	154.5	155.5	155.5	155.0	154.0	153.5	152.5	153.5	154.0	155.5	153.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	154.5	155.0	157.0	155.5	154.0	155.5	155.5	154.5	155.5	155.5	154.0	0.0	0.0	0.0
4.2	0.0	0.0	155.5	153.5	154.5	152.5	154.0	153.0	154.5	153.0	154.5	155.0	155.5	154.5	156.0	0.0	0.0
4.3	0.0	157.5	156.5	156.0	157.0	159.0	156.0	153.0	153.5	152.5	154.0	154.0	155.0	154.0	156.0	157.0	0.0
4.4	156.5	157.5	157.0	156.0	156.5	157.0	158.5	151.0	154.0	153.0	153.0	154.5	153.0	155.0	156.0	157.5	156.0
4.5	155.0	157.5	156.5	156.0	157.5	156.5	155.0	154.5	155.5	153.0	152.5	154.0	155.5	155.5	156.0	155.5	158.0
4.6	158.0	158.5	158.0	157.5	156.5	156.0	158.0	152.5	157.5	158.0	155.5	153.0	155.5	156.0	154.5	155.5	156.5
4.7	0.0	160.0	157.0	157.0	158.0	157.5	156.5	157.5	158.5	157.0	155.0	154.0	156.0	156.5	155.5	156.5	156.5
4.8	0.0	159.0	158.0	157.5	158.0	158.0	159.0	157.5	158.0	160.0	158.0	157.5	158.0	157.0	158.0	156.5	0.0
4.9	0.0	0.0	158.5	158.5	157.5	158.0	159.5	159.0	158.0	158.0	159.5	158.0	159.0	159.0	158.0	0.0	0.0
5.0	0.0	0.0	0.0	159.0	158.5	159.0	159.5	158.5	158.5	157.5	154.5	156.0	157.5	158.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	159.0	159.5	157.5	156.5	156.5	157.5	157.5	156.5	158.5	158.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	157.0	157.5	158.0	157.5	158.0	157.5	161.5	157.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	158.0	159.0	158.0	157.5	156.5	156.5	154.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	159.0	160.0	157.0	157.5	155.0	159.5	156.5	158.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	157.5	160.0	159.0	157.5	158.5	158.5	158.5	158.0	159.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	160.0	160.0	159.5	158.5	159.0	159.5	158.0	156.5	159.0	160.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	159.0	158.5	158.5	158.5	158.0	158.0	158.0	158.0	156.5	159.5	157.0	157.5	0.0	0.0
5.8	0.0	0.0	160.0	160.0	160.0	159.0	161.0	159.0	158.5	159.0	157.5	157.5	157.5	158.0	158.5	158.5	0.0
5.9	0.0	162.0	159.0	159.0	159.0	160.0	158.0	161.0	159.0	157.5	156.5	158.5	159.0	159.0	157.5	160.0	0.0
6.0	0.0	162.5	158.5	159.0	160.0	160.0	160.0	159.0	159.0	158.5	158.5	155.0	159.5	159.5	160.0	161.0	160.5
6.1	162.5	160.0	160.0	159.5	159.5	159.5	160.0	157.5	160.0	161.5	158.0	160.5	159.0	159.0	159.0	160.0	161.0
6.2	163.0	161.5	160.0	160.0	159.5	160.0	159.5	160.5	161.0	157.5	161.5	162.0	160.0	157.5	160.0	159.0	161.0
6.3	158.5	163.5	160.5	160.0	159.0	159.0	158.5	159.0	158.0	157.5	159.0	158.0	159.5	160.0	157.5	158.5	159.5
6.4	0.0	160.5	161.5	159.0	159.0	159.0	159.0	159.0	158.0	157.0	160.0	159.0	156.0	158.0	159.5	158.0	0.0
6.5	0.0	0.0	160.0	159.5	159.5	158.0	157.5	158.5	159.5	159.5	161.0	164.0	157.0	157.0	160.5	0.0	0.0
6.6	0.0	0.0	0.0	159.0	159.0	159.0	157.5	159.0	158.0	156.0	160.5	154.0	159.0	160.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	158.0	157.0	159.0	159.0	160.5	161.0	162.0	155.5	158.0	158.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	158.5	160.0	156.0	158.5	155.5	161.5	160.0	161.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	159.5	159.5	160.5	162.5	159.0	158.5	160.0	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 2.49 l/s S = 0.0040 beta = 9.94 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	149.5	145.0	143.5	147.0	145.0	143.0	146.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	150.0	145.5	145.5	144.5	143.5	143.5	142.5	145.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	144.5	146.5	147.5	148.5	147.5	146.5	145.0	145.5	145.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	143.0	146.5	147.0	144.0	145.5	147.5	146.0	144.5	148.5	148.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	147.0	147.5	146.0	147.0	145.5	147.0	146.0	147.5	148.0	150.0	149.0	150.0	0.0	0.0
1.0	0.0	0.0	149.5	147.0	144.5	147.0	149.0	149.0	148.0	146.0	148.0	141.0	151.5	160.0	143.0	150.5	0.0
1.1	0.0	148.5	146.5	148.5	148.5	149.0	147.0	147.0	143.0	148.0	143.5	149.5	150.0	148.5	148.0	151.0	0.0
1.2	0.0	149.0	148.0	147.5	148.0	149.5	149.0	147.5	150.0	150.0	148.0	147.5	152.5	146.0	151.0	154.5	150.0
1.3	150.0	149.5	148.5	147.5	148.5	148.0	149.0	148.0	145.0	147.5	144.5	149.5	147.0	150.5	149.5	149.5	149.0
1.4	148.5	149.5	148.5	149.5	147.5	148.5	148.0	144.5	147.5	144.5	148.0	146.0	149.0	148.0	150.5	147.0	147.5
1.5	0.0	149.5	148.0	148.0	147.0	148.5	147.0	147.0	150.0	151.0	145.5	150.5	147.0	150.5	144.5	150.5	0.0
1.6	0.0	0.0	148.5	148.0	147.5	149.0	147.5	151.0	148.0	151.0	148.5	150.5	148.5	151.0	146.5	147.0	0.0
1.7	0.0	0.0	0.0	150.0	149.0	148.5	149.5	149.0	151.5	152.5	145.5	150.0	146.0	150.0	150.0	0.0	0.0
1.8	0.0	0.0	0.0	149.0	148.5	149.5	148.5	149.5	152.5	145.0	149.0	147.0	149.5	150.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	150.5	150.5	150.5	151.5	153.0	150.0	142.5	149.5	150.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	150.0	150.5	152.0	151.5	147.5	154.0	154.0	154.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	153.0	151.0	151.5	154.5	153.0	148.5	150.5	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	151.0	151.5	146.0	153.5	145.0	146.5	151.5	0.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	152.0	153.0	152.0	148.5	150.5	148.0	154.0	153.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	154.0	151.5	150.0	153.0	155.0	154.5	149.5	151.0	151.5	0.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	157.0	150.5	150.0	152.0	150.5	147.0	156.0	144.0	151.5	152.5	155.0	0.0	0.0	0.0
2.6	0.0	0.0	153.5	149.5	152.0	149.0	151.5	151.5	147.5	149.0	148.5	147.5	151.5	150.5	153.5	0.0	0.0
2.7	0.0	150.0	150.5	148.5	147.0	152.0	145.5	142.5	151.0	150.0	151.0	147.0	151.5	153.0	153.0	0.0	0.0
2.8	0.0	152.5	150.0	149.5	150.0	149.5	152.0	152.0	147.5	153.0	150.5	152.0	151.0	150.0	152.0	153.5	153.5
2.9	151.0	149.0	149.5	150.5	150.5	150.0	149.5	147.5	143.5	153.5	153.0	153.5	151.5	151.5	152.5	152.5	153.5
3.0	149.0	150.0	150.0	151.0	149.0	147.5	149.5	150.5	145.0	148.5	154.0	150.5	150.5	150.5	150.5	152.0	153.5
3.1	0.0	150.0	151.0	149.0	148.0	151.0	151.0	151.0	152.5	149.0	148.0	149.0	151.0	153.0	152.5	153.5	152.5
3.2	0.0	0.0	150.5	149.5	149.5	150.0	150.0	147.0	151.0	149.0	149.0	148.5	149.5	151.5	152.5	152.0	0.0
3.3	0.0	0.0	0.0	153.0	152.0	150.0	153.5	153.5	152.0	153.0	149.5	148.5	150.0	152.0	0.0	0.0	0.0
3.4	0.0	0.0	0.0	0.0	152.5	151.0	151.5	151.0	146.0	150.0	154.0	153.5	152.0	153.5	0.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	0.0	154.5	156.5	152.5	150.0	153.0	150.0	155.5	155.0	0.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	153.0	153.5	155.5	158.5	151.5	155.5	154.5	0.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	152.5	153.5	150.5	155.5	152.0	154.0	154.5	156.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	158.5	155.5	155.0	158.0	157.5	155.5	156.0	157.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	156.5	155.5	155.0	155.5	155.0	154.0	154.0	154.5	157.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	158.0	157.5	156.5	153.0	148.5	154.0	156.5	157.5	153.5	155.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	156.0	156.5	155.5	151.0	150.0	156.0	155.5	156.5	156.0	150.5	158.5	0.0	0.0	0.0
4.2	0.0	0.0	155.0	153.0	156.5	157.0	155.5	151.5	148.5	151.5	153.5	154.5	157.0	153.0	155.0	0.0	0.0
4.3	0.0	157.0	157.0	155.0	156.5	155.5	152.5	152.0	156.0	156.0	148.0	152.5	156.0	154.5	155.0	155.5	0.0
4.4	0.0	156.5	157.0	153.0	153.5	153.5	154.0	154.0	150.5	153.5	154.0	157.0	153.5	156.0	155.5	156.0	156.5
4.5	157.5	156.5	157.5	157.5	157.5	155.5	156.5	151.0	158.0	153.5	156.5	151.5	156.5	155.0	156.0	157.5	157.0
4.6	158.0	156.0	157.5	157.0	156.0	154.0	159.0	157.5	153.5	156.5	148.5	153.5	156.5	155.5	155.0	155.5	156.5
4.7	0.0	158.0	158.5	155.5	157.5	157.0	156.0	157.5	157.5	157.0	159.0	156.0	155.0	156.5	157.0	157.5	156.5
4.8	0.0	0.0	0.0	159.5	159.0	157.5	156.0	157.0	159.0	158.5	156.5	154.5	156.0	158.0	159.0	159.0	0.0
4.9	0.0	0.0	0.0	160.5	159.5	159.0	160.0	151.0	156.5	158.5	157.5	160.5	156.5	155.5	159.0	0.0	0.0
5.0	0.0	0.0	0.0	160.0	157.5	157.0	155.0	159.0	158.0	159.5	158.5	157.0	160.0	157.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	160.0	159.5	160.0	158.0	161.0	158.0	159.5	162.0	160.0	0.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	160.5	159.0	160.0	160.0	157.0	158.0	158.5	155.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	161.0	158.0	157.0	162.5	157.5	158.5	159.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	156.0	159.5	158.0	157.0	156.5	158.0	156.5	160.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	155.5	158.0	156.5	156.5	157.5	156.5	154.0	160.5	160.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	156.5	156.0	157.5	157.0	152.0	159.0	160.0	154.0	157.5	157.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	156.0	157.0	159.5	156.0	159.0	160.5	158.0	156.5	159.0	156.0	157.5	158.0	0.0	0.0
5.8	0.0	0.0	158.5	158.0	157.5	159.0	155.5	156.5	159.5	157.5	154.0	158.0	157.0	157.0	161.0	161.5	0.0
5.9	0.0	162.0	157.5	160.5	157.5	157.0	155.5	160.5	159.5	158.0	152.5	159.5	159.5	155.5	159.0	159.5	0.0
6.0	0.0	159.0	160.5	159.5	155.0	161.5	161.0	156.5	155.0	157.0	156.0	156.0	156.0	158.5	160.0	159.5	160.0
6.1	161.0	160.0	160.0	162.5	158.5	158.5	158.5	160.5	158.0	157.5	154.0	162.5	157.0	157.0	160.0	160.0	160.5
6.2	161.5	159.0	162.0	160.0	159.5	160.0	159.0	160.5	160.0	158.5	157.5	159.0	159.0	163.0	162.0	160.5	162.0
6.3	157.0	159.0	159.0	157.0	156.5	159.5	156.0	158.5	156.5	158.5	160.5	157.5	159.5	159.0	156.5	161.0	160.5
6.4	0.0	159.0	160.0	160.0	159.5	161.0	160.5	159.5	155.5	161.0	157.0	159.0	158.5	157.5	160.0	161.5	0.0
6.5	0.0	0.0	158.5	159.5	158.0	159.0	158.0	158.0	161.5	159.0	154.5	158.0	158.5	158.0	160.5	0.0	0.0
6.6	0.0	0.0	0.0	158.0	158.0	159.0	156.0	158.5	162.0	159.0	160.0	158.5	159.0	160.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	159.5	159.5	159.0	157.5	161.5	160.0	159.5	160.5	165.5	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	158.5	161.5	156.5	158.5	163.0	160.0	165.5	162.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	167.0	160.0	159.0	159.5	156.5	156.0	161.5	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 2.92 l/s   S = 0.0040   beta = 9.09   epsilon = 0.375

x(m)	y(m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	139.0	138.5	140.0	134.0	140.5	137.5	133.0	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	135.0	137.5	139.0	136.5	138.5	134.5	138.0	0.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	137.0	138.5	138.5	138.0	139.0	133.0	138.5	138.0	138.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	136.0	136.5	139.5	138.0	137.5	139.0	138.5	139.0	134.0	141.0	139.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	139.5	135.5	137.5	138.5	133.0	132.2	137.5	137.0	140.5	139.0	136.5	140.5	0.0	0.0
1.0	0.0	0.0	139.5	138.5	139.0	142.5	140.5	135.5	138.5	140.5	138.0	134.0	138.5	138.5	137.0	139.0	0.0
1.1	0.0	139.5	139.0	141.0	137.0	139.5	137.0	130.0	136.5	135.0	139.0	139.5	139.0	140.5	137.0	140.0	0.0
1.2	141.5	141.0	141.0	138.0	139.0	140.5	137.5	141.5	140.0	133.5	142.0	141.5	138.0	141.5	141.5	143.5	142.0
1.3	142.0	140.0	140.0	139.0	139.5	140.5	144.0	138.5	141.0	142.5	138.0	137.5	140.5	142.0	143.0	141.0	141.0
1.4	140.5	141.0	139.5	140.5	141.0	141.5	138.0	133.5	137.0	142.0	136.5	140.5	139.5	140.5	140.0	140.0	143.0
1.5	0.0	142.5	141.0	139.0	138.0	141.5	140.0	134.5	139.5	143.5	142.0	138.0	139.5	142.0	140.5	138.5	0.0
1.6	0.0	141.0	141.0	141.0	141.5	140.5	141.0	138.0	141.0	142.0	137.5	139.5	137.5	141.5	142.0	140.0	0.0
1.7	0.0	0.0	141.5	137.5	142.5	143.0	144.0	146.0	138.5	144.5	137.5	140.5	140.5	143.0	141.0	0.0	0.0
1.8	0.0	0.0	0.0	142.5	140.5	142.5	142.5	144.0	141.5	142.0	141.5	139.0	142.0	142.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	145.5	142.0	139.5	141.5	143.0	143.0	141.0	143.5	143.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	142.5	144.0	143.0	142.5	142.5	146.0	143.0	143.0	145.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	147.0	146.5	146.0	146.5	136.5	143.0	146.5	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	149.0	148.5	149.5	151.0	146.0	145.5	146.5	142.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	146.0	146.5	141.5	146.5	148.5	149.0	145.5	149.0	146.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	148.5	145.0	148.0	145.0	145.0	142.0	146.5	150.5	148.0	149.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	146.5	146.5	147.5	146.0	148.0	147.5	138.5	148.5	147.0	143.0	147.0	0.0	0.0	0.0
2.6	0.0	0.0	145.5	140.0	145.5	145.5	147.0	147.0	143.0	145.5	146.0	143.5	143.5	145.5	147.5	0.0	0.0
2.7	0.0	147.0	145.5	142.5	144.5	141.5	142.5	139.5	146.0	145.0	141.5	145.5	146.5	144.5	147.5	146.5	0.0
2.8	147.5	146.5	143.5	145.0	143.0	141.5	144.0	141.0	141.5	144.0	141.5	140.0	145.0	144.5	147.5	144.0	148.0
2.9	146.5	145.5	145.0	144.5	145.0	141.0	145.0	144.5	149.5	146.0	145.5	146.0	141.5	145.0	145.5	147.0	148.0
3.0	145.0	145.0	146.5	146.0	149.0	145.0	147.0	145.5	150.5	143.5	142.0	146.5	147.5	146.5	144.5	146.0	147.0
3.1	139.5	147.5	145.0	144.0	143.5	146.0	144.5	145.0	144.0	143.5	145.0	146.5	146.5	145.5	146.0	145.0	147.0
3.2	0.0	143.0	146.0	146.5	147.0	146.0	142.5	146.5	146.5	142.5	144.0	145.5	145.0	145.5	146.0	146.0	0.0
3.3	0.0	0.0	145.5	146.0	145.0	149.0	144.5	147.0	145.5	150.5	147.5	147.5	143.0	143.0	146.0	0.0	0.0
3.4	0.0	0.0	0.0	146.0	148.5	148.5	149.0	147.5	145.5	145.5	146.0	147.5	148.5	147.0	147.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	147.0	146.5	148.0	144.0	146.5	147.0	149.5	150.0	150.5	149.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	151.0	151.5	153.5	147.5	151.5	145.5	152.5	153.0	149.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	151.5	148.0	151.0	149.0	154.0	149.5	150.0	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	152.5	152.0	149.0	146.0	149.0	153.0	150.5	0.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	151.0	153.0	149.0	150.0	153.0	153.5	151.5	150.5	151.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	152.0	148.5	146.0	145.0	150.5	151.5	149.5	151.5	148.0	150.5	151.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	152.0	151.0	152.5	149.5	150.0	153.5	152.5	151.5	149.0	151.0	149.5	0.0	0.0	0.0
4.2	0.0	0.0	149.5	147.5	149.0	147.0	149.0	145.5	153.5	151.5	152.0	148.0	147.5	149.5	149.0	0.0	0.0
4.3	0.0	149.5	152.0	148.5	150.0	149.5	155.0	152.5	148.5	144.5	153.0	150.0	148.5	152.5	150.5	150.5	0.0
4.4	150.5	152.5	147.5	149.5	149.5	153.5	148.0	150.5	141.5	150.0	146.5	144.0	145.0	148.5	145.5	154.5	148.0
4.5	152.5	150.5	147.5	152.0	151.5	150.0	149.5	151.0	146.5	149.5	143.5	149.5	150.5	150.5	152.0	151.0	149.5
4.6	153.0	152.0	155.5	151.5	157.0	152.0	148.5	154.0	149.5	145.0	149.0	149.0	150.5	150.5	152.0	150.5	153.0
4.7	149.5	154.5	154.5	152.0	149.5	148.5	148.5	147.5	153.5	157.0	153.0	148.0	151.5	151.5	151.0	151.5	152.5
4.8	0.0	154.5	154.5	153.5	151.5	155.0	153.5	152.0	152.5	154.0	151.5	147.0	152.0	151.5	151.5	153.0	0.0
4.9	0.0	0.0	154.0	155.0	154.0	154.5	153.0	152.5	149.0	156.0	154.0	152.0	154.0	153.0	154.0	0.0	0.0
5.0	0.0	0.0	0.0	151.0	154.0	150.5	154.0	150.0	149.5	152.0	153.5	152.5	154.0	152.5	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	154.5	153.5	152.5	154.0	152.5	151.0	153.0	157.0	155.5	155.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	151.0	154.0	156.0	148.5	151.0	155.0	153.5	155.0	157.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	157.5	158.0	153.0	160.0	158.5	156.5	156.0	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	158.0	156.5	157.0	153.0	151.5	158.5	153.0	0.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	154.5	151.5	156.5	155.5	158.0	148.5	158.5	156.0	157.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	157.5	156.5	154.5	154.5	148.5	156.0	156.5	156.5	157.0	154.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	154.5	158.0	157.5	159.5	152.5	160.0	155.5	152.5	156.5	155.0	154.0	155.0	0.0	0.0
5.8	0.0	0.0	156.5	156.5	157.0	157.0	153.0	151.0	154.5	153.5	153.0	155.5	156.5	157.0	157.0	156.0	0.0
5.9	0.0	158.0	157.0	156.5	155.5	152.0	153.5	148.5	153.5	153.5	151.0	155.5	154.0	156.5	153.5	155.5	0.0
6.0	158.5	158.5	157.0	158.5	150.0	160.0	155.5	154.5	160.5	152.5	157.5	151.0	157.0	155.5	155.0	157.0	155.5
6.1	157.0	155.5	157.0	156.5	159.5	158.5	156.0	157.0	154.5	160.0	158.0	155.0	157.0	156.5	157.0	157.0	157.5
6.2	157.5	155.0	158.0	156.5	154.5	156.0	153.5	155.5	156.5	158.0	153.0	161.5	156.5	153.5	158.5	156.5	158.0
6.3	154.5	159.0	158.0	156.5	156.5	158.0	155.5	150.5	162.5	156.5	155.5	155.5	158.0	156.5	155.5	158.5	157.5
6.4	0.0	153.5	156.0	157.0	157.5	155.0	156.0	159.0	157.0	157.0	152.0	157.0	158.0	155.0	157.5	157.5	0.0
6.5	0.0	0.0	161.5	159.5	158.0	158.5	156.5	157.0	155.5	157.0	155.5	156.5	156.0	157.5	155.0	0.0	0.0
6.6	0.0	0.0	0.0	158.5	157.0	157.5	157.0	157.5	161.0	157.0	160.0	151.5	155.5	154.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	157.5	159.0	157.0	156.5	156.0	157.0	155.0	161.0	160.0	159.5	159.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	157.0	158.5	158.0	156.0	158.5	163.5	162.0	158.5	160.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	162.0	160.5	159.0	158.5	164.0	157.5	160.5	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 0.97 l/s S = 0.0054 beta = 14.63 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	151.0	150.5	150.0	150.0	150.5	150.0	151.5	151.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	151.0	150.5	151.0	150.5	151.5	151.5	152.0	152.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	152.0	150.5	150.5	150.5	150.5	151.0	151.0	151.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	153.5	151.5	150.5	150.5	151.5	151.5	151.5	151.5	151.0	152.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	152.5	152.5	151.0	150.5	151.0	151.0	151.0	151.5	152.0	151.5	153.0	151.5	0.0	0.0
1.0	0.0	0.0	152.5	153.0	152.5	151.5	151.0	152.0	151.0	152.0	152.0	152.0	152.0	152.5	153.0	153.5	0.0
1.1	0.0	153.0	154.0	153.0	152.5	152.5	152.5	152.5	151.5	152.5	152.0	153.5	152.5	153.0	153.5	152.5	153.5
1.2	0.0	154.0	154.5	154.5	153.5	153.0	153.0	152.5	152.5	152.5	153.0	158.5	154.0	154.0	155.0	153.5	152.0
1.3	154.0	155.5	155.0	154.0	154.0	153.5	153.0	153.5	153.0	153.0	153.0	153.5	154.0	154.5	155.0	152.5	151.5
1.4	154.0	154.0	154.0	153.5	153.5	153.0	152.5	152.0	152.5	152.5	152.5	152.5	153.5	154.0	155.5	152.0	152.0
1.5	0.0	154.0	153.5	153.0	153.5	153.0	152.5	152.0	152.5	152.5	152.0	152.5	153.0	153.5	154.5	150.0	157.5
1.6	0.0	0.0	153.5	153.5	153.0	153.5	153.0	152.0	152.0	152.0	153.0	153.0	152.5	154.5	155.5	156.0	0.0
1.7	0.0	0.0	0.0	154.0	153.0	152.5	152.0	151.5	152.0	152.5	152.0	152.0	152.5	154.0	154.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	153.0	153.0	153.5	153.0	152.5	152.5	152.5	152.5	153.5	155.0	154.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	153.0	153.0	154.0	152.5	152.5	152.5	153.0	153.5	155.0	155.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	153.5	154.0	153.0	152.0	152.5	152.5	154.0	155.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	153.0	153.5	153.5	153.5	153.0	154.0	155.5	155.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	152.0	153.5	153.0	154.5	155.5	156.5	155.5	156.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	154.0	154.0	153.5	154.0	154.5	155.5	155.5	156.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	154.5	154.0	154.5	154.0	153.5	154.0	155.0	156.5	156.0	156.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	155.5	154.5	154.5	154.0	153.5	154.0	154.0	154.5	156.0	156.0	156.0	0.0	0.0	0.0
2.6	0.0	0.0	153.5	155.5	154.5	154.0	154.0	153.5	154.0	154.0	153.5	154.0	155.5	156.0	155.5	0.0	0.0
2.7	0.0	0.0	154.5	154.0	154.0	153.0	152.5	153.0	153.0	153.0	153.0	154.5	155.0	156.0	156.0	155.5	0.0
2.8	0.0	152.5	154.5	153.5	153.5	152.5	153.5	152.5	153.5	152.5	153.0	153.0	153.5	155.0	155.0	156.0	158.0
2.9	157.0	152.5	154.5	153.5	153.0	153.0	152.5	152.5	153.0	153.0	153.5	153.5	154.0	155.5	155.5	156.0	156.0
3.0	156.5	153.0	154.5	154.0	153.5	153.5	153.0	152.5	153.0	153.0	152.5	153.5	154.0	154.0	155.0	155.5	156.5
3.1	0.0	153.0	154.0	154.0	153.5	153.0	153.0	153.0	153.5	153.0	153.5	153.5	154.0	155.0	155.5	156.5	157.0
3.2	0.0	155.0	155.0	154.0	154.0	154.0	153.5	153.5	153.5	153.5	154.0	154.0	155.0	154.0	155.0	156.0	0.0
3.3	0.0	0.0	0.0	155.0	154.5	154.0	154.0	154.0	154.0	154.5	153.5	154.0	154.5	155.5	156.0	0.0	0.0
3.4	0.0	0.0	0.0	156.0	156.5	155.0	155.0	155.0	154.5	154.5	155.0	155.0	155.0	156.0	155.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	156.0	156.0	155.5	155.0	155.5	155.0	155.5	155.0	155.5	156.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	157.5	157.5	156.0	155.5	155.5	156.0	156.5	156.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	157.0	157.0	157.0	156.5	156.0	156.0	156.0	157.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	157.5	157.0	156.0	156.0	156.0	156.0	156.0	158.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	157.0	156.0	155.0	155.5	155.0	156.0	157.0	156.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	158.0	156.5	155.5	154.0	154.5	155.5	154.5	154.5	157.0	157.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	155.0	157.5	155.5	154.5	153.5	154.0	155.5	155.0	154.5	156.0	155.0	0.0	0.0	0.0
4.2	0.0	0.0	157.0	156.0	157.0	155.5	154.5	153.5	155.5	155.0	154.5	154.0	154.5	156.0	155.5	0.0	0.0
4.3	0.0	156.5	157.0	156.0	156.5	155.0	156.0	156.5	155.5	154.0	154.5	153.5	154.5	155.0	155.0	155.0	0.0
4.4	0.0	156.5	155.5	156.5	156.5	155.5	156.0	154.0	154.5	153.5	153.5	153.5	153.5	154.5	155.0	154.5	155.0
4.5	159.5	159.5	155.5	156.5	156.5	156.0	155.0	154.5	154.0	153.5	153.5	153.5	153.5	154.5	154.5	154.0	154.5
4.6	0.0	158.5	157.0	157.0	157.5	157.0	154.5	155.0	154.5	154.0	154.0	154.0	153.5	154.0	154.0	155.0	155.0
4.7	0.0	159.5	159.0	159.0	157.5	155.0	155.0	155.0	154.5	154.0	154.5	154.0	154.0	154.0	154.5	154.5	156.0
4.8	0.0	159.5	159.0	158.0	156.5	155.0	155.5	155.5	155.0	155.0	155.0	155.0	155.0	154.5	155.5	155.5	0.0
4.9	0.0	0.0	158.5	158.0	156.0	155.5	156.0	155.5	155.5	155.5	155.0	155.0	155.0	156.0	155.5	0.0	0.0
5.0	0.0	0.0	0.0	157.5	157.0	156.0	155.5	155.5	154.5	155.0	154.5	154.5	155.0	155.5	155.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	156.5	155.0	155.5	155.0	154.5	154.5	154.0	154.5	155.0	155.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	156.5	155.0	155.0	154.5	154.5	154.0	154.5	154.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	156.0	155.0	154.5	154.5	154.0	154.5	155.0	155.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	155.5	155.0	154.5	153.5	154.5	154.0	154.5	155.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	155.5	155.0	154.5	155.0	154.0	154.5	154.5	156.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	156.0	155.0	155.0	154.5	155.0	154.0	154.5	155.5	155.0	154.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	156.0	155.0	155.5	154.5	155.0	154.5	154.0	154.5	154.5	154.5	155.0	154.5	0.0	0.0
5.8	0.0	0.0	153.5	156.0	155.5	155.0	154.5	154.0	165.0	154.5	154.0	154.5	155.0	154.5	155.0	155.5	0.0
5.9	0.0	153.5	157.0	155.5	155.0	155.0	155.0	154.5	155.5	155.0	155.0	155.5	155.5	156.0	155.5	157.5	159.0
6.0	0.0	156.0	155.5	155.5	155.0	155.0	154.5	155.5	155.5	155.5	155.0	156.0	156.0	156.5	156.5	156.0	159.0
6.1	161.0	154.0	154.0	155.0	155.0	154.5	154.0	156.0	156.0	156.5	156.5	156.0	156.5	157.5	157.0	157.5	159.0
6.2	159.5	153.5	152.5	153.5	154.0	153.5	153.5	156.0	155.5	155.5	155.0	156.5	156.5	157.0	157.5	157.5	157.5
6.3	0.0	155.0	153.0	152.0	152.0	152.0	152.5	153.5	156.5	156.5	156.0	156.0	157.0	157.0	157.0	157.0	159.5
6.4	0.0	159.5	155.0	152.0	151.5	150.5	151.0	152.0	157.0	156.0	156.5	156.5	156.5	157.0	157.5	158.5	0.0
6.5	0.0	0.0	161.5	152.5	151.5	150.5	150.5	152.0	154.0	157.0	157.0	156.5	157.0	157.5	158.5	0.0	0.0
6.6	0.0	0.0	0.0	159.0	152.5	150.5	150.0	150.5	151.0	157.5	157.0	157.5	156.5	157.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	159.0	159.5	154.5	152.5	153.5	158.0	157.5	158.0	158.5	157.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	157.5	160.0	152.5	158.0	157.5	157.0	158.0	156.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	160.5	160.5	157.5	158.0	157.5	158.5	157.0	156.5	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.05 l/s   S = 0.0054   beta = 13.68   epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	150.5	146.0	145.5	151.5	150.0	150.0	150.5	150.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	151.0	148.0	149.0	151.5	150.5	150.5	149.0	151.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	150.0	147.5	151.0	151.5	150.0	150.5	150.0	158.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	148.0	149.5	149.5	150.5	151.0	150.5	150.0	150.0	150.5	151.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	148.0	147.0	150.0	150.0	151.5	150.5	150.5	151.5	150.5	151.5	152.0	151.0	0.0	0.0
1.0	0.0	0.0	149.5	148.0	147.0	146.5	150.5	151.0	151.0	151.0	151.5	151.0	151.0	151.0	152.5	152.5	0.0
1.1	0.0	0.0	154.0	150.0	148.5	149.0	149.0	150.5	153.0	152.0	151.5	151.5	152.5	152.0	151.5	152.5	152.5
1.2	0.0	152.5	150.5	150.0	149.5	149.5	153.0	153.0	152.0	152.0	152.0	151.5	152.5	152.5	152.0	152.5	153.0
1.3	0.0	154.5	152.0	151.5	150.5	149.0	153.5	153.0	152.0	152.0	152.0	152.0	152.0	152.5	153.0	152.5	153.0
1.4	153.5	154.0	153.5	154.0	151.5	151.0	153.0	151.5	151.5	151.5	151.0	152.0	151.5	151.5	151.5	152.5	152.0
1.5	0.0	153.0	154.5	154.5	150.5	152.0	151.5	151.0	151.5	151.0	150.5	151.0	152.0	151.0	151.5	152.5	153.5
1.6	0.0	0.0	155.0	149.5	153.0	151.5	151.5	150.5	151.5	151.0	151.0	151.5	152.0	151.5	151.5	152.5	0.0
1.7	0.0	0.0	0.0	153.5	152.5	152.0	150.5	150.5	151.5	151.0	151.5	152.0	152.0	151.5	153.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	152.0	152.0	151.5	151.5	152.0	151.5	152.0	152.0	152.0	153.5	154.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	151.0	151.5	152.0	151.5	151.5	152.0	153.0	152.5	152.5	153.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	152.0	152.5	152.0	152.5	152.0	152.0	152.5	153.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	153.0	153.0	153.0	153.0	152.5	152.5	153.5	153.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	154.0	153.5	152.5	153.0	153.0	153.0	153.5	154.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	155.0	154.5	153.5	154.0	154.0	153.5	154.0	154.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	155.0	154.5	154.0	154.5	154.5	154.0	154.0	154.5	155.0	154.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	155.5	155.5	154.5	155.0	154.0	154.5	154.5	155.0	154.5	154.5	155.0	155.5	0.0	0.0
2.6	0.0	0.0	155.5	155.0	155.0	154.5	154.0	154.5	154.0	153.5	154.5	154.5	154.0	155.0	154.5	0.0	0.0
2.7	0.0	0.0	155.0	156.0	154.5	153.5	153.5	154.0	153.0	153.5	154.0	154.0	154.0	154.0	155.0	157.0	0.0
2.8	0.0	155.5	155.5	155.0	155.0	153.5	154.5	153.5	152.5	153.5	154.0	154.0	154.0	154.0	154.5	153.5	153.0
2.9	156.5	155.0	154.5	154.5	154.0	153.0	153.0	153.0	152.5	152.5	153.5	154.0	153.0	154.5	154.5	154.0	155.0
3.0	156.0	155.0	155.5	155.5	154.5	154.0	153.0	153.5	152.5	153.0	154.0	154.5	154.5	154.5	155.0	153.5	156.0
3.1	0.0	155.0	155.0	155.0	154.5	153.5	154.0	153.5	153.0	153.0	154.0	154.5	154.5	155.0	154.5	154.0	156.5
3.2	0.0	0.0	155.5	155.0	155.0	154.0	153.5	153.5	154.0	153.0	154.0	154.5	155.0	154.5	155.0	155.5	0.0
3.3	0.0	0.0	0.0	156.0	155.5	154.5	155.0	155.0	154.0	154.5	154.5	155.0	155.5	156.0	155.5	0.0	0.0
3.4	0.0	0.0	0.0	155.0	155.5	154.5	155.5	155.5	155.5	155.0	155.0	155.5	156.5	156.0	158.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	156.5	156.0	156.0	156.6	155.0	155.0	155.5	156.0	157.0	158.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	156.5	157.0	156.0	156.0	155.5	156.0	156.5	158.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	158.0	156.5	156.5	156.5	156.0	155.5	156.5	158.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	156.5	156.0	155.5	156.5	156.5	155.5	156.0	156.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	157.0	156.0	155.5	154.5	155.5	155.5	155.5	155.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	157.5	157.0	156.0	155.5	155.5	155.0	155.0	155.5	155.5	155.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	153.0	155.0	155.5	156.0	155.5	155.5	154.5	155.0	154.5	155.5	155.5	0.0	0.0	0.0
4.2	0.0	0.0	157.5	153.0	155.5	154.5	155.0	155.0	155.0	155.0	155.0	155.0	155.5	155.5	156.0	0.0	0.0
4.3	0.0	156.5	157.5	152.5	153.5	154.0	154.5	154.5	154.5	155.0	157.0	155.0	155.5	156.5	155.5	156.5	0.0
4.4	0.0	156.5	154.0	153.5	154.5	154.0	154.5	154.5	155.0	155.0	155.0	155.5	156.0	156.0	156.0	157.0	157.0
4.5	156.5	158.5	155.0	153.5	153.0	154.0	154.5	154.5	154.5	155.0	155.5	156.0	155.5	156.5	156.5	157.0	157.5
4.6	0.0	159.0	156.0	154.5	154.5	154.0	154.0	154.5	155.0	155.5	156.0	156.0	157.0	158.0	157.5	157.0	158.0
4.7	0.0	160.5	156.0	155.0	154.5	153.5	153.5	153.5	154.5	155.0	156.0	156.5	157.0	157.5	157.5	158.0	158.5
4.8	0.0	168.0	160.0	156.5	156.0	155.0	154.5	154.0	155.0	156.0	155.5	156.0	157.5	158.0	159.0	159.0	0.0
4.9	0.0	0.0	159.0	158.5	158.5	157.5	155.0	155.0	154.0	154.0	156.0	157.0	158.5	159.0	159.0	158.0	0.0
5.0	0.0	0.0	0.0	159.0	159.5	157.5	157.0	155.0	155.0	154.0	154.5	156.5	156.5	157.5	157.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	159.5	159.5	158.0	157.5	158.0	158.5	159.0	159.0	157.5	157.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	159.5	157.0	156.0	159.0	159.0	158.5	158.5	157.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	159.0	158.0	158.0	158.0	157.5	156.5	157.0	156.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	158.5	158.0	157.5	157.5	157.0	157.5	157.5	157.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	159.0	158.0	157.5	157.5	157.0	157.5	158.0	157.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	159.0	158.5	158.0	157.0	157.5	157.0	157.5	157.0	157.0	157.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	160.5	159.5	158.5	158.0	157.5	158.0	158.0	157.5	157.5	157.0	156.0	156.5	0.0	0.0
5.8	0.0	0.0	161.0	160.5	159.0	159.0	158.5	158.0	158.5	158.0	157.5	157.0	157.5	156.5	155.0	158.5	0.0
5.9	0.0	162.0	161.0	160.5	160.0	159.0	158.5	159.0	159.0	158.0	157.5	157.0	156.5	155.5	155.5	156.5	160.5
6.0	0.0	162.5	161.5	161.0	161.0	160.0	159.5	159.0	159.0	158.5	157.5	157.5	155.5	154.5	157.0	156.5	162.5
6.1	161.5	162.5	162.0	161.0	160.0	160.5	161.5	159.0	158.5	158.5	158.5	156.0	155.5	156.5	158.5	156.5	162.5
6.2	161.0	162.5	162.5	161.0	162.0	161.5	160.0	159.0	159.0	158.5	158.0	156.5	156.0	157.0	158.0	157.0	162.0
6.3	0.0	162.0	161.0	160.5	160.5	160.0	159.5	158.5	158.5	158.0	156.0	154.0	155.0	157.0	158.5	158.5	164.0
6.4	0.0	0.0	161.5	162.0	161.0	160.0	159.0	159.0	158.5	156.5	153.5	153.5	154.5	156.0	158.5	162.5	0.0
6.5	0.0	0.0	159.0	160.5	159.5	159.5	159.5	158.5	158.5	153.5	153.5	154.0	155.0	159.0	162.5	0.0	0.0
6.6	0.0	0.0	0.0	160.0	160.0	159.5	159.5	159.5	157.5	156.0	156.0	158.5	161.5	160.5	162.5	0.0	0.0
6.7	0.0	0.0	0.0	0.0	159.5	160.0	159.5	159.5	159.5	156.5	160.5	163.0	159.0	160.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	160.0	159.5	159.5	159.5	159.0	162.0	163.5	164.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	160.0	160.0	160.0	160.0	159.5	162.5	163.0	163.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 1.52 l/s   S = 0.0054   beta = 12.20   epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	150.5	149.0	149.0	149.5	149.0	149.0	149.5	148.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	150.5	149.0	150.0	149.0	150.0	149.5	150.0	150.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	150.5	150.0	150.0	150.0	149.5	149.5	149.5	149.5	150.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	151.5	150.0	150.5	149.5	149.5	150.0	149.5	149.5	150.5	150.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	149.0	151.0	150.0	150.0	150.0	150.5	149.5	149.5	150.0	150.5	152.0	150.5	0.0	0.0
1.0	0.0	0.0	148.5	148.5	151.0	151.0	149.5	150.0	150.0	150.5	149.5	149.5	150.5	151.0	152.0	151.5	0.0
1.1	0.0	151.5	147.0	151.5	150.0	151.5	151.0	150.0	150.5	150.5	150.0	150.5	151.5	151.0	151.5	151.5	152.5
1.2	0.0	149.0	147.5	148.5	151.0	151.0	150.0	150.5	151.0	151.0	151.0	151.0	151.5	151.5	152.0	154.0	153.0
1.3	149.5	149.5	148.5	148.0	151.0	150.5	150.5	151.0	150.5	151.0	151.0	151.0	151.5	151.5	152.5	152.0	152.0
1.4	150.5	154.0	154.5	148.5	147.0	149.0	150.5	150.5	150.5	150.5	150.5	150.5	151.0	151.0	152.0	151.5	152.5
1.5	0.0	153.5	150.0	147.0	146.0	147.5	151.0	151.0	150.5	150.5	150.0	150.5	151.0	151.0	151.0	152.0	152.0
1.6	0.0	0.0	155.0	148.0	146.5	147.5	152.0	150.5	150.5	150.5	150.0	151.0	151.0	151.5	151.5	152.5	0.0
1.7	0.0	0.0	0.0	152.5	148.0	148.5	152.0	151.0	151.0	150.0	149.5	150.0	150.5	150.5	151.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	149.0	149.0	152.5	150.5	150.5	150.5	150.5	150.0	151.0	151.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	0.0	152.0	151.5	151.0	150.5	150.0	151.0	151.0	150.5	151.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	153.0	151.5	150.5	150.5	151.0	151.5	151.5	152.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	152.0	151.5	152.0	151.0	151.5	150.5	151.0	151.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	153.5	152.5	151.5	151.0	151.0	151.0	151.0	152.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	153.0	152.0	152.0	151.0	150.5	151.5	151.0	151.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	154.0	152.5	152.0	151.0	151.5	151.5	153.0	152.5	152.0	152.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	154.0	154.0	152.0	152.0	151.0	151.5	151.5	152.0	151.0	151.5	151.0	0.0	0.0	0.0
2.6	0.0	0.0	0.0	153.0	152.5	151.0	151.0	150.0	150.0	149.5	149.0	150.0	151.5	150.0	151.5	0.0	0.0
2.7	0.0	0.0	151.5	152.0	151.5	150.0	150.0	150.0	149.5	149.5	150.0	150.0	150.0	150.0	151.0	151.0	0.0
2.8	0.0	154.0	151.5	152.5	150.5	150.5	149.5	149.0	149.5	150.0	148.0	149.5	150.0	150.0	151.0	151.0	152.5
2.9	154.5	150.0	150.5	152.0	151.0	150.0	149.0	149.5	149.5	149.5	149.0	150.0	150.0	150.5	151.0	152.0	152.5
3.0	153.5	152.0	151.0	152.0	151.0	149.5	149.5	149.0	148.5	150.0	148.5	149.0	149.5	150.0	151.0	151.0	151.5
3.1	0.0	153.0	151.5	150.5	150.5	150.5	149.0	148.5	149.0	150.0	149.5	150.0	149.5	150.0	150.5	151.0	152.5
3.2	0.0	0.0	152.5	151.0	150.5	150.5	149.5	149.5	150.0	150.0	149.5	149.5	150.5	150.5	150.5	151.0	0.0
3.3	0.0	0.0	0.0	151.5	151.0	150.5	150.5	149.5	150.0	149.5	149.5	149.5	151.0	151.0	151.5	0.0	0.0
3.4	0.0	0.0	0.0	151.0	150.5	151.0	150.0	150.0	149.0	148.5	149.5	151.0	151.0	152.0	153.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	152.0	152.0	152.0	150.5	151.5	151.0	151.0	150.5	151.5	153.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	151.5	151.0	151.5	151.0	151.0	151.5	152.5	153.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	152.5	152.0	152.0	152.0	152.5	152.0	152.0	153.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	152.5	151.0	151.0	153.0	151.0	152.0	151.5	152.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	151.5	151.0	151.0	151.0	150.0	150.0	150.5	150.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	152.0	151.0	151.0	152.0	150.0	149.5	150.0	151.0	150.5	150.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	152.0	150.5	150.5	149.0	150.0	149.5	149.5	149.5	150.0	151.0	151.5	150.0	0.0	0.0
4.2	0.0	0.0	152.5	151.0	150.5	150.0	149.5	149.5	149.5	150.0	149.5	150.0	149.5	150.5	149.0	0.0	0.0
4.3	0.0	153.5	151.5	151.0	151.0	150.5	149.0	148.5	149.5	149.5	149.5	149.5	150.0	151.0	147.5	147.5	0.0
4.4	0.0	152.5	150.5	151.0	150.5	150.0	149.0	149.0	149.0	149.5	150.0	150.0	150.5	150.5	148.5	149.5	149.5
4.5	153.0	152.5	151.5	151.0	150.5	150.0	149.5	148.5	149.5	149.5	149.5	149.5	151.0	150.0	150.0	148.0	150.5
4.6	0.0	152.5	151.0	152.5	150.5	149.5	150.0	149.5	149.5	150.0	150.0	150.0	150.5	150.0	149.5	149.5	153.5
4.7	0.0	152.0	151.5	152.0	150.0	150.0	150.0	150.0	149.5	150.0	150.0	150.0	150.5	150.0	150.5	149.5	155.0
4.8	0.0	0.0	152.0	151.0	151.5	151.0	150.0	150.5	150.0	150.0	150.5	150.5	150.5	150.0	152.0	153.0	0.0
4.9	0.0	0.0	151.5	152.0	151.5	151.5	150.5	151.0	150.0	150.5	150.5	150.5	151.0	150.0	153.0	0.0	0.0
5.0	0.0	0.0	0.0	151.5	151.5	151.5	150.5	150.0	151.0	151.0	150.5	150.5	150.5	151.5	153.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	152.0	150.5	150.5	150.5	150.5	150.0	149.0	150.0	150.0	152.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	152.0	151.0	150.0	151.0	151.0	150.5	150.0	150.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	152.0	151.0	151.0	150.5	151.5	151.0	150.5	150.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	151.5	151.0	151.0	150.5	150.5	150.5	151.0	151.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	151.5	151.0	151.0	151.0	150.0	150.5	151.0	151.0	151.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	152.5	151.0	151.0	150.5	150.5	148.5	149.5	150.0	150.5	150.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	151.0	151.0	151.0	150.0	150.5	150.0	149.5	149.5	149.5	150.5	150.0	151.0	0.0	0.0
5.8	0.0	0.0	152.5	150.5	150.5	151.0	150.5	150.5	149.5	149.5	150.0	150.0	150.0	150.5	150.5	151.5	0.0
5.9	0.0	150.5	153.0	150.0	150.5	150.5	150.0	150.0	150.0	149.5	150.5	150.0	150.0	151.0	151.5	152.0	152.5
6.0	0.0	150.5	153.5	150.5	150.5	150.5	150.5	150.5	151.0	150.5	150.0	150.0	150.5	150.5	150.0	152.0	152.0
6.1	0.0	151.0	154.0	151.0	151.0	151.0	151.5	151.0	150.0	150.5	150.5	150.0	150.0	150.5	151.0	151.0	152.5
6.2	154.5	151.0	153.5	150.5	150.5	151.0	151.0	150.5	150.0	150.0	150.0	149.5	149.5	151.0	151.0	151.0	152.0
6.3	0.0	152.5	153.0	150.0	150.0	150.0	150.5	150.0	149.5	149.5	149.0	149.5	149.5	149.5	150.5	150.5	151.5
6.4	0.0	0.0	152.0	152.5	150.0	150.0	150.0	150.5	150.0	149.5	149.0	149.5	150.0	149.5	150.0	150.5	0.0
6.5	0.0	0.0	0.0	153.5	149.5	149.5	150.0	150.5	150.5	149.5	149.5	150.0	149.5	150.0	150.0	0.0	0.0
6.6	0.0	0.0	0.0	152.0	153.5	150.0	150.0	150.5	151.0	150.5	149.5	150.0	149.5	150.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	151.5	152.5	151.0	150.0	152.0	151.0	150.0	149.5	149.0	149.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	151.5	152.0	152.0	152.0	150.5	149.5	149.5	149.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	150.5	151.0	151.5	151.5	150.5	149.5	149.0	149.5	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 2.02 l/s   S = 0.0054   beta = 10.84   epsilon = 0.375

x (m)									y (m)								
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	-0.03	-0.06	-0.09	-0.12	-0.15	-0.18	-0.21	-0.24
0.5	0.0	0.0	0.0	0.0	0.0	152.5	153.5	152.0	152.5	152.5	152.0	152.0	153.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	151.5	153.5	153.5	153.0	152.5	153.5	152.0	153.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	154.5	152.5	152.5	150.5	152.5	151.5	151.0	151.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	154.5	152.5	153.0	153.5	155.0	154.0	153.0	153.0	152.5	155.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	153.5	154.0	154.5	154.0	149.5	151.0	152.0	153.5	151.0	152.5	155.0	155.0	0.0	0.0
1.0	0.0	0.0	154.0	154.5	153.5	153.5	152.5	154.0	153.0	152.5	153.5	154.5	153.5	156.0	153.5	154.0	0.0
1.1	0.0	155.5	154.5	153.5	152.0	153.5	153.5	151.0	151.0	152.0	152.5	154.5	154.0	152.0	151.5	155.0	155.5
1.2	0.0	155.5	154.0	154.5	154.0	153.0	155.0	154.0	152.5	152.0	149.0	153.0	153.0	153.5	154.5	153.5	155.5
1.3	156.0	153.5	153.0	153.5	152.5	153.5	154.0	151.5	153.0	154.5	155.0	155.5	153.5	154.0	151.0	151.0	154.5
1.4	155.5	153.0	153.0	152.5	153.0	152.0	153.5	153.0	153.5	152.5	150.5	154.0	154.0	154.0	153.5	154.0	154.5
1.5	0.0	154.5	153.5	153.5	153.0	151.5	152.5	153.0	153.0	151.5	156.0	154.5	152.0	152.0	152.5	153.5	154.0
1.6	0.0	0.0	154.5	153.5	152.5	153.5	153.0	152.5	153.0	152.0	155.5	153.5	153.0	153.0	152.0	155.5	0.0
1.7	0.0	0.0	0.0	154.0	152.0	153.0	154.0	153.5	150.5	151.0	150.0	153.0	151.0	153.0	154.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	153.5	153.5	153.0	151.5	154.0	155.0	153.5	152.5	154.0	153.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	154.0	155.0	153.0	152.5	152.0	154.0	157.0	151.0	154.0	155.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	154.5	153.5	154.5	154.0	150.0	159.0	154.5	154.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	155.0	155.5	154.5	153.0	152.5	151.0	153.5	153.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	154.0	155.5	154.5	153.5	157.5	155.0	156.0	155.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	155.0	155.5	157.0	154.0	156.0	156.0	155.5	156.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	156.5	155.5	155.5	153.5	155.0	158.5	153.5	153.5	155.5	156.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	155.5	155.0	155.5	155.5	157.5	155.0	154.5	156.0	155.0	153.5	156.0	0.0	0.0	0.0
2.6	0.0	0.0	156.0	154.5	155.5	155.0	156.0	150.5	152.5	153.5	158.5	153.5	155.0	155.5	156.5	0.0	0.0
2.7	0.0	155.0	154.5	154.0	153.5	154.0	154.5	156.5	155.0	157.5	156.5	153.5	154.0	154.5	153.5	155.5	0.0
2.8	0.0	155.5	153.5	153.0	154.5	152.5	153.5	153.0	154.5	155.5	153.5	153.0	153.0	154.5	155.0	154.5	155.0
2.9	155.5	154.5	154.0	153.0	152.5	152.5	151.5	151.5	154.5	156.0	150.0	153.0	154.0	152.5	154.0	154.5	155.0
3.0	154.5	154.5	153.5	152.0	154.0	152.0	154.5	152.5	151.0	156.5	155.0	152.5	153.0	154.5	155.0	154.0	155.0
3.1	0.0	153.5	153.5	151.5	154.5	153.0	151.5	152.5	152.0	151.5	154.0	153.0	154.0	153.5	154.0	154.5	154.5
3.2	0.0	0.0	154.0	153.0	155.0	155.0	152.5	152.0	151.5	152.0	153.5	153.5	151.5	153.0	154.5	154.0	0.0
3.3	0.0	0.0	0.0	154.0	153.5	154.0	154.0	155.0	153.5	149.5	153.5	155.0	153.5	153.5	154.0	0.0	0.0
3.4	0.0	0.0	0.0	154.0	154.5	153.5	155.0	152.0	150.5	153.5	154.5	154.5	153.5	155.5	153.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	155.0	155.5	154.5	156.0	155.0	155.5	153.5	154.5	155.0	153.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	155.5	155.5	153.5	156.5	155.5	155.0	155.5	155.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	156.5	156.0	154.0	155.5	155.0	157.5	155.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	153.5	154.0	153.0	157.5	152.5	153.0	155.0	0.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	154.0	152.0	153.0	150.0	152.5	155.0	153.5	154.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	154.0	153.5	152.5	152.5	157.0	157.0	151.0	154.5	153.0	154.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	153.0	154.0	154.5	155.5	154.5	151.0	151.0	152.0	151.5	152.0	153.0	0.0	0.0	0.0
4.2	0.0	0.0	154.5	153.0	154.0	155.0	153.5	153.0	150.0	151.5	152.5	153.0	152.5	153.0	153.0	0.0	0.0
4.3	0.0	0.0	155.0	153.0	153.5	152.5	151.5	148.0	149.5	154.5	154.0	151.5	152.0	153.5	153.5	153.0	0.0
4.4	0.0	155.0	153.0	151.5	151.5	151.5	153.0	153.0	153.0	154.0	153.5	153.0	151.0	151.5	153.5	152.5	154.0
4.5	155.5	154.0	153.5	153.0	153.5	155.5	152.0	149.5	155.0	151.5	151.5	151.0	152.5	152.5	153.5	152.5	154.0
4.6	154.0	154.5	154.0	153.5	153.5	152.5	153.5	152.0	151.0	150.0	152.0	152.5	151.0	151.0	152.5	152.5	154.0
4.7	0.0	155.5	154.5	153.5	155.0	153.5	153.0	154.0	152.5	153.5	152.5	151.0	153.0	152.5	153.5	153.0	153.5
4.8	0.0	153.5	154.5	153.0	153.0	154.5	152.0	153.0	154.5	150.0	152.0	152.0	152.5	151.5	153.0	153.5	0.0
4.9	0.0	0.0	154.5	154.5	153.0	152.0	154.0	155.5	153.5	152.5	152.0	154.0	153.0	152.5	153.5	0.0	0.0
5.0	0.0	0.0	0.0	153.5	155.5	151.5	150.5	152.5	152.5	154.0	153.0	153.0	152.0	153.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	154.0	153.5	153.0	153.5	153.5	152.5	153.0	153.5	153.0	153.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	153.0	151.5	155.0	152.5	151.0	151.0	153.0	153.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	153.5	154.0	151.0	152.5	149.0	152.5	154.0	153.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	153.5	154.0	153.0	152.0	153.5	152.5	153.0	153.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	149.5	154.0	155.0	154.0	155.0	152.0	151.5	153.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	152.0	152.0	151.5	149.5	153.5	152.5	154.0	151.5	153.0	153.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	151.5	151.5	153.5	152.0	152.0	153.5	153.5	152.5	151.5	152.5	153.0	153.5	0.0	0.0
5.8	0.0	0.0	153.0	151.5	153.5	152.0	150.0	150.0	152.0	153.5	149.0	150.5	154.0	153.5	154.0	154.0	0.0
5.9	0.0	155.0	153.5	153.0	151.5	153.0	151.5	152.0	152.5	151.0	154.5	153.5	151.5	155.0	154.5	154.0	154.0
6.0	0.0	155.5	154.5	152.5	153.5	152.0	152.0	153.0	152.5	150.0	148.5	155.0	156.0	151.5	153.5	153.0	155.0
6.1	156.0	155.5	155.5	153.0	152.5	152.5	152.5	153.0	152.0	152.5	150.5	151.0	156.5	151.5	153.5	154.0	155.0
6.2	155.5	156.0	154.0	153.0	152.5	152.5	152.0	152.5	150.5	152.5	152.5	152.0	152.5	154.5	154.0	153.0	153.5
6.3	0.0	153.5	153.0	152.5	153.5	152.5	152.0	151.5	153.5	151.5	149.0	152.0	152.5	151.5	152.0	152.0	154.0
6.4	0.0	0.0	153.0	151.5	151.5	151.0	151.5	152.0	153.0	150.0	151.0	152.0	151.5	154.0	149.5	151.5	0.0
6.5	0.0	0.0	151.0	152.0	152.0	152.5	151.5	151.0	153.0	152.0	152.5	151.5	151.0	153.0	153.5	0.0	0.0
6.6	0.0	0.0	0.0	152.0	153.0	151.5	151.5	152.0	152.0	152.0	151.5	151.5	151.0	152.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	151.5	151.5	152.0	151.5	152.5	152.0	152.5	153.5	152.0	151.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	151.5	152.0	152.0	151.5	153.0	151.5	153.0	153.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	152.5	152.0	152.5	152.5	153.5	152.5	152.5	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 2.53 l/s S = 0.0054 beta = 8.79 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	153.5	151.5	150.0	150.0	150.0	153.5	150.0	149.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	153.0	151.0	153.0	151.0	152.5	152.5	151.5	151.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	153.5	151.5	153.0	150.0	147.5	154.0	148.5	151.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	149.5	150.5	152.5	151.5	148.0	147.0	151.0	151.0	152.5	151.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	150.0	149.5	152.0	151.5	150.5	151.5	150.5	153.0	152.0	152.0	153.0	152.0	0.0	0.0
1.0	0.0	0.0	152.5	151.0	152.0	152.5	151.5	152.0	151.0	152.0	153.0	153.5	152.0	151.0	153.5	151.5	0.0
1.1	0.0	154.5	152.0	150.5	152.5	151.5	151.5	150.0	152.5	149.5	152.5	151.0	152.0	152.0	153.0	152.5	0.0
1.2	0.0	153.0	152.0	155.5	152.0	150.0	150.5	149.0	153.5	152.0	146.5	151.0	151.0	153.0	152.5	153.0	153.0
1.3	154.0	153.0	153.0	151.0	149.5	149.5	151.5	149.5	147.0	151.0	152.0	152.5	152.0	151.5	151.0	152.5	153.0
1.4	150.5	152.0	152.5	152.5	151.0	150.0	149.5	149.5	152.5	150.0	150.0	152.0	151.5	150.5	151.5	152.5	151.5
1.5	0.0	151.0	151.0	150.0	149.5	150.0	151.0	151.0	152.5	151.5	150.5	150.0	152.0	151.5	151.0	151.5	151.0
1.6	0.0	0.0	151.5	151.5	152.0	150.0	151.0	153.5	151.5	152.5	153.5	151.0	150.5	152.0	152.5	152.5	0.0
1.7	0.0	0.0	0.0	152.0	151.5	150.5	151.5	153.0	152.0	149.5	151.5	150.0	150.5	152.0	151.5	0.0	0.0
1.8	0.0	0.0	0.0	150.0	151.0	150.5	149.5	150.5	151.5	149.0	150.5	149.0	149.5	150.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	150.5	151.0	151.0	148.0	148.0	152.0	151.5	151.0	151.5	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	151.0	150.5	150.0	149.0	152.5	151.0	150.5	152.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	152.5	150.5	150.0	153.0	152.5	151.5	153.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	152.5	150.0	154.0	151.0	149.0	150.5	151.5	152.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	151.5	153.0	152.0	152.0	154.5	153.0	151.5	152.0	153.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	152.0	152.5	152.5	151.0	147.0	149.5	150.5	154.0	155.0	154.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	151.0	151.5	152.5	150.5	152.0	147.0	150.5	152.5	152.0	152.5	155.0	0.0	0.0	0.0
2.6	0.0	0.0	151.5	151.0	151.5	151.0	150.0	148.0	149.0	153.0	150.5	151.0	149.5	151.0	152.5	0.0	0.0
2.7	0.0	0.0	152.5	149.5	151.5	150.5	149.0	150.5	147.5	149.0	147.5	150.0	151.5	152.5	152.5	152.5	0.0
2.8	0.0	151.5	149.5	149.5	151.0	151.0	151.5	150.0	150.0	145.0	152.0	150.0	149.0	149.0	152.5	151.5	151.0
2.9	152.5	150.0	149.5	149.5	148.0	148.5	147.5	147.5	144.5	153.5	148.0	148.5	152.5	151.5	150.5	149.5	151.5
3.0	152.5	149.5	150.0	149.0	149.0	150.0	148.5	151.5	146.0	144.5	147.5	150.0	148.0	151.0	150.0	151.0	151.0
3.1	0.0	149.5	150.5	149.0	149.5	148.0	150.0	149.0	148.0	151.0	148.5	150.5	150.0	150.5	151.5	151.0	150.5
3.2	0.0	148.5	149.0	148.5	149.0	148.0	148.0	149.0	146.0	146.0	151.0	149.5	150.0	150.5	150.0	151.0	0.0
3.3	0.0	0.0	150.0	150.0	148.5	149.0	152.0	150.0	148.5	146.0	149.5	149.0	148.5	149.5	150.0	149.0	0.0
3.4	0.0	0.0	0.0	148.5	151.0	148.5	149.0	149.0	154.0	153.0	149.0	149.0	150.5	149.0	149.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	150.5	150.5	150.0	149.0	151.0	150.0	149.5	149.0	150.0	149.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	150.5	150.0	149.0	151.5	150.0	150.5	149.0	150.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	150.0	150.5	149.0	150.5	150.0	149.5	149.5	152.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	152.0	151.5	150.0	144.5	150.5	150.5	149.5	149.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	148.5	150.0	151.0	150.0	148.5	149.0	149.0	150.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	148.0	146.0	146.0	147.0	148.5	150.0	149.0	148.5	149.5	149.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	146.5	150.0	146.5	149.0	148.5	144.0	149.0	148.5	151.0	148.0	150.0	0.0	0.0	0.0
4.2	0.0	0.0	150.0	147.5	149.0	148.0	148.5	149.0	148.0	148.0	144.5	148.0	148.5	148.5	149.5	0.0	0.0
4.3	0.0	149.0	148.0	146.5	149.5	145.0	145.5	145.0	143.5	147.5	149.5	148.5	147.5	148.0	148.5	149.0	0.0
4.4	0.0	149.5	148.5	147.0	147.5	147.5	147.5	149.5	143.0	150.5	147.0	147.5	148.0	148.5	147.5	148.5	150.5
4.5	150.0	149.5	147.5	148.0	147.0	146.5	147.5	143.5	146.5	149.5	150.0	147.0	147.5	146.5	150.5	148.0	150.0
4.6	149.0	149.5	147.5	148.5	148.5	149.0	146.5	147.0	149.5	149.0	149.0	146.5	147.0	147.0	147.0	149.0	148.5
4.7	0.0	147.0	148.5	147.5	148.0	149.0	147.0	144.5	151.5	143.5	149.5	147.5	149.0	149.0	150.5	150.0	149.5
4.8	0.0	0.0	149.0	149.0	148.5	148.0	148.5	148.5	147.5	148.0	147.5	147.5	146.0	148.0	148.0	148.5	0.0
4.9	0.0	0.0	148.5	149.0	148.5	149.0	149.0	151.0	149.0	147.5	144.0	150.0	149.0	150.5	148.5	0.0	0.0
5.0	0.0	0.0	0.0	150.0	148.0	149.5	148.5	147.0	146.5	146.5	146.5	148.0	149.5	149.5	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	148.5	147.5	148.0	148.0	148.5	147.0	148.5	148.0	148.5	148.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	148.5	147.0	145.0	147.5	148.5	149.0	148.0	146.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	149.0	148.0	150.0	149.0	149.0	146.5	148.0	148.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	147.5	149.5	147.0	146.5	148.5	149.0	149.5	149.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	144.5	149.0	147.0	146.5	149.0	149.5	149.0	150.0	149.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	149.0	147.0	148.5	146.0	146.0	147.0	149.0	147.5	150.5	150.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	147.0	150.0	145.5	147.0	149.5	146.5	149.0	148.0	149.0	148.5	149.0	149.5		0.0
5.8	0.0	0.0	147.5	147.0	148.0	147.0	148.5	147.0	148.0	146.5	147.0	147.0	148.0	147.0	149.0	149.5	0.0
5.9	0.0	149.0	147.5	148.0	149.0	148.0	146.5	146.0	146.0	148.0	146.0	150.0	149.0	149.0	149.5	150.5	0.0
6.0	0.0	149.0	148.0	147.5	148.0	146.5	147.5	150.5	146.5	147.5	147.5	149.5	148.5	148.5	148.5	149.5	150.5
6.1	150.5	149.5	148.0	146.0	148.0	148.5	146.5	144.0	147.0	148.5	147.0	148.0	149.0	149.5	148.0	147.5	148.5
6.2	149.0	148.5	146.5	146.5	147.5	146.0	150.0	150.0	149.5	146.5	144.0	146.5	149.0	145.5	147.5	148.5	149.5
6.3	0.0	147.5	146.0	147.5	147.5	145.0	146.0	146.5	142.5	148.5	146.0	146.0	150.0	146.0	149.5	148.5	148.0
6.4	0.0	147.5	146.0	145.0	146.0	146.0	145.5	146.5	143.5	144.5	147.0	147.5	148.5	146.0	148.0	147.5	0.0
6.5	0.0	0.0	146.5	147.0	147.5	146.5	146.0	144.0	146.0	144.5	147.0	146.5	146.0	148.0	148.0	0.0	0.0
6.6	0.0	0.0	0.0	146.5	148.0	147.0	146.5	147.0	147.0	146.0	147.0	146.0	146.0	148.0	146.5	0.0	0.0
6.7	0.0	0.0	0.0	0.0	147.0	146.5	147.5	143.0	146.5	147.5	147.5	149.0	147.0	148.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	147.5	147.5	146.5	147.0	146.0	147.0	147.0	147.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	147.0	147.0	146.5	146.0	147.0	149.0	147.0	0.0	0.0	0.0	0.0	0.0

Water Surface Elevation Measurements (mm)

Q = 3.29 l/s   S = 0.0054   beta = 7.93   epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	150.0	145.5	147.0	148.0	146.0	151.0	146.0	148.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	148.0	146.5	151.5	142.5	143.5	150.5	144.5	152.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	150.0	148.5	146.0	148.5	151.0	151.0	152.0	148.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	148.0	147.5	147.0	148.0	148.0	146.0	150.0	148.0	145.5	148.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	147.5	151.0	150.0	149.0	149.0	148.0	146.0	148.0	145.5	148.0	148.0	149.0	0.0	0.0
1.0	0.0	0.0	148.0	147.0	148.0	147.5	146.0	147.5	148.5	146.5	149.5	146.5	148.5	148.5	147.5	0.0	0.0
1.1	0.0	150.5	148.0	150.0	148.5	146.5	146.5	145.5	146.0	146.0	138.5	147.5	149.0	147.0	149.5	148.5	0.0
1.2	0.0	150.5	149.5	149.0	150.0	148.0	145.5	147.5	147.0	149.5	148.0	145.5	150.0	147.5	149.0	150.0	149.5
1.3	0.0	149.0	147.0	149.0	148.5	148.5	147.5	147.0	146.5	151.0	147.5	145.5	147.0	146.5	151.0	147.0	148.5
1.4	148.5	147.5	146.5	149.0	147.0	147.0	148.0	145.5	149.0	146.0	146.0	145.0	147.5	146.0	150.5	148.5	149.5
1.5	0.0	147.5	146.5	147.5	147.0	147.0	146.0	146.0	145.5	143.0	147.5	147.5	148.5	148.0	148.5	146.0	148.5
1.6	0.0	0.0	146.5	148.5	146.5	147.0	145.5	147.0	144.0	143.0	143.5	146.0	146.5	146.5	147.5	148.5	0.0
1.7	0.0	0.0	0.0	147.5	149.5	147.5	147.5	147.5	147.5	145.0	144.5	148.0	148.0	145.5	147.5	0.0	0.0
1.8	0.0	0.0	0.0	147.5	147.5	147.0	143.5	147.0	146.0	142.5	147.5	146.5	148.5	146.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	148.0	147.5	147.5	147.0	146.0	146.5	141.0	146.5	147.5	147.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	149.5	150.0	149.5	145.5	146.5	148.0	148.0	147.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	149.5	148.0	145.0	147.5	146.5	150.5	147.0	149.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	151.5	148.5	150.5	146.5	143.5	149.5	150.5	152.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	148.5	150.5	149.5	150.0	150.5	147.0	149.5	147.0	148.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	148.0	149.0	149.5	151.0	147.5	149.0	150.0	148.0	149.0	150.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	148.5	149.5	149.5	148.0	147.0	144.5	151.0	147.5	149.0	148.0	150.0	0.0	0.0	0.0
2.6	0.0	0.0	148.5	149.0	149.0	151.0	149.5	145.0	148.5	153.0	144.0	147.5	149.0	148.5	149.5	0.0	0.0
2.7	0.0	148.5	149.0	147.5	149.5	148.0	148.0	147.0	145.0	151.5	149.5	147.0	146.0	150.0	147.5	150.5	0.0
2.8	0.0	148.5	149.5	148.0	147.5	148.0	147.0	146.5	145.0	152.0	150.0	147.0	148.5	144.5	148.5	149.5	149.0
2.9	147.0	147.0	145.0	146.0	148.0	148.0	146.5	147.0	157.5	143.5	151.5	150.5	147.0	146.0	148.0	147.0	149.0
3.0	146.5	145.5	148.0	148.5	145.5	146.0	146.5	144.5	153.0	149.0	147.0	149.0	148.5	147.0	148.0	148.0	148.5
3.1	0.0	147.5	147.5	148.0	148.0	141.0	146.0	147.5	140.5	149.5	147.5	147.5	147.0	147.0	149.0	148.5	147.5
3.2	0.0	148.0	146.5	147.0	147.0	148.0	146.0	148.0	148.5	148.0	145.0	148.0	148.0	147.5	148.0	148.5	0.0
3.3	0.0	0.0	0.0	149.5	147.5	149.0	147.0	148.5	142.5	145.5	149.0	150.5	148.0	149.5	148.0	0.0	0.0
3.4	0.0	0.0	0.0	148.0	149.0	145.0	147.5	145.0	151.5	148.5	147.0	147.5	148.0	148.5	148.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	147.5	148.0	149.0	153.5	149.0	146.0	146.5	145.5	148.0	147.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	149.5	149.0	145.5	147.5	149.0	148.5	150.0	151.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	151.0	147.5	147.0	151.5	154.5	149.5	151.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	151.5	148.5	147.0	148.5	153.0	147.5	149.5	150.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	149.5	149.0	147.0	151.0	149.0	149.0	150.5	151.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	146.5	149.5	147.5	151.0	145.0	147.5	147.5	145.0	148.5	149.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	149.0	148.0	146.5	145.0	149.0	149.0	149.0	146.0	147.5	145.0	149.0	0.0	0.0	0.0
4.2	0.0	0.0	147.0	145.5	146.5	146.5	147.5	147.0	148.5	148.0	148.5	147.0	146.0	148.0	148.0	0.0	0.0
4.3	0.0	146.5	146.0	145.5	146.5	148.0	146.5	148.5	145.5	144.0	146.5	146.5	146.0	145.5	145.5	146.0	0.0
4.4	0.0	147.5	145.5	149.5	145.5	146.5	145.0	146.0	144.5	147.0	146.5	145.5	146.5	145.5	147.0	146.5	146.0
4.5	149.5	145.5	148.0	146.0	147.5	144.0	145.0	147.5	146.0	144.0	146.5	145.0	147.0	143.5	146.0	145.5	148.0
4.6	146.5	144.5	145.0	148.5	145.0	147.0	144.0	145.0	146.0	142.0	145.5	145.5	146.0	145.0	144.5	144.0	145.5
4.7	0.0	149.5	148.0	147.0	147.5	145.5	148.0	147.5	146.5	147.5	145.5	146.5	144.0	146.5	147.0	146.5	147.5
4.8	0.0	149.0	148.0	150.0	146.0	147.0	149.0	144.5	146.5	146.0	144.5	146.5	147.0	149.0	146.5	146.5	0.0
4.9	0.0	0.0	150.0	148.5	148.5	148.0	148.0	147.5	147.0	145.5	150.0	146.5	147.5	147.5	145.5	148.5	0.0
5.0	0.0	0.0	0.0	149.0	149.0	148.0	147.5	146.0	149.0	143.0	139.0	146.0	146.0	146.0	147.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	148.0	147.5	147.0	143.5	145.0	143.0	148.5	145.5	146.0	146.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	145.0	145.0	147.5	148.5	147.0	142.0	145.0	147.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	145.5	147.0	146.5	147.5	145.5	147.0	143.0	146.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	149.5	148.0	145.0	149.0	151.0	144.0	147.5	142.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	145.5	146.5	145.0	147.0	148.0	149.5	145.5	146.5	146.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	148.5	148.5	147.5	147.0	146.0	140.0	148.5	148.0	146.0	144.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	146.5	146.0	148.5	147.0	144.5	144.5	148.5	146.5	144.0	144.5	147.0	148.0	0.0	0.0
5.8	0.0	0.0	147.5	147.0	145.5	148.0	146.0	148.5	144.5	143.5	147.5	146.0	146.0	145.0	147.0	148.0	0.0
5.9	0.0	146.5	148.0	144.5	146.0	146.5	144.5	145.5	144.0	146.5	150.0	145.5	144.5	146.0	144.0	148.0	0.0
6.0	0.0	147.0	147.0	146.5	146.0	147.0	145.5	147.0	146.5	146.5	147.0	146.0	148.0	149.0	148.5	148.0	147.5
6.1	147.5	146.5	146.5	146.5	144.0	146.0	145.5	144.0	146.5	144.5	148.0	148.0	147.5	146.5	145.5	146.0	148.5
6.2	147.5	145.5	144.0	145.0	146.5	144.5	144.0	144.5	144.0	145.5	144.5	149.0	146.0	147.0	146.5	147.0	148.5
6.3	0.0	146.5	146.5	146.5	145.5	144.5	145.5	146.0	145.0	141.0	144.0	145.0	146.5	145.5	145.5	145.5	147.5
6.4	0.0	146.0	145.0	143.5	143.5	144.0	144.0	145.0	142.5	143.0	145.0	144.5	144.5	146.0	146.5	146.0	0.0
6.5	0.0	0.0	146.0	144.0	143.0	142.5	145.0	145.0	144.0	141.5	144.5	146.0	143.5	146.0	146.5	0.0	0.0
6.6	0.0	0.0	0.0	144.5	147.0	144.0	147.5	145.0	143.0	146.0	145.0	144.0	145.0	143.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	144.0	144.5	144.0	147.0	146.0	145.0	145.5	144.0	143.0	144.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	146.0	143.5	146.0	146.0	146.0	146.0	144.5	145.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	145.0	145.0	144.5	146.5	140.5	143.5	145.5	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.54 l/s S = 0.0030 beta = 12.15 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	154.5	150.0	149.5	148.5	150.0	155.0	167.5	173.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	154.0	150.5	149.5	149.0	152.5	159.5	167.0	169.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	152.0	153.0	151.0	150.5	151.0	153.5	159.0	161.0	167.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	149.5	151.5	150.5	150.5	152.0	155.0	157.0	157.0	158.0	158.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	146.0	149.0	151.5	150.5	150.5	153.5	156.0	157.0	155.0	156.0	156.0	157.0	0.0	0.0
1.0	0.0	0.0	143.5	146.5	149.0	151.0	151.0	150.0	152.5	157.0	156.5	151.0	154.0	155.5	156.5	0.0	0.0
1.1	0.0	144.5	142.0	144.0	148.5	151.0	151.5	151.5	154.0	157.0	157.0	153.5	153.5	154.0	155.0	153.5	0.0
1.2	150.5	144.0	142.5	144.0	149.5	152.0	152.0	152.0	154.0	157.0	156.5	154.0	153.0	153.5	153.5	154.0	153.5
1.3	155.5	146.0	142.5	142.5	150.0	152.0	151.5	152.5	155.0	156.5	156.0	154.0	152.5	152.5	153.0	153.5	152.5
1.4	148.5	146.0	143.0	143.5	151.0	151.0	152.5	153.0	156.0	156.5	155.5	154.5	152.5	151.5	152.0	152.0	153.0
1.5	0.0	150.5	145.5	144.5	151.5	151.0	152.0	153.5	155.5	156.5	155.5	154.0	152.0	150.5	151.0	152.5	154.5
1.6	0.0	0.0	151.5	147.0	151.0	151.5	153.0	155.5	155.5	156.5	155.5	152.5	151.5	151.0	152.0	155.0	0.0
1.7	0.0	0.0	0.0	150.0	151.5	152.0	154.5	157.0	157.0	156.5	155.0	152.0	151.5	151.5	156.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	154.0	154.0	156.5	158.0	157.5	157.0	155.0	152.0	152.5	156.0	164.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	154.0	155.5	159.0	160.0	159.5	158.5	153.5	153.5	156.5	160.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	159.5	161.0	161.5	160.0	156.0	156.0	157.5	161.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	163.0	163.5	162.5	161.0	157.5	157.0	158.0	159.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	163.0	163.5	164.0	162.0	157.5	158.0	157.5	156.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	162.0	164.5	164.0	162.5	158.0	156.5	155.5	154.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	161.0	164.0	165.0	163.5	162.0	158.5	156.5	155.5	156.0	152.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	158.5	160.5	162.5	162.5	162.0	158.0	156.0	155.0	154.0	154.0	151.0	151.5	0.0	0.0
2.6	0.0	0.0	153.0	159.5	160.5	162.5	162.0	159.5	156.0	155.5	154.0	152.0	151.5	150.5	149.0	0.0	0.0
2.7	0.0	150.5	155.5	159.5	162.5	162.0	160.5	158.0	155.5	154.0	153.0	151.5	151.0	149.5	149.5	153.0	0.0
2.8	0.0	151.0	158.0	160.0	162.0	162.5	160.5	156.5	153.5	154.0	152.5	151.0	150.0	149.5	149.5	151.5	152.5
2.9	154.5	153.5	157.5	161.5	163.0	160.5	157.0	154.5	154.0	153.5	152.0	150.5	149.5	149.0	149.0	150.5	152.5
3.0	155.0	156.0	160.0	163.5	163.5	159.0	157.5	155.0	154.0	153.0	151.5	150.5	150.0	149.0	150.0	151.0	154.0
3.1	0.0	158.5	160.5	164.5	164.5	159.0	156.5	155.0	154.5	153.5	151.5	151.0	149.5	149.5	151.5	151.0	157.0
3.2	0.0	0.0	162.0	165.5	165.0	160.0	156.0	155.5	153.5	153.0	152.0	151.0	150.5	149.0	151.0	153.5	0.0
3.3	0.0	0.0	172.5	170.0	167.5	160.0	156.5	155.5	154.5	153.0	152.5	152.0	150.5	150.0	157.5	168.0	0.0
3.4	0.0	0.0	0.0	185.5	172.0	162.5	158.0	156.0	155.0	154.0	153.5	152.5	153.0	155.5	160.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	190.0	174.0	159.0	157.0	156.0	154.5	154.0	155.0	160.0	156.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	186.5	173.5	158.0	156.5	155.5	156.0	158.5	158.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	183.5	179.0	170.5	158.0	157.0	156.5	160.0	166.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	178.0	176.0	169.5	160.5	157.5	157.0	160.0	162.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	172.0	170.5	167.0	162.0	158.5	156.5	164.5	159.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	167.5	166.5	165.5	164.0	160.5	161.5	162.0	162.0	158.5	156.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	162.5	164.0	164.0	162.5	161.5	160.0	161.5	162.5	161.0	158.0	155.0	154.0	0.0	0.0
4.2	0.0	0.0	159.5	161.5	161.0	159.5	160.0	159.5	159.0	160.5	161.5	160.0	157.5	155.5	153.5	0.0	0.0
4.3	0.0	157.5	158.5	159.0	158.5	158.5	158.5	159.0	159.0	160.0	161.0	160.0	157.0	155.0	154.5	153.0	0.0
4.4	0.0	157.5	158.5	158.5	158.0	158.0	158.5	159.0	159.5	160.5	161.5	159.5	157.0	156.0	154.5	153.0	155.0
4.5	158.5	158.5	159.0	158.0	156.5	157.5	158.0	159.5	159.5	161.0	162.0	160.0	157.5	156.0	155.5	152.5	155.5
4.6	160.0	158.5	159.0	158.0	156.5	157.5	158.0	158.5	160.0	161.5	162.5	162.0	158.5	157.0	156.5	155.0	156.5
4.7	0.0	159.5	158.5	157.5	157.5	158.0	159.0	159.0	159.5	162.0	163.5	163.5	160.0	158.5	156.5	158.0	157.0
4.8	0.0	165.0	159.5	158.0	158.0	158.5	159.0	159.5	161.5	162.0	163.5	165.0	162.5	159.5	157.5	158.5	0.0
4.9	0.0	0.0	168.0	159.0	157.0	158.0	160.0	161.0	160.5	162.5	164.5	166.5	164.0	160.0	158.5	161.5	0.0
5.0	0.0	0.0	0.0	165.5	159.0	157.5	159.5	160.0	161.5	163.5	165.5	166.5	165.5	162.0	167.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	167.0	161.5	159.0	159.5	160.5	164.0	166.0	167.5	169.0	168.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	165.0	161.0	159.0	160.5	163.5	168.0	171.0	176.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	166.0	164.0	161.0	160.0	164.0	169.5	173.0	182.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	165.0	164.5	162.5	161.0	161.5	166.5	175.0	180.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	162.0	164.0	163.0	162.0	162.0	166.0	173.5	173.5	173.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	159.0	160.0	162.0	162.5	161.5	162.0	164.5	170.5	171.5	170.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	156.5	158.0	158.5	160.5	161.5	162.0	162.0	164.5	168.5	170.5	169.5	167.5	0.0	0.0
5.8	0.0	0.0	157.5	156.5	158.0	158.0	160.0	161.5	162.0	162.5	163.0	166.5	169.0	169.0	168.5	167.0	0.0
5.9	0.0	156.0	157.5	157.0	158.0	158.5	159.5	161.5	160.5	161.5	162.5	166.0	168.5	169.0	168.5	167.0	164.5
6.0	0.0	155.5	158.5	157.5	158.0	158.5	159.0	161.0	161.5	162.0	163.0	165.0	168.5	169.5	169.0	169.0	168.0
6.1	160.5	162.0	160.5	159.5	157.0	157.0	158.5	160.0	161.5	163.0	163.5	165.0	168.5	170.0	169.5	169.0	168.0
6.2	162.0	158.0	156.0	164.0	157.0	157.0	157.5	158.5	160.0	161.0	163.5	166.5	168.5	170.0	172.0	170.5	171.5
6.3	0.0	159.0	156.5	160.0	158.0	156.5	156.5	157.5	160.0	160.5	162.0	164.5	169.0	171.0	172.0	171.0	174.5
6.4	0.0	164.0	158.5	159.5	159.0	160.0	158.0	156.5	157.5	158.0	163.0	165.5	169.5	174.5	177.0	180.5	0.0
6.5	0.0	0.0	164.0	156.5	158.5	159.5	156.5	157.0	157.5	157.5	158.5	165.5	171.5	177.0	187.0	0.0	0.0
6.6	0.0	0.0	0.0	162.0	160.5	163.0	157.5	157.0	158.0	159.0	159.5	161.5	180.0	196.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	162.0	163.5	160.0	159.0	158.5	158.5	161.5	180.5	193.0	202.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	167.0	162.0	161.5	163.5	171.5	175.0	185.5	199.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	169.5	164.5	163.0	171.5	177.5	178.0	189.0	190.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.57 l/s S = 0.0030 beta = 11.58 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	162.0	153.0	151.0	151.5	149.5	151.0	155.0	164.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	159.5	154.5	152.5	152.0	151.0	152.5	159.5	160.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	154.5	154.0	153.0	150.5	151.5	153.0	156.5	156.0	155.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	152.5	152.0	153.5	153.0	152.0	152.0	153.5	154.0	153.5	152.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	149.5	150.0	151.0	152.5	152.5	152.0	152.5	153.0	153.5	152.5	152.0	152.5	0.0	0.0
1.0	0.0	0.0	145.0	148.5	149.0	150.5	152.0	153.0	153.5	151.5	151.5	153.5	153.5	151.5	151.0	150.0	0.0
1.1	0.0	147.5	145.0	147.5	148.5	151.0	153.0	154.0	154.5	154.0	154.0	153.0	153.0	151.5	151.0	151.5	149.5
1.2	0.0	145.0	145.5	147.5	149.0	151.0	153.0	154.5	155.5	155.5	154.5	154.0	152.5	151.5	151.5	150.0	152.0
1.3	150.0	144.5	144.5	145.5	148.0	151.0	154.5	155.5	156.5	155.0	155.0	154.0	152.5	151.5	151.0	150.5	152.0
1.4	152.5	145.5	144.5	145.0	146.5	151.5	155.0	156.0	157.0	155.0	154.0	153.5	152.0	151.0	150.0	149.5	149.5
1.5	0.0	151.5	145.0	144.5	145.5	150.5	156.5	158.0	157.0	156.5	154.0	153.5	152.0	150.5	149.5	150.0	153.5
1.6	0.0	0.0	157.0	149.0	146.0	151.0	157.5	158.5	156.5	155.0	154.5	153.5	152.5	150.5	151.0	153.0	0.0
1.7	0.0	0.0	0.0	147.0	147.5	153.0	159.0	160.0	158.0	155.5	155.5	154.5	152.5	151.0	153.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	153.0	154.0	160.0	160.5	158.5	157.5	155.0	154.5	153.5	156.0	162.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	158.0	154.5	159.5	161.5	159.0	157.5	156.5	156.0	158.5	160.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	157.5	160.0	162.0	160.0	158.5	158.5	159.0	161.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	159.5	162.5	164.5	162.0	161.0	159.5	161.5	160.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	160.0	162.5	164.5	162.5	161.5	161.0	159.5	159.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	159.5	163.5	163.5	162.0	161.5	160.5	158.5	157.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	156.5	159.0	163.0	164.5	161.5	161.0	160.5	157.5	158.0	156.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	154.5	157.0	159.5	162.0	163.0	160.5	160.0	158.5	157.0	156.5	156.0	153.5	0.0	0.0
2.6	0.0	0.0	155.0	154.5	156.0	158.0	162.0	161.0	160.5	159.5	157.5	156.0	154.5	154.5	152.5	151.5	0.0
2.7	0.0	156.0	153.0	154.5	157.0	159.5	161.5	160.5	159.5	158.0	156.0	154.0	153.5	153.0	152.5	150.5	0.0
2.8	0.0	156.0	158.0	154.0	157.0	161.5	161.5	158.5	158.5	158.5	152.5	153.0	153.5	153.5	152.5	150.5	154.0
2.9	159.0	153.5	153.0	155.0	157.5	162.0	161.5	159.5	155.5	153.5	153.0	153.5	153.5	153.5	152.5	150.0	151.0
3.0	160.5	154.5	153.5	156.0	159.5	161.5	160.5	156.5	154.5	154.0	153.5	154.0	154.5	154.5	154.5	151.0	154.0
3.1	0.0	160.0	154.5	157.0	161.5	162.5	156.0	155.0	155.5	154.0	154.5	154.5	154.5	154.5	154.5	151.0	156.5
3.2	0.0	0.0	160.5	159.5	164.5	162.0	156.0	156.0	156.5	155.5	155.5	154.5	154.5	155.0	155.5	152.5	0.0
3.3	0.0	0.0	173.5	162.5	165.0	160.5	155.5	156.5	155.5	156.0	156.5	155.5	156.5	156.5	155.5	0.0	0.0
3.4	0.0	0.0	0.0	178.5	170.5	165.0	156.5	157.0	157.5	157.5	157.5	158.0	158.5	158.0	166.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	180.5	172.5	157.5	158.5	158.0	157.5	158.0	159.0	161.0	163.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	184.0	167.5	159.0	160.0	160.0	160.5	161.5	165.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	189.0	176.5	163.0	159.5	159.5	161.0	163.5	165.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	182.5	181.5	171.0	160.5	161.0	162.0	164.0	165.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	172.0	178.0	167.5	160.0	160.0	161.5	161.5	161.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	170.5	173.5	166.5	161.5	158.0	159.0	160.0	160.5	160.5	158.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	164.5	165.5	167.5	166.0	162.0	159.0	158.5	159.0	159.5	158.5	157.0	153.5	0.0	0.0
4.2	0.0	0.0	163.0	165.0	165.5	165.5	164.0	162.0	160.0	159.5	159.0	159.0	158.5	157.0	153.5	0.0	0.0
4.3	0.0	162.0	162.5	163.0	164.0	162.5	161.0	160.0	159.5	158.5	159.0	158.5	157.5	156.5	153.5	153.0	0.0
4.4	0.0	163.0	162.0	163.5	163.5	161.0	161.5	160.5	160.5	159.5	159.0	157.0	156.5	155.5	153.5	153.0	159.0
4.5	162.5	163.5	162.5	163.5	162.0	162.0	161.5	161.5	160.5	159.5	159.0	158.0	157.0	156.5	154.0	153.0	159.0
4.6	164.5	164.5	164.5	163.5	163.0	162.5	162.5	162.5	161.5	159.5	158.0	157.0	156.5	156.0	154.5	153.5	161.5
4.7	0.0	166.0	166.0	164.5	163.0	163.0	163.5	162.5	160.5	160.0	159.5	157.5	156.5	155.5	154.5	154.5	162.0
4.8	0.0	171.5	168.5	166.5	164.0	164.0	165.0	164.5	162.5	161.5	159.5	157.0	156.0	155.0	155.0	160.5	0.0
4.9	0.0	0.0	186.0	168.5	165.0	166.5	168.0	166.5	163.5	159.0	158.0	157.5	157.0	157.0	161.5	165.0	0.0
5.0	0.0	0.0	0.0	185.5	171.5	169.0	168.0	166.5	160.0	159.6	158.5	158.0	157.5	158.5	168.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	190.0	176.0	169.0	161.5	161.0	159.5	158.5	158.0	158.5	168.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	187.0	177.0	163.0	160.5	159.5	160.0	160.5	167.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	196.0	182.5	166.5	160.5	159.5	160.0	161.5	170.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	193.0	180.0	170.0	160.0	160.5	161.5	164.5	167.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	175.5	175.5	170.5	161.0	160.5	162.0	163.5	165.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	177.0	169.0	170.5	167.0	164.0	161.5	162.0	163.0	163.5	162.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	171.0	169.0	167.5	168.0	168.5	166.0	163.5	162.0	162.0	162.5	163.5	163.0	0.0	0.0
5.8	0.0	0.0	169.5	168.0	167.5	166.5	166.0	166.5	164.0	162.5	162.0	162.5	162.5	163.0	162.0	163.0	0.0
5.9	0.0	162.0	167.0	166.5	166.5	167.0	167.0	166.5	165.0	164.0	161.5	161.5	162.0	163.0	163.0	163.0	0.0
6.0	0.0	162.5	167.5	168.0	166.0	166.5	167.0	167.5	166.0	161.5	162.0	162.0	162.0	162.5	162.5	162.5	165.5
6.1	164.5	162.0	167.5	168.0	167.0	168.0	167.5	167.5	163.0	162.0	162.0	162.0	162.0	162.5	162.5	163.0	165.5
6.2	165.0	163.0	166.0	166.5	167.0	167.0	166.5	166.0	162.0	162.0	162.5	163.0	162.0	162.5	162.0	162.0	166.5
6.3	0.0	167.5	165.0	167.0	169.0	168.0	165.0	162.5	162.5	163.0	162.5	162.5	163.0	162.5	162.0	162.5	170.0
6.4	0.0	0.0	165.0	166.0	167.5	168.0	165.5	162.0	163.0	162.5	163.0	162.5	163.0	164.5	165.0	167.0	0.0
6.5	0.0	0.0	166.5	167.5	169.5	169.0	163.5	162.5	163.0	163.0	163.0	162.5	163.0	164.5	170.0	0.0	0.0
6.6	0.0	0.0	0.0	169.0	170.0	170.5	166.0	163.5	163.5	163.5	163.5	164.0	165.0	173.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	173.0	174.5	167.5	164.0	164.0	164.0	164.5	165.5	176.0	184.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	176.5	171.5	165.0	165.0	165.5	166.0	171.0	184.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	180.0	171.5	167.0	167.0	167.0	169.5	181.5	184.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.78 l/s S = 0.0030 beta = 11.16 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	158.0	156.0	153.0	151.0	151.0	154.5	166.0	172.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	157.0	156.5	153.5	152.5	153.0	156.5	164.0	170.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	155.0	155.0	154.0	153.5	154.5	158.0	159.0	161.5	162.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	150.5	152.5	154.5	154.0	153.5	156.5	159.0	159.0	157.0	156.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	147.0	150.0	152.0	153.0	153.0	153.0	157.5	159.0	158.5	156.0	154.5	157.0	0.0	0.0
1.0	0.0	0.0	144.0	147.5	150.0	151.5	152.5	153.5	153.5	156.0	158.5	157.0	156.5	154.5	155.5	154.0	0.0
1.1	0.0	147.0	144.5	145.5	149.5	152.5	153.5	154.5	155.0	156.5	159.0	158.5	156.5	154.0	154.5	154.0	154.5
1.2	0.0	144.0	143.5	145.5	149.0	153.0	154.0	155.0	156.5	157.5	159.5	156.5	156.0	154.5	154.0	155.0	155.0
1.3	153.0	144.5	144.0	145.5	147.0	153.0	154.0	155.0	156.0	157.5	158.5	157.0	156.5	155.5	153.5	154.5	155.5
1.4	0.0	145.0	143.5	145.0	146.0	153.0	154.0	155.0	156.0	157.5	157.0	156.5	155.5	154.5	154.0	154.0	154.5
1.5	0.0	154.5	145.0	144.0	147.0	153.5	154.0	155.0	156.5	157.5	156.5	157.0	156.0	155.0	154.0	153.5	160.5
1.6	0.0	0.0	147.0	146.0	150.0	152.5	154.0	155.5	157.5	158.0	157.5	157.5	157.0	154.0	152.5	157.5	0.0
1.7	0.0	0.0	0.0	147.0	151.0	153.0	154.5	156.0	157.5	158.0	158.6	158.5	159.0	156.0	159.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	149.5	154.0	155.0	156.5	158.5	159.0	160.0	160.0	157.5	159.5	168.5	0.0	0.0
1.9	0.0	0.0	0.0	0.0	150.5	155.5	157.5	157.5	159.0	159.5	160.0	160.0	167.0	167.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	156.5	158.0	159.0	160.0	160.0	162.0	165.5	168.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	159.0	160.0	159.0	161.0	161.5	164.0	170.0	174.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	158.5	159.5	160.0	160.5	162.5	165.0	170.5	165.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	158.0	159.5	160.5	160.5	162.5	164.0	167.0	166.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	155.0	157.5	159.0	160.0	161.0	162.0	163.0	164.5	164.0	161.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	153.0	155.5	157.5	158.5	159.5	161.0	160.5	161.0	162.0	161.5	165.5	162.5	0.0	0.0
2.6	0.0	0.0	152.0	153.0	154.5	156.5	158.0	158.5	159.5	160.5	161.0	161.5	160.0	158.5	157.5	153.0	0.0
2.7	0.0	0.0	150.0	152.5	155.0	156.5	157.0	158.5	158.5	159.5	159.5	160.0	159.0	161.5	160.5	155.5	0.0
2.8	0.0	154.0	151.0	153.0	155.0	156.5	156.5	157.5	158.5	158.5	158.5	158.5	157.5	157.0	154.5	156.5	150.5
2.9	157.5	151.5	151.0	154.0	156.0	157.5	157.5	158.0	158.5	158.5	158.5	158.0	157.0	158.5	159.0	156.5	151.5
3.0	160.5	152.0	151.5	154.0	156.0	157.5	157.5	158.0	159.0	160.0	159.5	156.5	155.0	154.5	154.0	155.0	152.0
3.1	0.0	157.5	152.0	154.5	156.0	157.0	157.0	158.0	160.0	159.0	159.5	156.5	155.0	154.5	154.5	154.5	155.0
3.2	0.0	0.0	156.0	155.0	157.0	157.5	158.0	158.5	160.0	159.5	156.5	156.5	155.5	156.0	155.0	156.5	0.0
3.3	0.0	0.0	0.0	159.5	158.0	159.0	159.5	160.5	159.0	158.5	157.5	156.5	156.5	157.5	157.5	164.0	0.0
3.4	0.0	0.0	0.0	172.5	161.5	160.0	161.0	160.5	159.0	158.5	158.5	158.0	158.5	161.0	164.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	174.0	160.5	162.5	161.5	160.0	159.5	159.0	159.5	162.5	166.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	177.0	166.0	162.0	161.5	161.0	161.0	162.0	171.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	178.5	170.5	164.0	162.0	162.0	162.5	166.0	174.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	173.0	169.0	164.0	162.5	162.5	164.5	166.5	169.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	168.0	167.5	165.0	162.5	161.5	164.0	164.0	163.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	164.0	163.5	166.5	164.0	161.0	162.0	162.0	162.5	159.0	159.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	161.0	160.0	164.0	164.5	164.0	161.0	161.0	161.0	161.0	158.0	157.0	155.0	0.0	0.0
4.2	0.0	0.0	159.5	159.0	160.0	163.0	163.0	162.5	161.0	160.5	160.5	160.5	158.0	157.0	155.5	0.0	0.0
4.3	0.0	158.5	160.0	158.5	160.0	160.0	161.5	162.0	161.5	161.0	160.0	160.0	158.0	157.0	155.0	150.0	0.0
4.4	0.0	158.5	159.0	158.5	160.5	161.0	162.0	162.0	162.0	160.5	158.5	158.5	157.0	157.0	155.5	150.0	155.5
4.5	162.5	157.0	158.0	159.0	161.0	162.5	162.5	162.5	161.0	160.0	159.5	158.5	157.0	157.0	155.5	150.0	157.0
4.6	163.0	160.5	160.5	161.0	162.0	163.0	162.5	162.5	162.0	161.0	160.5	159.0	158.0	157.0	157.0	153.0	154.0
4.7	0.0	160.0	158.0	159.5	161.5	163.5	164.0	163.5	162.0	161.0	160.0	158.5	158.0	157.0	156.5	153.0	158.0
4.8	0.0	173.0	163.5	161.0	163.5	165.0	163.0	162.5	163.0	161.0	160.5	160.5	160.0	158.5	157.5	157.0	0.0
4.9	0.0	0.0	180.5	164.5	162.0	163.0	163.5	163.5	162.5	162.0	161.0	161.0	160.5	158.5	157.0	162.5	0.0
5.0	0.0	0.0	0.0	186.5	172.0	163.0	161.5	162.0	162.0	162.5	162.5	162.5	161.0	159.0	163.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	189.0	170.5	163.5	162.0	161.5	162.0	162.0	162.0	161.0	161.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	188.5	172.5	162.5	162.0	162.0	163.5	164.0	163.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	191.5	179.0	164.0	163.0	163.0	163.5	164.5	163.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	194.0	181.5	166.5	162.0	162.5	164.0	164.5	162.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	184.5	173.5	164.5	163.0	163.0	164.0	163.0	160.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	181.5	173.0	173.0	165.5	162.0	162.0	163.0	162.0	159.5	158.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	176.5	172.5	170.0	169.0	163.5	164.5	162.0	161.5	159.5	159.5	157.5	155.5	0.0	0.0
5.8	0.0	0.0	171.0	169.0	167.0	170.5	169.0	165.5	162.5	161.0	161.0	160.5	159.5	157.0	156.0	158.5	0.0
5.9	0.0	167.0	170.5	168.0	168.5	169.0	167.5	163.5	162.0	161.0	161.0	160.5	159.0	158.0	156.5	156.5	163.0
6.0	0.0	168.0	168.5	167.0	169.5	169.0	167.0	163.0	161.0	160.5	160.5	160.0	159.0	158.5	157.5	156.5	161.0
6.1	161.5	168.5	168.5	169.0	170.0	170.0	165.0	161.5	161.5	161.0	161.0	160.0	159.5	159.0	157.5	157.0	161.0
6.2	163.5	168.0	167.5	169.5	170.5	170.0	162.0	161.5	162.0	160.5	161.0	160.0	160.0	159.5	158.0	157.0	161.0
6.3	0.0	167.5	167.0	170.5	171.5	166.5	163.0	162.5	160.5	159.5	162.0	159.0	159.0	159.0	158.0	157.5	165.0
6.4	0.0	167.5	168.5	171.0	172.0	168.5	161.5	162.0	160.0	161.0	161.0	162.5	159.5	159.5	158.5	161.5	0.0
6.5	0.0	0.0	171.0	174.0	175.0	172.0	162.5	161.0	161.0	160.5	161.0	162.5	159.0	159.5	160.5	0.0	0.0
6.6	0.0	0.0	0.0	176.0	177.0	174.0	164.5	163.0	162.0	161.0	162.0	161.0	159.5	160.0	170.5	0.0	0.0
6.7	0.0	0.0	0.0	0.0	187.0	181.0	165.0	162.5	162.0	161.5	162.5	162.5	162.5	169.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	194.0	173.5	163.5	163.0	163.0	162.5	164.0	167.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	201.0	183.0	168.5	163.0	162.5	163.0	167.0	167.5	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 2.11 l/s S = 0.0030 beta = 10.16 epsilon = 0.375

x (m)									y (m)								
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	163.5	155.0	151.0	155.5	155.5	156.5	164.5	175.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	159.5	159.5	153.5	155.0	156.0	160.0	166.0	170.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	156.0	158.5	154.5	155.0	157.5	159.5	160.0	160.5	163.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	152.5	155.0	158.0	155.0	154.5	156.0	158.5	158.5	156.5	159.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	151.5	152.0	155.0	155.0	155.0	154.5	156.0	157.0	157.0	155.0	155.0	157.0	0.0	0.0
1.0	0.0	0.0	145.5	150.5	150.5	154.5	154.5	155.0	155.0	155.5	156.0	156.5	155.0	154.0	154.0	152.5	0.0
1.1	0.0	144.5	146.5	148.0	150.0	155.0	155.5	156.0	156.0	156.0	156.0	155.5	155.5	155.0	154.0	152.5	150.0
1.2	0.0	144.5	147.5	148.0	150.5	155.5	156.0	156.5	157.0	157.5	158.0	156.5	156.0	154.5	152.5	152.0	151.5
1.3	151.5	144.0	146.5	147.0	148.0	152.5	154.5	154.5	158.0	158.5	157.5	157.5	155.5	154.5	152.0	151.5	151.5
1.4	152.0	144.0	145.5	146.0	147.5	152.0	154.0	154.5	155.5	156.5	157.0	157.0	156.0	154.0	152.5	153.0	153.0
1.5	0.0	144.5	144.0	145.5	148.0	152.0	153.5	155.0	156.0	155.0	157.0	157.5	157.0	154.5	153.0	152.5	155.5
1.6	0.0	0.0	144.0	143.5	147.5	154.0	154.0	155.5	157.0	158.5	157.0	156.5	157.0	155.5	155.0	156.0	0.0
1.7	0.0	0.0	144.5	144.0	154.0	155.0	155.5	157.0	158.0	157.5	157.5	159.0	158.5	156.5	158.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	148.0	154.0	156.0	157.0	157.0	159.5	159.0	158.5	159.5	161.5	170.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	150.5	157.5	157.0	157.0	158.5	160.5	161.5	161.5	163.0	174.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	158.0	159.0	158.5	158.5	160.0	162.5	164.0	175.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	159.0	160.5	160.0	159.5	163.0	165.0	167.5	177.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	157.0	159.0	159.5	160.5	164.0	166.0	168.5	170.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	157.0	161.0	160.5	161.0	164.0	166.5	164.0	164.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	154.5	157.0	159.0	161.0	162.0	165.0	165.0	164.0	162.0	162.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	152.0	154.0	155.5	157.5	161.0	163.0	163.5	163.0	161.5	159.5	158.5	156.5	0.0	0.0
2.6	0.0	0.0	151.0	151.0	153.0	154.0	156.5	158.0	162.5	162.0	162.5	161.5	159.0	157.5	156.5	152.0	0.0
2.7	0.0	0.0	149.5	151.0	158.5	155.0	156.0	157.0	158.0	160.5	162.5	160.0	158.5	157.0	156.0	152.5	0.0
2.8	0.0	149.5	149.0	151.5	153.5	153.5	156.0	157.0	158.0	158.0	158.0	157.0	157.5	158.0	156.5	154.5	152.5
2.9	159.0	148.5	148.5	151.5	153.0	156.5	156.5	157.0	157.5	159.5	156.0	155.5	158.5	157.0	155.0	154.0	153.0
3.0	164.5	147.5	149.0	151.5	154.0	156.0	157.5	157.5	156.5	156.5	157.0	156.5	156.0	155.0	153.5	153.0	153.0
3.1	0.0	158.0	149.0	151.5	153.0	153.5	155.0	156.0	159.0	157.5	157.5	157.5	156.5	155.5	154.0	153.0	155.5
3.2	0.0	0.0	156.0	151.5	153.0	153.5	154.0	156.0	158.0	159.0	158.5	158.5	158.0	156.0	154.5	154.5	0.0
3.3	0.0	0.0	0.0	157.0	155.5	155.0	154.5	155.0	157.0	159.0	160.0	159.0	158.5	157.5	157.0	164.0	0.0
3.4	0.0	0.0	0.0	171.0	160.0	156.5	156.0	156.5	157.0	158.5	159.0	160.5	161.5	159.5	168.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	173.0	160.5	157.5	157.0	159.0	159.0	160.5	162.0	163.0	173.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	171.0	161.0	159.5	160.5	162.5	160.5	165.0	167.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	177.0	166.0	161.0	160.0	161.0	162.5	170.0	180.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	173.0	167.5	163.5	161.0	161.5	162.5	166.5	172.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	165.0	165.0	163.0	162.5	160.5	162.0	165.0	165.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	162.0	159.5	162.5	162.5	160.5	160.5	161.0	161.0	162.0	161.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	158.0	158.5	160.0	162.5	161.0	160.5	159.5	159.0	160.5	160.5	159.5	159.5	0.0	0.0
4.2	0.0	0.0	157.0	157.5	157.5	159.0	160.5	161.0	160.5	160.0	159.0	159.0	158.0	158.5	158.5	0.0	0.0
4.3	0.0	154.5	155.5	157.0	158.0	158.5	159.5	159.5	159.0	157.5	161.5	159.0	157.5	157.0	158.0	150.5	0.0
4.4	0.0	155.5	156.0	157.0	157.0	159.0	158.0	158.5	159.0	159.0	158.0	157.5	157.5	156.5	156.5	152.5	150.5
4.5	160.0	155.5	155.5	156.0	156.5	158.0	158.0	159.5	159.5	159.5	158.0	158.0	158.0	156.5	156.5	154.5	148.5
4.6	160.5	155.5	157.0	157.0	157.5	158.5	159.0	159.5	159.0	159.5	158.5	158.5	157.5	155.0	154.5	154.0	151.0
4.7	0.0	157.5	156.5	157.5	160.0	159.5	160.0	160.5	161.0	160.0	159.5	158.5	159.0	156.0	155.5	154.5	157.0
4.8	0.0	166.5	158.0	159.0	161.0	160.5	160.5	161.5	161.5	161.0	160.5	157.5	156.0	154.5	154.5	156.0	0.0
4.9	0.0	0.0	172.0	162.5	162.5	162.0	161.5	162.0	162.5	162.5	161.5	158.5	158.0	156.0	157.5	164.5	0.0
5.0	0.0	0.0	0.0	174.0	165.0	162.5	162.0	162.5	163.0	162.0	159.0	158.5	158.5	159.0	163.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	179.0	169.0	164.0	162.5	164.5	161.5	158.5	159.5	160.5	163.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	179.5	167.5	164.5	164.0	159.5	160.5	163.0	165.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	182.0	173.0	166.5	164.0	161.5	162.5	165.0	169.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	176.0	171.5	169.0	166.0	164.0	162.0	165.5	165.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	171.0	167.5	169.0	168.0	165.5	164.0	164.0	162.0	159.5	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	166.5	165.0	164.5	168.0	167.5	166.5	162.5	161.5	161.0	158.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	163.5	163.0	162.0	163.5	167.0	167.0	166.5	163.5	162.0	160.5	158.0	154.0	0.0	0.0
5.8	0.0	0.0	160.5	161.5	160.5	160.5	163.0	167.0	167.0	166.0	163.5	162.0	160.0	158.5	154.0	154.0	0.0
5.9	0.0	159.0	161.0	161.5	160.5	160.5	163.5	165.0	165.5	164.0	163.5	161.5	161.0	159.0	154.5	151.5	159.0
6.0	0.0	160.0	161.5	160.5	160.0	161.0	164.0	164.0	164.5	164.0	164.0	162.5	161.5	160.0	155.0	152.0	156.0
6.1	159.5	162.0	161.5	162.0	161.0	160.0	162.5	164.5	163.5	164.0	165.0	163.0	161.5	160.5	155.5	152.5	155.5
6.2	160.5	161.0	160.5	159.5	159.5	160.5	162.0	163.5	163.0	163.0	163.0	163.5	162.5	160.5	154.5	152.0	157.5
6.3	0.0	163.5	162.0	161.0	160.5	160.5	161.5	162.5	162.5	162.0	162.0	163.0	162.5	160.0	155.0	153.5	165.0
6.4	0.0	164.5	163.0	161.0	160.5	159.5	160.5	162.0	162.5	162.5	162.0	161.5	162.5	159.0	155.5	163.5	0.0
6.5	0.0	0.0	166.5	164.0	162.5	161.5	161.0	161.0	162.0	162.0	161.5	162.5	162.5	160.0	163.5	0.0	0.0
6.6	0.0	0.0	0.0	169.5	164.0	162.5	162.5	161.5	161.5	162.0	161.5	162.5	164.5	163.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	176.5	166.0	162.5	162.5	162.5	162.0	162.5	165.5	169.5	173.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	175.0	166.5	165.5	164.5	163.0	165.0	170.5	174.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	176.0	171.0	166.5	164.5	164.5	168.0	175.0	182.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 3.08 l/s   S = 0.0030   beta = 8.81   epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	170.5	162.0	152.0	156.0	156.0	155.5	163.0	175.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	164.5	161.0	159.0	158.5	157.5	160.0	165.5	173.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	157.5	157.0	159.0	157.5	158.5	159.5	157.5	161.5	163.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	156.0	154.5	156.0	160.0	158.5	161.5	160.5	156.0	155.0	158.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	152.5	152.0	152.0	156.0	158.0	158.0	158.5	160.5	156.0	153.0	152.5	153.0	0.0	0.0
1.0	0.0	0.0	149.0	150.5	150.0	151.0	155.0	156.5	156.5	159.5	155.5	155.5	153.5	152.5	153.5	150.0	0.0
1.1	0.0	147.0	148.5	148.5	148.0	152.5	155.5	157.0	158.0	158.0	158.5	155.0	153.5	151.5	151.0	149.5	145.0
1.2	0.0	146.5	147.0	146.5	149.5	152.0	154.0	157.0	157.5	157.0	156.0	154.5	154.0	151.0	150.0	147.5	145.0
1.3	0.0	147.0	146.0	147.5	148.5	150.0	153.0	154.0	157.0	156.0	156.5	154.5	153.0	151.0	150.0	149.0	147.0
1.4	154.0	146.0	145.5	146.5	148.5	150.5	152.0	156.0	154.5	155.5	155.5	153.5	150.5	150.5	147.0	146.5	147.5
1.5	0.0	150.0	147.5	147.5	149.0	152.0	153.0	153.5	155.5	157.5	155.0	152.5	151.0	149.5	148.0	148.0	149.5
1.6	0.0	0.0	152.0	148.5	150.0	152.0	154.0	155.5	153.5	155.5	154.5	153.0	152.0	150.0	147.0	150.0	0.0
1.7	0.0	0.0	0.0	155.0	150.5	152.5	154.5	155.5	156.0	155.5	154.0	153.5	153.0	151.0	151.5	161.0	0.0
1.8	0.0	0.0	0.0	0.0	161.5	153.5	156.0	157.5	156.0	157.5	157.0	155.5	155.0	156.5	161.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	172.0	162.0	156.0	157.0	158.0	157.5	157.5	158.5	160.5	162.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	168.5	163.0	162.5	159.5	161.0	158.5	165.0	166.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	173.0	168.0	167.5	165.0	161.5	160.5	165.5	163.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	167.5	166.0	168.5	166.0	164.5	164.0	166.0	158.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	165.0	164.0	167.5	166.0	165.5	163.5	162.5	157.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	179.0	160.0	161.0	165.0	169.5	167.5	163.0	160.0	154.5	153.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	155.5	157.5	159.0	163.0	164.0	167.0	165.0	158.5	158.5	156.0	152.0	0.0	0.0	0.0
2.6	0.0	0.0	0.0	154.5	155.5	157.5	159.5	161.0	164.5	163.5	162.5	151.5	152.5	151.0	150.0	0.0	0.0
2.7	0.0	0.0	151.5	153.0	153.5	155.5	159.0	162.0	162.0	161.5	160.0	157.5	150.5	149.0	147.5	146.5	0.0
2.8	0.0	149.5	150.5	153.0	154.0	156.0	157.0	157.5	160.5	157.5	155.5	153.5	153.0	150.0	147.5	147.5	144.5
2.9	150.0	150.0	149.5	150.0	152.0	156.0	158.5	158.0	159.0	159.0	154.5	153.5	151.5	149.0	147.5	146.5	145.5
3.0	157.5	151.5	149.5	150.5	152.5	155.0	158.0	157.5	155.5	155.5	156.5	154.0	152.0	149.5	149.5	148.5	146.5
3.1	0.0	151.5	148.0	149.5	153.5	154.5	156.0	156.0	154.5	155.5	155.0	154.0	153.0	151.0	148.5	147.5	150.0
3.2	0.0	0.0	152.0	151.5	150.5	155.5	155.5	156.0	156.5	156.0	155.0	154.5	154.0	152.5	146.0	148.5	0.0
3.3	0.0	0.0	0.0	155.5	154.5	156.0	157.5	156.0	157.5	158.5	155.5	155.5	155.5	153.5	152.0	0.0	0.0
3.4	0.0	0.0	0.0	171.5	160.0	158.0	157.5	157.0	158.0	157.5	158.0	156.5	153.0	153.0	163.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	174.5	163.5	159.0	161.5	160.0	161.0	158.5	159.5	160.5	165.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	173.0	167.5	163.0	162.0	159.5	160.0	162.0	170.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	180.0	171.0	168.0	163.5	161.0	164.0	171.5	172.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	171.5	173.0	170.5	164.0	162.0	166.0	168.5	169.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	164.0	165.5	164.5	166.0	162.5	165.0	167.5	162.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	159.0	159.0	160.5	164.5	164.0	163.5	166.5	161.0	159.0	156.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	156.5	157.0	156.5	159.5	163.0	164.5	161.5	158.5	158.0	157.0	156.5	155.5	0.0	0.0
4.2	0.0	0.0	0.0	153.5	154.0	155.5	158.0	162.0	163.5	162.5	159.0	158.0	153.5	151.5	152.0	0.0	0.0
4.3	0.0	150.0	150.5	151.5	153.5	155.0	156.5	159.5	160.5	160.0	159.5	156.0	156.0	151.5	150.0	148.0	0.0
4.4	0.0	150.0	150.0	151.0	152.5	154.0	156.5	158.5	160.5	159.5	158.5	157.0	155.5	150.5	148.0	147.5	147.5
4.5	150.5	150.5	151.0	150.5	151.0	152.5	156.0	158.0	159.5	158.5	159.5	157.5	154.5	152.0	148.0	147.0	148.0
4.6	155.0	150.5	151.0	150.0	150.5	153.0	155.0	157.0	159.5	159.0	156.5	156.0	155.0	152.5	150.0	149.0	150.0
4.7	0.0	151.0	149.0	150.0	150.5	153.0	156.0	157.5	160.5	157.5	157.0	156.5	155.0	154.0	151.0	150.5	155.0
4.8	0.0	158.5	151.5	150.0	151.0	153.5	155.5	157.0	158.5	158.5	157.0	156.5	156.0	156.0	154.0	155.5	0.0
4.9	0.0	0.0	161.5	155.0	154.0	154.0	156.0	157.5	159.0	159.0	156.0	157.5	157.0	156.5	161.5	173.5	0.0
5.0	0.0	0.0	0.0	165.5	156.5	154.5	155.5	157.0	157.5	158.0	157.5	158.0	159.5	170.0	183.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	167.5	157.0	158.5	157.0	158.5	160.0	160.0	160.0	171.5	185.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	166.5	163.5	159.5	161.0	163.0	159.0	172.5	187.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	167.0	166.0	163.0	159.5	162.5	168.0	181.0	190.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	160.5	165.0	165.0	163.5	166.5	173.5	177.0	180.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	156.5	159.5	163.0	166.0	168.5	169.0	169.5	173.0	172.5	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	152.5	154.5	158.5	162.5	163.0	167.5	167.5	163.5	167.5	168.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	151.0	152.5	152.5	156.0	160.5	165.0	169.5	167.0	163.5	161.0	164.5	164.5	0.0	0.0
5.8	0.0	0.0	147.5	151.0	152.0	153.5	155.0	158.0	162.5	167.0	164.0	162.0	159.5	157.5	159.0	157.5	0.0
5.9	0.0	148.0	149.0	151.0	152.0	154.0	156.0	157.5	161.5	165.0	165.0	161.5	159.0	157.0	157.0	157.0	156.5
6.0	0.0	148.0	149.5	150.0	151.5	154.5	157.5	158.0	163.0	162.0	162.0	159.0	157.0	157.0	156.5	158.5	157.0
6.1	154.5	149.0	148.5	150.5	152.0	155.5	156.5	158.0	160.5	160.5	160.0	160.0	157.5	156.5	158.0	158.0	158.0
6.2	157.5	149.0	149.0	149.5	152.0	154.5	156.5	158.5	159.0	159.0	159.0	160.0	158.5	158.0	157.0	158.0	158.0
6.3	0.0	150.5	148.0	148.5	151.5	153.5	156.0	156.5	157.5	160.5	159.5	158.5	158.5	157.5	157.0	158.0	159.5
6.4	0.0	156.5	149.0	149.0	151.0	154.0	156.5	157.5	157.0	160.0	162.0	158.5	158.5	159.0	160.5	162.5	0.0
6.5	0.0	0.0	158.0	150.0	150.0	154.0	155.5	157.0	159.0	158.5	158.0	158.0	160.5	160.5	165.0	0.0	0.0
6.6	0.0	0.0	0.0	159.5	152.0	153.5	158.5	158.5	156.5	159.5	163.0	161.0	163.0	168.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	0.0	165.0	155.0	156.5	158.5	158.0	160.5	163.0	163.0	181.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	169.5	160.5	158.5	161.0	165.0	167.0	172.0	186.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	174.5	166.0	160.0	161.5	167.5	171.5	179.0	183.5	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

$Q = 1.02$ l/s $S = 0.0040$ beta = 14.36 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	168.0	164.0	162.5	159.0	154.5	155.5	160.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	161.0	161.5	159.5	161.5	157.5	156.5	159.0	173.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	155.0	156.5	158.5	158.0	159.0	159.0	158.0	158.0	163.5	172.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	152.0	154.0	155.0	157.5	157.5	158.5	158.5	158.5	159.5	160.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	151.0	151.0	153.5	153.5	155.5	156.0	157.5	156.5	157.5	156.0	164.0	171.0	0.0	0.0
1.0	0.0	0.0	156.5	151.5	150.0	152.5	153.0	154.5	155.5	157.5	156.5	157.5	156.5	154.5	164.5	175.5	0.0
1.1	0.0	157.0	154.5	152.0	152.0	151.0	150.0	151.5	154.0	157.0	159.0	158.5	158.0	158.0	161.0	170.0	0.0
1.2	158.0	156.5	154.5	153.0	152.0	151.5	151.0	152.0	154.5	155.0	159.0	160.5	159.5	159.5	161.5	164.5	176.0
1.3	160.5	157.0	155.0	152.5	151.5	150.5	150.0	151.0	153.0	155.0	156.5	161.0	161.5	161.0	160.5	164.0	174.0
1.4	161.5	156.0	154.0	153.5	152.5	152.0	150.0	150.5	152.0	152.5	155.0	159.0	162.0	162.0	163.0	165.5	181.0
1.5	160.5	159.0	157.0	155.5	155.5	154.0	151.5	150.0	151.0	152.5	153.5	157.5	160.0	163.0	164.0	176.5	190.0
1.6	0.0	0.0	161.0	164.5	155.0	156.5	156.0	155.5	156.0	152.0	152.5	154.5	161.0	163.0	179.0	191.0	0.0
1.7	0.0	0.0	0.0	171.0	159.5	161.0	163.0	160.0	159.0	159.0	158.5	161.5	173.5	180.5	191.0	0.0	0.0
1.8	0.0	0.0	0.0	158.5	156.0	156.0	164.0	165.5	162.5	158.5	159.0	169.0	178.0	189.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	165.0	160.0	162.5	164.5	157.5	157.0	165.0	173.5	180.5	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	163.0	170.0	158.5	158.5	163.5	167.5	173.5	177.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	169.5	168.5	159.5	163.0	164.5	166.0	169.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	170.0	161.5	162.5	162.0	162.0	162.0	163.5	163.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	177.0	165.0	162.0	161.0	162.0	160.5	161.5	161.0	161.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	170.0	164.5	162.5	162.0	160.5	161.0	160.5	160.0	159.0	158.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	171.0	167.0	163.5	162.0	160.5	160.5	159.5	159.0	158.5	158.5	154.5	0.0	0.0	0.0
2.6	0.0	0.0	174.0	166.0	163.5	162.0	160.5	157.5	159.0	157.5	157.5	155.5	156.0	154.0	156.5	0.0	0.0
2.7	0.0	174.5	168.5	166.0	163.0	161.0	159.0	158.5	157.0	156.5	155.0	155.5	154.0	154.0	156.0	163.5	0.0
2.8	0.0	169.0	167.0	164.0	162.5	159.0	158.0	157.0	156.5	156.0	154.0	152.0	153.5	155.0	159.0	156.5	167.5
2.9	180.0	170.5	166.0	162.5	160.5	159.5	157.0	156.5	155.0	155.5	153.0	155.0	154.0	156.0	159.0	160.0	159.5
3.0	188.0	175.0	166.0	163.0	161.0	158.0	158.0	157.5	155.0	153.0	154.0	154.0	156.0	157.0	161.5	168.5	159.0
3.1	0.0	185.5	171.0	165.5	161.0	159.5	156.0	155.0	156.0	155.5	155.5	157.0	157.5	160.0	161.0	161.5	161.5
3.2	0.0	0.0	189.5	175.0	162.5	157.0	155.5	158.5	159.0	157.5	157.0	157.0	166.0	168.5	163.0	164.5	0.0
3.3	0.0	0.0	0.0	198.0	190.0	172.5	162.5	160.5	160.0	157.5	158.5	160.5	165.0	160.0	159.5	0.0	0.0
3.4	0.0	0.0	0.0	205.0	195.0	181.0	164.0	164.0	158.5	159.0	161.0	161.0	161.0	161.5	0.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	197.0	186.5	172.0	165.0	163.0	162.0	164.0	164.5	162.5	169.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	181.5	171.5	167.5	164.0	162.0	167.0	169.5	169.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	177.5	173.0	169.0	164.0	163.5	164.0	173.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	164.0	165.5	164.0	169.5	165.5	171.0	168.0	180.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	160.5	162.0	163.0	163.0	163.0	165.5	165.5	167.5	171.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	158.5	159.0	161.0	161.0	163.0	163.0	167.0	167.0	170.0	176.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	156.5	157.0	158.0	160.0	160.5	160.5	162.5	163.0	167.0	166.0	171.5	0.0	0.0	0.0
4.2	0.0	0.0	158.0	157.0	156.0	157.5	159.5	159.5	160.0	161.5	163.0	163.0	164.5	168.0	172.5	0.0	0.0
4.3	0.0	162.5	159.0	158.5	158.5	156.0	158.0	161.0	161.0	161.0	161.0	164.0	164.5	167.0	169.5	173.5	0.0
4.4	166.0	164.5	157.5	160.0	159.5	158.5	156.5	158.0	158.0	161.5	161.0	164.5	165.0	165.0	168.0	172.5	177.5
4.5	166.0	165.5	161.0	160.0	160.0	159.0	156.5	158.0	160.0	160.0	161.0	163.0	166.5	166.5	167.5	171.0	177.0
4.6	173.0	170.5	160.0	160.0	158.5	159.0	158.0	157.5	157.0	158.5	161.0	161.5	164.0	166.0	171.0	172.5	187.5
4.7	0.0	163.0	166.0	160.0	159.5	159.0	159.0	160.0	160.5	159.0	158.0	163.5	164.0	167.5	169.5	183.0	195.5
4.8	0.0	0.0	171.0	162.5	161.5	160.0	161.5	161.5	162.0	163.0	159.0	159.5	164.5	168.0	185.5	202.0	0.0
4.9	0.0	0.0	171.0	162.0	162.5	161.5	160.5	161.5	165.5	167.0	165.5	164.0	177.5	189.0	202.0	0.0	0.0
5.0	0.0	0.0	0.0	166.5	163.5	164.5	163.0	161.0	165.0	167.5	170.0	180.0	178.5	191.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	167.5	164.0	165.0	162.5	167.0	171.0	177.5	175.0	180.0	184.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	166.5	165.5	166.5	171.0	178.0	171.5	173.5	174.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	168.0	170.5	172.5	175.0	172.5	169.5	171.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	170.0	174.5	173.5	172.0	170.0	168.5	168.0	166.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	168.0	177.5	176.0	171.0	170.0	169.0	166.0	166.5	163.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	176.0	173.5	172.0	170.0	169.0	166.5	165.0	163.0	161.5	161.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	172.0	175.0	172.0	170.5	169.0	167.5	165.5	163.5	161.0	160.5	160.0	163.5	0.0	0.0
5.8	0.0	0.0	171.0	173.0	174.0	171.0	170.5	168.0	166.5	163.5	162.5	162.0	162.0	160.0	165.0	163.0	0.0
5.9	0.0	171.5	171.0	173.0	172.5	172.5	170.0	169.0	165.5	162.5	161.0	161.5	161.0	162.0	166.5	162.0	0.0
6.0	0.0	170.5	171.5	172.5	174.5	172.5	172.0	164.5	163.5	161.5	161.0	161.0	161.0	160.5	163.0	163.0	165.0
6.1	177.0	174.0	172.0	175.0	175.0	174.0	169.5	163.5	163.5	163.0	162.0	162.0	161.5	162.5	163.0	160.0	167.0
6.2	179.0	175.0	173.0	175.5	174.0	172.0	167.5	164.0	163.5	164.0	163.0	162.0	162.0	163.0	168.5	163.5	168.0
6.3	0.0	177.0	174.5	175.5	174.5	170.0	167.5	165.0	165.0	164.0	162.5	160.5	161.5	163.5	168.5	166.0	166.0
6.4	0.0	0.0	178.5	175.0	173.0	170.0	168.0	166.5	164.5	163.0	161.0	161.0	161.5	162.0	163.5	176.5	0.0
6.5	0.0	0.0	191.5	180.5	172.5	169.5	168.0	166.0	164.0	164.0	162.0	160.5	162.0	162.5	171.0	0.0	0.0
6.6	0.0	0.0	0.0	191.0	181.0	170.5	168.0	167.0	164.0	164.5	163.5	163.5	165.0	168.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	190.5	180.5	169.5	166.5	164.5	164.5	165.0	166.5	168.5	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	187.5	179.0	167.5	166.0	165.0	167.0	167.0	172.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	183.5	181.5	175.5	169.5	165.5	168.5	171.0	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.47 l/s   S = 0.0040   beta = 12.62   epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	174.5	173.0	169.0	154.5	148.5	150.5	150.0	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	173.0	161.5	166.0	159.0	152.5	146.5	150.5	158.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	169.0	158.5	153.0	160.0	161.0	154.5	149.5	148.5	153.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	158.5	151.5	153.5	157.0	158.5	154.5	150.5	149.0	147.5	157.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	154.0	154.0	151.0	152.5	154.0	158.0	153.5	152.0	150.0	150.5	155.0	174.0	0.0	0.0
1.0	0.0	0.0	152.0	152.5	151.5	150.0	150.5	152.0	154.0	155.5	152.5	151.5	150.0	150.0	158.0	168.0	0.0
1.1	0.0	151.5	153.0	152.5	149.5	150.0	149.5	151.0	151.5	153.0	152.5	152.0	151.0	147.5	151.0	165.5	0.0
1.2	148.5	152.0	152.5	151.0	150.0	149.0	150.0	151.5	152.0	154.5	153.0	153.0	152.5	152.0	150.0	158.0	170.5
1.3	149.0	151.0	153.0	150.5	150.0	148.5	150.0	149.5	152.0	152.0	152.5	152.0	151.5	152.5	152.5	152.0	171.5
1.4	153.0	150.0	151.0	149.0	149.0	146.5	148.5	146.5	150.5	152.5	153.0	152.5	152.0	157.0	152.0	161.0	179.5
1.5	0.0	151.0	152.0	150.0	149.5	149.0	149.5	149.5	151.5	152.0	152.0	153.0	154.0	154.5	153.5	154.0	172.5
1.6	0.0	0.0	151.0	150.0	149.5	149.5	149.5	150.0	150.5	152.0	152.0	153.5	153.0	155.5	167.0	182.5	0.0
1.7	0.0	0.0	0.0	151.5	149.5	150.5	150.0	152.0	152.5	153.0	153.5	153.5	154.0	166.0	184.0	0.0	0.0
1.8	0.0	0.0	0.0	156.5	150.0	149.0	148.5	153.0	154.0	155.5	155.0	155.0	168.5	183.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	157.5	151.0	149.0	150.0	155.5	158.5	158.5	167.5	182.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	161.0	157.0	151.5	150.5	152.5	160.5	167.0	177.5	186.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	152.0	155.0	150.5	153.5	167.0	174.5	187.5	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	158.5	157.0	154.5	158.5	169.5	171.0	178.0	0.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	154.0	156.0	156.5	158.5	166.0	166.5	170.0	170.0	175.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	153.5	152.5	154.0	155.5	156.0	162.5	167.0	167.0	166.0	167.0	171.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	151.0	152.5	154.0	155.0	156.0	160.0	168.0	164.5	164.5	164.0	165.5	0.0	0.0	0.0
2.6	0.0	0.0	152.5	150.0	150.0	152.0	154.0	155.0	157.0	167.5	165.5	164.5	162.5	163.0	163.0	0.0	0.0
2.7	0.0	155.5	152.0	151.0	150.5	151.5	152.0	154.0	154.0	165.5	166.0	163.5	161.5	160.5	161.0	163.5	0.0
2.8	162.0	153.0	151.0	151.0	152.5	153.5	152.5	154.0	154.0	165.0	165.5	163.0	159.5	160.0	160.5	161.5	158.5
2.9	162.0	152.5	152.0	152.0	152.0	153.0	153.0	153.0	154.5	156.5	162.0	162.0	162.5	161.0	159.5	158.0	159.5
3.0	168.5	153.0	155.0	152.0	152.5	152.0	153.0	154.5	158.5	160.5	162.0	163.0	162.0	160.0	158.0	158.5	161.5
3.1	0.0	161.5	156.0	152.5	153.0	152.0	153.5	157.0	159.0	161.0	161.5	164.0	162.0	159.0	157.5	159.5	162.0
3.2	0.0	175.5	158.5	154.0	152.0	153.5	154.5	157.0	159.5	161.5	162.0	163.5	161.5	159.0	160.5	164.5	0.0
3.3	0.0	174.0	158.5	153.5	154.0	156.5	158.5	160.5	162.0	163.0	162.5	161.5	160.0	167.0	0.0	0.0	0.0
3.4	0.0	0.0	0.0	178.0	162.0	155.0	158.0	160.5	162.5	163.0	163.5	163.0	165.5	167.0	0.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	169.5	157.5	159.5	160.0	162.0	163.5	165.0	165.0	170.0	173.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	165.5	161.5	161.0	162.5	165.0	167.5	170.5	172.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	171.5	162.5	162.5	163.0	167.5	166.5	169.0	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	168.5	163.0	163.5	164.0	167.5	165.5	166.0	164.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	171.0	166.0	163.5	163.0	162.5	163.0	163.0	162.5	159.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	172.0	163.5	162.0	160.0	162.5	162.5	161.0	159.0	160.5	156.5	161.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	164.0	164.5	160.5	161.0	160.0	165.5	159.5	156.5	157.5	156.0	154.5	0.0	0.0	0.0
4.2	0.0	0.0	164.0	164.0	162.5	153.5	162.0	161.0	160.5	156.0	159.5	158.0	155.5	155.5	153.5	0.0	0.0
4.3	0.0	166.5	163.5	164.0	162.5	163.0	159.5	159.0	158.0	158.0	157.5	157.5	156.0	154.5	152.0	156.0	0.0
4.4	164.5	164.5	163.0	163.0	161.5	162.5	159.0	158.5	157.0	157.0	156.5	155.5	157.0	154.5	154.0	153.0	161.0
4.5	0.0	170.0	166.5	166.0	160.5	161.0	157.5	156.5	156.5	158.5	156.5	155.5	154.0	158.0	155.5	154.5	170.5
4.6	173.0	169.0	165.5	160.0	159.0	159.0	164.5	160.5	158.5	159.0	157.5	158.0	157.5	157.0	155.0	157.5	158.5
4.7	0.0	159.0	165.0	161.0	160.5	161.5	162.0	161.0	160.0	159.0	158.0	156.5	157.5	156.0	156.0	161.0	166.5
4.8	0.0	183.5	166.0	162.5	162.5	166.0	161.0	161.5	160.0	160.0	158.5	157.0	158.0	156.5	155.5	163.5	0.0
4.9	0.0	0.0	191.5	174.0	165.0	165.5	164.0	163.5	162.0	159.0	157.0	157.0	156.5	157.0	163.5	0.0	0.0
5.0	0.0	0.0	0.0	189.0	176.5	167.0	164.5	163.5	161.0	158.0	157.5	157.0	156.0	164.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	184.5	178.5	165.5	162.5	159.5	158.0	158.0	158.5	163.0	172.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	192.0	186.0	178.5	168.0	162.0	158.0	157.0	159.0	169.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	185.5	182.0	174.5	168.0	159.0	156.0	166.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	179.0	177.0	177.0	171.0	162.5	161.5	164.5	0.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	175.0	173.5	171.5	174.5	170.0	169.0	166.0	164.0	162.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	170.0	170.0	169.0	168.0	168.5	170.5	169.0	168.5	164.5	163.0	161.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	167.0	167.0	164.5	167.0	167.5	169.0	168.0	167.0	167.0	165.0	162.0	0.0	0.0	0.0
5.8	0.0	0.0	164.5	165.0	163.0	165.0	166.0	167.0	167.0	167.0	166.5	166.0	165.0	164.0	164.5	0.0	0.0
5.9	0.0	163.0	164.0	163.5	163.0	162.5	164.0	165.0	167.0	167.0	166.5	166.0	165.0	165.5	164.5	164.0	0.0
6.0	164.5	164.0	164.0	163.0	162.0	163.0	164.0	165.0	166.0	166.5	167.5	165.5	166.0	165.0	166.0	167.5	168.0
6.1	164.0	163.0	162.5	162.0	162.0	163.0	163.5	165.0	166.0	165.0	167.0	165.0	166.0	165.0	166.0	169.0	171.5
6.2	164.5	163.5	163.0	161.5	162.0	162.5	163.0	164.5	165.0	165.0	166.0	166.5	166.0	166.0	167.0	168.0	172.5
6.3	0.0	164.5	162.0	162.0	161.5	162.0	162.5	163.5	164.0	164.0	165.0	166.0	166.5	166.5	166.0	173.0	177.0
6.4	0.0	172.0	168.0	161.5	162.0	162.5	162.0	163.0	163.0	163.5	165.0	166.0	166.0	167.0	168.0	187.0	0.0
6.5	0.0	0.0	167.0	163.5	161.5	161.0	163.0	163.0	163.5	163.0	164.0	166.0	166.5	170.5	188.5	0.0	0.0
6.6	0.0	0.0	0.0	167.0	162.0	162.0	162.5	163.0	164.0	164.5	164.0	166.5	172.5	190.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	178.5	166.0	161.5	163.0	164.0	165.0	165.0	167.0	170.5	187.0	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	176.0	165.0	163.0	163.5	164.0	165.5	177.5	186.5	198.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	171.0	164.0	164.0	164.0	168.0	185.0	192.0	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.50 l/s S = 0.0040 beta = 11.86 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	155.5	150.5	147.5	150.0	155.5	157.5	168.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	152.0	154.0	149.5	149.0	155.0	161.5	168.0	175.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	153.5	151.5	152.0	148.0	149.0	154.5	161.0	162.5	163.0	165.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	150.5	151.5	150.5	148.5	150.0	155.5	158.5	163.5	162.5	161.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	148.5	150.5	150.0	150.0	150.0	152.0	155.5	155.5	160.0	160.5	158.5	156.5	0.0	0.0
1.0	0.0	0.0	149.0	149.0	150.0	150.5	150.0	150.0	150.5	154.5	154.5	158.5	159.0	159.5	157.5	153.0	0.0
1.1	0.0	149.0	148.0	149.0	149.0	150.0	151.0	151.0	150.0	154.5	154.0	157.0	158.0	158.5	158.5	154.0	0.0
1.2	150.5	151.0	149.0	150.0	150.0	151.5	150.5	150.5	151.0	154.0	155.0	159.0	159.0	156.0	155.5	158.5	152.0
1.3	149.0	152.0	148.5	149.0	150.5	150.0	151.5	151.0	152.5	151.5	155.5	156.0	159.0	156.5	155.5	155.5	154.0
1.4	0.0	152.0	151.0	150.0	151.0	152.0	152.0	152.0	153.0	154.5	155.5	155.5	155.5	154.5	154.5	158.5	154.5
1.5	0.0	153.0	150.0	150.0	150.5	151.0	151.5	152.0	154.0	154.5	155.0	156.0	154.5	154.0	155.0	157.5	158.0
1.6	0.0	0.0	153.0	150.0	151.0	151.0	152.0	154.0	155.0	156.0	157.0	155.0	155.0	156.0	155.0	157.0	0.0
1.7	0.0	0.0	0.0	153.5	150.0	153.0	154.0	156.0	156.0	156.5	157.0	157.0	156.5	156.5	160.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	166.5	152.5	151.5	155.0	157.0	156.5	158.0	157.0	161.0	159.0	158.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	158.5	151.5	157.0	158.5	158.5	158.0	158.5	161.0	162.5	160.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	160.0	159.5	159.0	160.0	162.0	159.5	160.5	161.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	171.0	159.0	161.5	160.5	163.5	160.0	160.5	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	168.5	161.5	161.5	161.0	159.0	160.0	160.0	157.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	169.0	164.0	163.0	162.5	159.5	159.5	158.5	157.0	155.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	166.0	164.0	163.5	160.5	158.5	157.5	158.5	156.0	156.0	152.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	167.0	162.0	162.5	160.5	158.5	158.0	157.5	156.5	156.5	154.5	151.5	0.0	0.0	0.0
2.6	0.0	0.0	166.5	160.5	162.5	160.0	159.0	157.0	157.5	156.0	154.5	156.0	153.0	151.0	149.0	0.0	0.0
2.7	0.0	163.5	163.0	159.0	160.5	158.5	156.5	155.0	154.5	154.5	152.0	152.5	152.0	151.0	149.0	150.0	0.0
2.8	0.0	162.5	161.0	160.0	160.0	157.0	155.5	154.5	153.0	153.0	153.5	154.5	152.0	150.0	148.0	149.0	155.0
2.9	162.0	163.5	162.5	160.5	158.0	155.0	154.0	154.0	152.5	153.0	152.5	152.0	152.5	151.5	150.0	151.0	154.0
3.0	163.0	165.0	163.0	160.5	157.0	156.0	153.0	152.0	152.0	152.5	153.0	152.5	152.0	151.5	151.0	150.0	155.0
3.1	0.0	172.0	161.5	161.5	155.0	153.5	152.5	153.0	153.0	153.0	152.5	152.0	152.0	151.5	151.0	150.0	161.5
3.2	0.0	177.0	171.0	163.0	154.0	154.0	154.0	153.5	153.0	153.0	152.0	151.5	151.0	150.5	151.5	157.5	0.0
3.3	0.0	0.0	197.5	180.0	161.0	154.5	155.0	154.0	153.0	152.0	151.0	150.0	150.0	150.5	156.0	0.0	0.0
3.4	0.0	0.0	0.0	194.0	179.0	163.0	154.0	152.5	152.0	152.5	150.0	149.5	151.0	153.5	168.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	191.0	180.5	164.0	155.0	151.5	152.0	151.0	150.0	154.0	165.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	202.0	195.0	179.0	168.0	162.5	152.0	152.0	157.0	160.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	189.0	183.0	178.5	163.0	164.5	163.0	169.0	167.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	186.5	181.0	178.0	165.5	159.0	163.0	163.5	164.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	171.5	169.5	165.0	169.0	165.5	157.5	161.5	162.0	166.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	164.0	161.5	168.0	171.0	162.0	158.5	155.5	158.5	166.5	172.5	0.0	0.0
4.1	0.0	0.0	0.0	161.5	161.5	159.5	158.5	157.5	154.5	157.0	157.5	155.5	161.0	167.0	0.0	0.0	0.0
4.2	0.0	0.0	159.0	161.0	159.0	157.5	157.5	157.0	156.5	157.0	156.0	155.5	156.0	159.5	171.5	0.0	0.0
4.3	0.0	157.5	157.0	157.0	156.5	158.0	158.0	157.0	157.0	156.5	155.0	155.0	156.0	155.0	166.5	170.5	0.0
4.4	0.0	156.0	157.5	156.0	157.0	157.0	156.5	156.0	158.0	157.0	155.5	155.5	155.0	155.0	160.5	173.0	182.0
4.5	157.0	158.0	157.0	157.0	156.0	155.0	156.0	155.5	157.0	157.5	157.5	156.0	155.5	155.5	163.0	165.5	168.0
4.6	160.0	157.5	158.0	157.0	156.0	155.0	156.0	156.0	156.5	157.0	159.0	158.0	156.5	156.0	160.5	163.0	167.0
4.7	166.0	160.5	159.5	159.0	156.5	157.0	157.0	156.5	157.0	157.5	158.0	159.0	158.0	156.0	163.0	165.0	172.5
4.8	0.0	163.5	163.0	159.0	158.0	159.0	159.0	159.0	158.0	159.0	158.5	158.0	158.0	159.5	166.0	172.5	0.0
4.9	0.0	0.0	165.5	163.5	159.0	160.0	159.5	159.0	159.0	159.5	158.5	159.0	158.5	163.0	176.0	0.0	0.0
5.0	0.0	0.0	0.0	169.0	161.5	161.0	160.0	160.0	159.5	158.0	158.0	158.5	161.0	174.5	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	172.0	162.5	162.0	160.5	160.0	159.0	159.0	158.5	177.0	188.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	181.0	171.0	161.0	160.0	160.0	160.0	160.0	167.0	179.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	179.0	164.5	161.5	159.5	160.5	160.0	178.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	171.5	166.5	161.0	160.5	158.0	173.0	171.5	171.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	171.5	167.0	167.0	165.0	162.0	160.0	162.5	174.0	169.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	164.5	163.5	166.0	163.5	163.0	159.5	161.0	170.0	164.5	163.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	164.5	163.5	164.0	166.0	164.5	163.0	160.5	160.5	163.0	167.5	164.0	168.0	0.0	0.0
5.8	0.0	0.0	158.5	163.5	162.0	164.0	164.0	164.0	163.5	162.0	161.0	164.0	163.0	161.5	160.0	0.0	0.0
5.9	0.0	156.0	162.5	165.0	164.0	165.0	164.0	164.5	164.0	162.5	158.5	160.0	162.5	162.0	161.0	165.5	0.0
6.0	0.0	156.0	161.5	163.5	164.0	165.5	165.0	165.0	164.5	163.0	159.0	161.0	161.5	161.0	161.5	161.5	164.5
6.1	161.0	159.5	164.5	163.0	163.0	167.0	166.0	164.5	163.0	160.5	160.0	160.0	161.0	160.0	161.5	165.0	165.0
6.2	162.0	162.0	162.5	162.5	164.0	165.5	166.0	163.0	161.5	161.0	160.5	160.0	160.0	159.0	160.5	166.5	165.0
6.3	0.0	161.5	165.0	164.5	164.5	165.0	163.0	162.5	162.0	161.0	160.5	159.5	160.0	160.0	162.5	165.5	0.0
6.4	0.0	0.0	163.5	165.0	165.0	165.5	164.5	163.0	162.5	160.0	159.0	159.0	159.5	159.0	164.0	168.0	0.0
6.5	0.0	0.0	164.5	166.5	166.5	167.0	165.0	164.0	163.0	160.0	159.0	159.0	160.0	161.5	173.0	0.0	0.0
6.6	0.0	0.0	0.0	169.0	166.0	166.0	166.5	162.0	159.0	161.0	160.5	158.0	160.5	172.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	170.0	167.0	164.5	167.5	163.0	161.0	160.5	161.5	170.0	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	174.5	169.5	168.0	168.0	165.0	162.5	163.5	169.5	184.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	173.5	170.5	168.5	165.5	163.5	167.5	177.0	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 2.00 l/s   S = 0.0040   beta = 10.90   epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	161.0	159.0	154.5	155.0	157.5	160.0	173.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	158.0	159.0	155.0	159.0	158.0	163.5	173.5	176.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	159.0	156.0	158.5	158.5	161.5	160.5	167.5	164.5	166.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	154.5	153.5	157.0	155.0	157.0	156.5	163.5	163.0	162.5	162.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	152.0	152.5	154.0	156.5	155.0	159.0	156.0	160.5	165.5	162.0	161.0	160.5	0.0	0.0
1.0	0.0	0.0	149.5	151.0	154.5	153.0	156.5	156.5	160.0	157.5	161.0	160.0	158.5	159.0	159.5	158.5	0.0
1.1	0.0	148.0	151.0	153.5	153.0	154.0	154.0	155.5	159.0	160.5	158.0	160.5	158.0	159.0	159.5	161.5	0.0
1.2	155.0	148.5	151.0	152.5	153.5	154.5	157.5	156.5	160.0	159.0	160.5	161.0	157.5	156.0	155.0	154.5	157.5
1.3	153.0	149.5	151.5	153.5	153.0	155.5	157.0	159.0	162.0	159.0	159.0	160.5	157.5	157.0	156.5	156.0	156.5
1.4	155.0	150.0	151.5	152.0	153.0	154.0	156.5	156.5	160.0	159.5	159.5	160.5	157.5	155.5	155.5	155.0	157.0
1.5	0.0	151.5	151.5	152.5	153.5	156.0	157.5	158.0	159.5	159.0	158.5	157.0	157.0	157.0	155.0	157.0	166.5
1.6	0.0	157.5	153.0	152.5	154.0	155.5	157.5	156.5	160.5	156.5	157.0	156.5	157.0	155.0	155.0	165.0	0.0
1.7	0.0	0.0	0.0	154.0	156.5	157.0	159.0	158.0	159.5	158.0	157.0	159.0	157.0	155.5	172.0	0.0	0.0
1.8	0.0	0.0	0.0	158.5	157.5	158.0	158.5	159.5	158.0	160.0	159.0	159.5	157.0	167.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	161.5	161.0	160.5	161.0	161.5	160.5	159.0	160.5	171.5	187.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	162.5	161.0	162.0	163.0	164.5	161.5	165.5	178.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	167.0	167.0	164.5	161.5	165.0	161.5	175.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	163.5	165.0	165.0	164.5	166.0	171.0	167.5	166.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	162.5	165.5	169.5	167.0	169.5	164.5	168.0	171.5	172.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	160.5	162.5	166.5	167.5	166.5	171.0	168.5	163.5	161.5	160.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	158.0	160.0	162.5	168.5	167.0	165.5	169.0	163.5	166.0	162.0	161.5	0.0	0.0	0.0
2.6	0.0	0.0	154.5	158.0	160.5	160.5	167.5	164.5	167.5	163.0	163.0	159.0	162.5	159.5	157.5	158.5	0.0
2.7	0.0	154.0	155.0	157.5	159.5	160.0	164.5	162.5	162.5	166.0	160.0	161.5	162.0	160.5	157.5	157.5	0.0
2.8	0.0	153.0	155.5	156.5	158.5	159.5	161.0	164.0	162.0	161.0	162.0	160.5	160.0	157.0	156.5	155.5	159.0
2.9	155.5	154.0	156.5	157.5	160.5	161.0	162.5	163.5	163.5	160.0	161.0	158.5	159.0	156.5	157.0	155.0	159.5
3.0	157.5	154.5	156.5	158.5	159.0	160.5	162.0	163.5	162.5	161.0	159.0	159.5	157.0	156.5	155.0	155.0	158.5
3.1	0.0	155.0	159.5	159.5	160.5	161.0	163.5	162.0	163.0	160.5	160.0	159.0	158.0	157.0	155.5	157.5	161.0
3.2	0.0	165.0	158.5	160.5	160.5	162.5	162.5	166.0	162.5	161.0	157.5	158.0	155.5	155.0	155.0	161.0	0.0
3.3	0.0	0.0	167.5	165.5	165.0	166.5	168.5	167.5	163.0	159.0	158.5	159.0	158.5	156.5	160.0	0.0	0.0
3.4	0.0	0.0	0.0	168.5	167.5	168.0	167.0	166.0	160.0	158.5	157.0	158.0	157.0	160.5	170.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	176.0	176.0	172.0	165.5	161.0	160.0	160.5	160.0	162.5	169.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	180.5	173.5	166.0	163.0	162.5	162.5	163.5	168.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	189.5	177.5	171.0	165.0	164.5	163.0	167.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	183.0	174.5	164.5	161.5	163.0	166.5	169.5	170.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	175.5	175.5	175.5	164.5	162.0	165.5	166.0	165.5	164.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	172.5	169.5	172.0	169.5	164.0	164.0	166.5	166.0	163.5	162.5	163.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	165.5	166.0	171.0	166.5	162.5	164.0	166.5	165.5	163.5	163.5	160.5	0.0	0.0	0.0
4.2	0.0	0.0	165.0	164.5	165.5	167.0	165.5	162.5	164.0	164.5	163.0	161.5	162.0	161.5	160.5	0.0	0.0
4.3	0.0	158.5	156.5	159.5	161.0	166.0	166.0	165.0	165.0	164.5	163.0	160.5	160.0	160.0	160.0	157.5	0.0
4.4	161.5	158.5	159.5	159.0	161.5	161.5	167.5	166.5	166.0	162.5	163.0	162.5	161.0	159.5	161.0	161.0	157.5
4.5	158.0	158.5	157.5	160.0	160.5	160.5	161.0	163.5	164.5	164.0	163.5	163.5	161.5	160.0	159.5	161.0	158.0
4.6	163.0	160.5	159.0	160.5	161.0	161.0	160.5	164.0	163.0	165.0	165.5	164.5	164.0	164.5	163.0	163.5	160.0
4.7	0.0	160.0	157.0	157.5	158.5	159.5	160.5	161.5	165.0	164.0	165.5	168.0	165.5	166.0	165.0	163.0	162.5
4.8	0.0	170.5	158.5	158.5	159.0	159.5	161.0	162.0	163.5	167.5	168.5	167.5	168.0	170.5	168.5	167.5	0.0
4.9	0.0	0.0	169.5	158.5	157.5	159.5	160.0	162.5	164.0	166.5	167.5	171.0	172.0	172.0	170.5	0.0	0.0
5.0	0.0	0.0	0.0	167.0	158.5	160.0	160.5	162.0	161.0	163.0	163.5	170.0	177.5	183.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	166.5	161.0	161.0	159.5	163.0	163.5	165.5	173.0	185.5	195.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	166.5	161.5	159.0	161.5	164.0	172.5	186.0	204.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	168.0	166.0	162.5	162.0	165.0	181.0	194.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	166.5	166.0	164.5	161.5	172.5	178.5	188.5	190.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	164.0	164.0	167.5	165.5	167.5	171.0	176.5	179.0	185.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	162.0	164.0	166.5	167.5	169.0	172.5	173.0	172.5	174.5	175.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	160.5	161.5	164.0	167.5	167.0	168.5	169.5	169.0	170.0	170.5	173.0	170.5	0.0	0.0
5.8	0.0	0.0	160.0	161.0	163.0	165.5	168.0	168.5	168.0	171.0	169.0	168.0	167.5	168.5	168.5	168.0	0.0
5.9	0.0	164.5	159.0	159.0	160.5	164.0	167.5	168.5	169.0	169.0	169.0	167.0	166.0	167.0	168.5	166.0	0.0
6.0	0.0	166.0	158.5	159.5	160.0	163.5	165.5	168.5	170.5	168.0	168.5	170.0	166.5	166.0	165.5	168.5	167.5
6.1	165.5	160.0	160.0	160.0	161.0	161.5	163.5	167.5	169.5	170.0	170.5	166.5	166.5	165.5	166.0	167.0	168.0
6.2	166.5	163.0	160.0	160.0	160.0	161.0	162.0	166.0	168.5	169.0	169.0	171.5	168.5	168.5	166.5	168.0	171.0
6.3	170.0	163.5	162.0	160.5	161.0	161.5	162.5	163.0	165.0	167.0	169.5	169.0	168.5	168.0	167.0	167.5	173.0
6.4	0.0	168.5	162.5	160.5	161.5	161.0	161.5	163.0	164.5	165.0	168.5	168.5	167.5	169.0	168.5	176.0	0.0
6.5	0.0	0.0	170.0	163.0	163.0	162.5	164.0	164.5	165.0	166.0	169.0	168.5	169.0	170.0	180.0	0.0	0.0
6.6	0.0	0.0	0.0	171.0	164.5	163.0	164.0	165.0	165.0	159.0	173.0	168.0	168.0	177.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	176.0	167.0	165.5	166.0	164.5	169.5	172.5	169.5	179.0	185.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	172.5	168.5	167.0	169.0	167.5	172.0	173.5	179.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	177.5	171.0	170.5	172.0	177.5	177.5	179.5	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 2.49 l/s S = 0.0040 beta = 9.94 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	165.0	158.5	157.5	154.0	156.5	167.0	172.5	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	161.0	161.0	158.0	157.5	169.0	166.5	171.0	169.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	157.5	156.5	159.5	160.0	165.5	163.0	163.0	166.0	150.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	154.5	154.5	159.0	162.0	160.5	163.5	165.5	159.5	159.5	158.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	152.5	153.5	154.0	157.5	160.0	162.0	161.5	160.5	159.5	159.5	159.0	157.5	0.0	0.0
1.0	0.0	0.0	150.5	153.5	153.5	153.5	156.0	161.0	162.0	161.0	161.0	157.0	158.0	159.5	156.0	154.5	0.0
1.1	0.0	150.0	150.5	152.0	152.0	155.5	156.5	159.5	160.0	162.0	161.0	158.5	158.5	157.5	157.0	156.5	0.0
1.2	0.0	150.0	150.0	151.5	153.0	155.0	157.0	158.5	160.0	164.5	162.0	157.5	162.0	154.5	158.5	158.5	155.0
1.3	152.0	149.5	150.0	151.0	152.0	155.5	157.0	159.0	158.0	159.5	158.0	161.5	157.0	156.5	155.5	159.0	155.0
1.4	153.0	150.0	150.5	150.5	152.5	155.0	157.0	159.0	162.0	159.5	161.5	160.0	156.0	154.0	155.5	154.0	155.5
1.5	0.0	151.5	150.5	152.0	153.0	155.5	157.5	158.5	160.0	163.5	160.0	159.0	156.0	157.0	156.0	155.5	0.0
1.6	0.0	0.0	151.0	151.0	154.5	157.0	158.5	162.0	162.0	162.0	160.5	159.5	158.0	156.5	157.0	162.5	0.0
1.7	0.0	0.0	0.0	151.5	154.5	158.0	159.0	162.0	163.0	160.5	159.5	161.0	156.5	158.5	156.0	0.0	0.0
1.8	0.0	0.0	0.0	161.5	155.5	150.0	162.0	161.5	166.0	162.5	161.5	159.0	162.0	167.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	163.5	159.5	161.5	167.5	164.0	163.5	163.0	164.0	167.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	163.5	163.0	170.5	165.0	166.5	167.5	171.0	172.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	168.5	167.5	168.5	167.0	171.0	171.0	172.5	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	165.0	165.5	163.0	167.0	172.0	167.0	165.0	0.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	162.0	167.0	169.0	170.0	171.5	168.5	167.5	165.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	160.0	162.5	163.5	163.5	171.0	174.0	165.5	165.5	165.0	0.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	157.5	159.0	159.0	162.0	166.5	168.0	170.5	163.5	164.5	164.0	159.5	0.0	0.0	0.0
2.6	0.0	0.0	156.5	155.5	158.5	161.0	164.0	169.0	166.5	164.5	168.0	162.5	161.5	159.5	158.0	0.0	0.0
2.7	0.0	155.0	157.0	158.0	159.5	164.0	165.0	165.0	164.0	162.0	162.5	159.5	156.5	154.5	156.5	0.0	0.0
2.8	0.0	154.5	155.0	157.5	161.0	162.5	165.0	165.0	164.0	164.0	160.0	160.5	158.5	155.0	154.0	154.0	155.5
2.9	154.0	155.0	157.0	158.5	161.5	163.0	163.0	163.0	161.0	161.0	161.5	160.0	157.0	155.5	153.0	154.0	156.0
3.0	156.0	156.5	159.0	160.0	161.0	160.5	161.0	161.5	160.0	159.5	158.5	156.0	156.5	155.0	153.0	153.5	155.0
3.1	0.0	157.5	160.0	160.5	157.5	160.0	158.0	161.0	161.5	159.5	157.5	155.5	157.0	155.0	154.5	154.5	158.0
3.2	0.0	0.0	159.5	159.0	160.5	158.0	159.0	157.5	157.0	160.0	158.0	156.5	156.5	157.5	155.0	158.5	0.0
3.3	0.0	0.0	0.0	178.0	164.0	160.5	162.5	162.5	163.0	162.5	158.5	158.5	159.0	162.5	0.0	0.0	0.0
3.4	0.0	0.0	0.0	0.0	179.5	164.0	162.5	162.0	161.5	163.0	162.5	161.0	163.5	173.5	0.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	0.0	176.5	168.5	165.0	164.0	167.0	166.5	167.0	173.0	0.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	181.5	174.0	171.0	169.0	164.5	169.0	173.0	0.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	176.5	174.0	168.5	169.5	164.5	168.5	168.0	170.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	178.5	178.0	169.5	171.0	174.0	171.0	171.5	171.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	169.0	168.5	173.0	176.5	170.5	171.5	169.0	167.0	167.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	169.0	166.5	175.0	170.0	169.0	171.0	169.0	169.5	162.5	163.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	165.0	166.0	168.5	169.0	169.5	168.0	168.5	168.0	169.5	162.0	164.0	0.0	0.0	0.0
4.2	0.0	0.0	163.0	163.5	164.0	169.0	170.0	170.0	168.0	165.5	164.5	165.0	167.0	159.5	159.5	0.0	0.0
4.3	0.0	161.0	160.0	166.0	164.0	168.0	167.0	168.0	167.0	169.0	164.5	163.5	163.0	163.0	160.5	158.5	0.0
4.4	0.0	160.0	161.0	163.5	163.5	164.0	165.5	164.5	167.0	168.5	165.0	165.0	161.0	162.5	160.0	159.0	158.0
4.5	162.0	159.0	159.5	161.0	162.0	164.0	166.0	165.5	169.0	163.5	168.0	163.5	163.0	162.0	161.0	159.0	159.0
4.6	162.0	159.5	160.5	162.0	160.5	161.5	164.0	168.0	170.0	169.0	165.0	166.5	165.0	163.0	163.0	161.5	161.0
4.7	0.0	161.5	161.5	160.5	167.5	163.0	163.5	165.0	166.0	164.5	167.0	168.0	167.5	166.0	163.5	163.5	165.0
4.8	0.0	0.0	0.0	163.5	164.0	163.0	164.5	164.5	165.5	167.5	167.5	167.0	166.0	168.0	167.5	167.5	0.0
4.9	0.0	0.0	0.0	165.0	164.0	164.5	166.5	166.5	166.5	166.5	167.0	170.5	168.0	167.5	172.5	0.0	0.0
5.0	0.0	0.0	0.0	172.5	165.0	165.0	167.0	166.0	172.5	169.5	172.0	169.5	169.0	177.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	174.0	167.5	167.5	171.0	171.0	170.5	171.5	174.5	183.0	0.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	173.0	171.0	170.0	173.5	168.0	170.5	184.5	195.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	174.0	174.0	173.5	171.5	173.0	178.0	187.0	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	171.0	172.0	172.5	174.0	171.5	181.0	183.0	189.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	172.0	169.0	172.0	172.0	175.0	172.5	176.5	178.5	178.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	167.0	167.0	168.5	174.0	169.5	173.5	176.0	172.0	173.5	175.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	168.0	166.0	168.5	165.5	171.5	176.0	175.5	171.0	173.0	171.5	170.0	170.5	0.0	0.0
5.8	0.0	0.0	164.5	166.0	167.5	170.5	170.5	169.0	173.0	170.5	168.5	170.0	165.0	164.0	165.0	167.0	0.0
5.9	0.0	163.0	164.5	166.5	169.0	168.5	171.0	169.0	173.5	169.5	167.0	164.5	163.5	162.0	162.5	162.0	0.0
6.0	0.0	163.0	163.5	163.5	164.5	167.0	170.5	167.5	172.0	171.0	168.0	166.5	164.5	164.5	165.5	165.5	165.5
6.1	164.0	163.5	163.0	163.0	163.0	165.0	167.5	167.5	171.5	168.0	167.0	171.5	166.0	165.0	163.5	163.5	166.5
6.2	165.0	163.0	165.0	163.0	164.5	167.0	166.5	170.0	173.5	169.5	169.0	170.0	168.5	168.5	166.5	167.0	167.5
6.3	170.0	164.5	164.0	164.5	164.0	164.5	166.0	166.5	170.0	172.0	169.0	169.0	169.5	166.0	167.0	167.5	170.5
6.4	0.0	171.5	166.5	165.0	166.0	165.5	166.0	168.0	166.5	169.5	170.0	166.0	168.5	167.5	170.0	172.5	0.0
6.5	0.0	0.0	175.0	169.5	167.0	165.5	165.5	170.0	168.5	168.5	166.0	167.5	166.0	170.0	178.0	0.0	0.0
6.6	0.0	0.0	0.0	179.0	171.0	170.5	168.0	171.0	172.5	168.0	169.0	168.0	167.5	182.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	186.5	175.5	174.5	171.5	173.5	169.5	169.0	167.0	173.0	0.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	191.0	182.0	172.5	167.5	168.0	167.0	169.5	177.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	199.5	187.0	179.0	171.5	172.0	171.5	171.5	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 2.92 l/s S = 0.0040 beta = 9.09 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	159.0	158.5	151.5	154.5	152.0	158.5	163.0	0.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	156.5	153.5	153.5	152.0	157.0	163.0	163.5	0.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	152.0	155.5	157.0	156.5	158.5	157.5	156.0	154.5	154.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	152.5	150.5	150.0	156.5	156.0	151.0	157.0	159.0	152.0	155.0	147.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	147.0	148.5	149.0	158.5	160.5	156.0	154.5	154.5	151.5	152.0	148.5	146.5	0.0	0.0
1.0	0.0	0.0	144.5	144.5	149.5	148.5	155.5	156.5	157.5	156.5	153.5	151.0	149.0	149.5	146.0	146.0	0.0
1.1	0.0	143.0	145.5	146.5	147.0	150.0	153.5	153.0	154.0	154.0	153.0	150.5	147.5	147.5	147.5	146.5	0.0
1.2	145.5	143.5	145.5	146.5	148.5	150.5	151.5	156.5	152.0	153.0	154.5	151.0	150.5	148.5	149.0	146.0	147.0
1.3	144.0	143.5	144.5	146.5	148.0	149.5	157.0	152.5	155.5	155.5	152.5	150.0	148.0	148.0	145.5	146.0	147.0
1.4	145.5	144.0	145.0	147.5	149.0	150.0	152.0	152.0	153.0	151.5	150.5	150.0	148.5	147.5	145.5	147.0	150.5
1.5	0.0	143.5	145.0	147.0	148.5	150.0	150.5	152.0	153.0	154.0	151.5	150.0	148.0	147.5	146.0	147.5	0.0
1.6	0.0	153.0	145.5	147.0	149.0	151.0	151.5	151.0	154.5	153.0	152.5	150.0	148.5	148.5	149.0	160.5	0.0
1.7	0.0	0.0	153.5	149.0	151.0	152.0	155.0	156.5	153.5	155.0	152.5	153.5	150.0	150.5	159.5	0.0	0.0
1.8	0.0	0.0	0.0	158.0	152.0	152.5	155.0	157.0	155.0	152.0	154.0	151.5	154.0	159.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	159.5	154.5	160.5	156.0	159.0	154.5	154.0	157.0	162.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	144.0	159.0	159.5	158.5	156.0	160.0	164.0	164.0	166.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	166.0	164.0	160.0	163.5	161.5	166.5	166.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	165.0	165.0	164.5	166.5	163.5	164.5	165.5	164.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	149.0	161.0	165.0	166.5	163.5	168.5	163.5	165.0	161.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	158.5	158.5	167.0	161.5	165.5	163.0	165.5	161.0	158.5	157.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	155.5	155.5	157.5	162.0	162.5	165.0	160.5	164.5	159.5	157.5	155.0	0.0	0.0	0.0
2.6	0.0	0.0	153.0	153.5	155.0	157.0	162.0	165.5	162.0	165.5	163.0	157.0	156.5	154.5	151.0	0.0	0.0
2.7	0.0	150.5	151.5	153.5	154.5	155.5	159.0	160.5	160.5	159.5	158.0	157.0	157.0	153.5	150.5	151.0	0.0
2.8	151.5	150.0	152.0	152.5	155.0	157.0	158.5	158.5	161.5	157.0	156.0	153.5	154.5	152.5	150.0	149.0	151.0
2.9	151.0	149.0	151.0	151.0	156.0	156.5	158.0	155.5	158.5	156.5	156.0	156.0	152.5	153.5	151.0	150.0	151.5
3.0	152.0	150.0	150.0	152.5	154.0	155.0	156.5	159.0	161.5	158.0	157.5	157.0	153.0	152.0	150.0	149.5	152.0
3.1	159.0	151.0	152.0	152.5	155.0	156.0	158.0	158.5	161.0	157.0	157.5	156.0	154.0	152.5	150.5	151.0	159.0
3.2	0.0	161.0	153.5	154.0	156.0	159.0	158.0	157.0	160.5	155.0	156.0	155.5	152.5	152.0	151.5	156.0	0.0
3.3	0.0	0.0	165.5	156.0	157.0	158.0	158.5	160.0	161.5	159.5	155.0	156.5	155.0	154.5	159.5	0.0	0.0
3.4	0.0	0.0	0.0	170.0	158.5	159.5	158.5	161.5	160.0	156.5	158.5	157.5	157.5	164.5	172.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	167.5	161.5	160.0	163.0	159.0	161.5	161.5	159.5	168.5	172.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	174.5	169.0	166.0	165.5	163.5	162.5	168.0	169.0	176.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	173.0	174.0	164.5	166.5	167.0	168.0	173.0	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	172.0	171.0	168.5	168.5	170.5	171.0	169.5	0.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	166.5	169.0	170.5	170.0	172.0	173.0	171.5	167.0	162.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	164.0	161.5	165.0	171.0	170.5	167.0	168.0	167.0	160.5	161.5	162.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	160.0	160.0	164.5	167.0	169.0	169.5	165.0	166.0	162.0	159.5	159.0	0.0	0.0	0.0
4.2	0.0	0.0	158.5	159.0	160.0	160.5	168.0	163.5	167.5	163.0	160.0	160.0	156.5	159.0	155.0	0.0	0.0
4.3	0.0	155.0	156.5	159.5	158.5	160.0	163.0	167.5	167.0	161.5	163.0	159.0	157.5	160.0	155.5	154.0	0.0
4.4	156.0	155.5	157.5	158.5	156.5	158.5	160.0	160.0	166.0	163.0	161.5	159.5	159.0	158.5	158.0	156.0	153.0
4.5	156.5	155.5	155.5	157.0	159.0	159.5	162.5	162.0	164.0	163.0	161.5	162.5	159.0	157.0	155.5	155.5	155.0
4.6	158.5	155.5	158.0	157.0	159.5	160.0	161.0	166.5	164.0	165.5	162.5	160.0	158.5	156.5	155.0	154.0	157.0
4.7	167.5	158.0	158.0	160.0	159.5	160.0	162.0	162.5	162.5	163.0	164.0	159.5	159.0	156.0	156.0	155.0	163.5
4.8	0.0	169.0	159.5	160.5	160.5	161.0	163.0	167.0	166.0	165.0	161.5	161.5	161.5	159.5	159.5	166.0	0.0
4.9	0.0	0.0	168.5	160.5	161.0	161.0	162.0	161.5	165.0	164.0	163.0	163.5	163.5	162.0	169.5	0.0	0.0
5.0	0.0	0.0	0.0	171.5	163.5	163.5	166.5	165.5	169.5	165.0	165.0	167.0	163.0	166.0	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	176.5	169.0	168.0	167.0	167.5	165.0	167.0	167.5	170.5	175.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	185.0	178.5	168.5	166.5	166.5	168.5	170.0	171.5	175.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	181.5	174.5	166.5	172.5	172.5	171.0	173.5	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	176.0	178.0	177.5	172.0	176.0	174.0	173.0	0.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	169.5	169.5	173.0	174.5	170.5	175.0	175.0	169.0	168.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	165.0	166.5	169.0	176.0	173.0	175.5	177.0	173.5	169.0	166.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	166.5	166.5	167.5	170.5	167.5	173.5	171.0	169.5	169.0	166.0	165.0	162.0	0.0	0.0
5.8	0.0	0.0	162.5	164.5	166.0	171.5	170.5	169.0	174.0	169.5	169.5	165.5	163.0	162.5	162.5	159.5	0.0
5.9	0.0	159.5	160.5	164.0	167.0	167.0	166.5	168.5	172.5	170.5	167.5	166.0	162.5	163.5	162.5	160.0	0.0
6.0	165.0	160.0	160.0	161.5	164.0	164.0	167.5	169.5	172.5	169.0	171.0	168.0	168.0	165.0	163.5	163.5	161.0
6.1	162.5	162.0	163.0	161.5	165.5	166.5	166.0	168.5	169.5	172.0	169.0	166.0	168.0	164.5	164.0	163.5	163.5
6.2	165.5	162.5	162.5	165.0	166.5	166.5	166.5	168.5	170.0	169.0	166.5	165.0	160.5	161.5	160.0	159.5	161.5
6.3	172.0	166.0	168.0	166.5	167.0	161.5	168.0	166.0	168.0	166.0	164.5	164.5	160.5	162.0	160.5	160.0	168.0
6.4	0.0	170.5	169.5	169.0	166.5	168.0	165.0	168.5	167.0	165.5	165.5	163.5	164.0	164.0	165.0	169.5	0.0
6.5	0.0	0.0	167.5	162.5	162.5	166.5	168.5	170.0	170.5	165.5	166.5	163.5	165.5	165.5	173.5	0.0	0.0
6.6	0.0	0.0	0.0	171.5	165.5	165.0	167.0	161.0	170.0	168.0	174.0	170.5	173.5	185.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	181.0	173.5	167.0	168.0	168.0	167.5	169.5	170.5	177.5	186.5	196.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	182.5	173.0	171.0	170.0	170.5	171.5	175.0	186.0	196.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	179.0	174.5	171.5	176.5	175.0	185.5	191.0	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 0.97 l/s S = 0.0054 beta = 14.63 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	160.5	157.5	157.0	155.5	155.0	158.5	174.5	167.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	157.0	158.0	156.5	156.0	155.0	157.5	171.0	166.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	157.0	157.0	156.5	156.0	154.5	154.5	164.5	173.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	154.0	155.0	155.5	155.5	155.0	153.5	154.0	157.0	165.0	163.0	0.0	0.0	0.0
0.9	0.0	0.0	0.0	153.5	154.5	155.0	155.0	154.5	154.5	153.5	154.0	158.0	162.0	161.5	164.0	0.0	0.0
1.0	0.0	0.0	153.0	153.0	154.5	154.5	154.0	154.0	154.0	153.5	154.0	159.5	160.0	160.0	161.0	157.0	0.0
1.1	0.0	154.0	154.5	156.0	156.0	155.0	154.5	155.0	154.0	154.0	154.5	160.0	157.5	160.5	160.5	156.0	154.5
1.2	0.0	154.5	156.0	156.0	155.5	153.0	155.5	154.5	154.5	155.0	156.5	157.0	157.5	158.0	158.5	154.5	152.5
1.3	157.5	156.5	157.0	156.5	156.5	156.0	155.0	156.0	155.0	155.0	155.5	155.5	157.0	159.5	158.0	153.0	151.5
1.4	158.5	157.0	156.5	156.0	157.0	156.0	155.0	154.0	153.5	153.5	154.5	155.0	155.5	156.5	157.5	152.0	152.5
1.5	0.0	159.5	159.0	158.0	157.5	156.0	155.0	152.5	153.0	153.5	154.0	155.0	155.5	158.5	157.5	150.5	160.0
1.6	0.0	0.0	159.5	158.5	158.5	156.5	155.5	152.5	152.5	153.5	153.5	154.5	151.5	158.5	158.0	156.0	0.0
1.7	0.0	0.0	0.0	165.5	163.0	158.0	152.5	153.0	153.0	153.5	153.5	153.5	154.0	162.0	157.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	164.5	161.5	154.0	153.0	153.0	153.5	154.0	154.0	154.5	164.0	163.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	182.5	166.5	154.0	153.5	153.0	153.0	154.0	154.5	162.0	168.5	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	174.0	165.5	153.5	153.5	153.5	154.0	157.0	169.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	176.5	169.0	161.5	153.5	153.5	155.0	163.0	169.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	169.0	166.5	162.5	158.5	158.5	162.5	167.5	164.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	165.5	164.0	160.5	160.0	159.0	160.5	164.5	164.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	162.5	163.0	161.0	159.0	159.0	160.5	159.0	162.5	164.5	162.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	161.0	160.5	159.5	158.5	157.5	159.0	160.5	160.0	159.0	162.0	163.0	0.0	0.0	0.0
2.6	0.0	0.0	153.5	160.0	159.5	158.0	157.5	157.0	157.0	158.5	160.0	157.5	159.0	160.5	159.5	0.0	0.0
2.7	0.0	0.0	156.0	158.5	157.5	156.5	156.0	156.0	156.0	157.0	158.5	157.0	157.0	159.0	159.5	155.5	0.0
2.8	0.0	152.5	156.0	156.5	156.5	156.0	155.5	155.0	155.5	156.0	157.0	158.5	157.0	158.0	158.5	157.5	161.5
2.9	160.0	153.5	156.0	155.0	155.0	155.5	155.5	155.0	158.5	155.5	156.5	158.0	157.5	157.5	158.0	158.0	158.5
3.0	160.5	153.5	155.0	155.0	154.5	155.0	155.0	155.0	155.5	155.5	155.5	157.0	158.0	158.0	158.5	158.5	158.5
3.1	0.0	154.5	154.5	155.5	154.5	155.0	155.0	155.5	155.0	155.0	156.0	157.0	158.0	159.0	159.0	160.0	163.0
3.2	0.0	163.5	156.0	154.5	155.0	155.5	155.5	155.5	156.0	156.0	156.5	156.0	158.0	159.5	160.5	163.0	0.0
3.3	0.0	0.0	0.0	157.0	156.0	155.0	156.0	156.0	156.0	156.0	157.0	157.5	157.5	160.0	165.0	0.0	0.0
3.4	0.0	0.0	0.0	163.0	158.0	157.0	156.0	156.0	156.5	155.5	157.5	158.5	160.0	164.5	179.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	164.0	158.0	158.5	156.5	157.0	157.0	157.5	160.0	169.0	178.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	161.5	160.5	158.0	157.0	157.5	158.0	169.0	181.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	161.5	159.5	158.5	157.5	157.5	162.5	175.5	181.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	162.5	160.0	157.0	159.5	160.5	166.5	171.0	172.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	159.5	160.0	156.0	156.5	160.5	166.0	168.0	168.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	160.5	158.5	157.0	155.0	155.5	159.5	164.0	166.5	165.0	164.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	155.0	160.0	157.0	156.0	153.5	155.0	158.5	162.5	164.5	163.5	162.5	0.0	0.0	0.0
4.2	0.0	0.0	157.0	156.5	160.0	156.0	156.0	154.0	156.0	159.0	161.0	162.5	161.5	161.5	162.0	0.0	0.0
4.3	0.0	156.5	157.0	156.0	158.0	156.5	157.5	157.0	157.0	158.5	159.0	160.5	160.0	160.0	161.0	159.0	0.0
4.4	0.0	157.0	156.5	156.5	157.0	158.0	158.5	155.5	157.0	158.0	158.0	158.5	159.0	159.0	159.0	159.5	157.0
4.5	163.0	159.5	156.0	156.5	157.5	160.0	156.5	156.5	156.5	156.5	157.5	157.5	157.5	158.0	158.0	158.5	156.0
4.6	0.0	159.0	157.0	158.0	163.5	159.0	155.5	155.5	156.5	157.0	157.0	157.0	157.5	157.0	158.0	159.0	155.0
4.7	0.0	163.0	165.0	164.5	159.5	156.0	155.0	156.0	156.5	157.0	157.0	156.5	157.0	156.5	157.5	158.5	161.0
4.8	0.0	169.5	170.5	165.5	157.0	156.0	155.5	156.5	156.5	157.0	157.0	157.0	157.0	158.0	158.0	159.5	0.0
4.9	0.0	0.0	158.5	167.0	156.5	155.5	157.0	157.0	156.5	157.0	157.0	156.5	158.0	158.5	162.0	0.0	0.0
5.0	0.0	0.0	0.0	184.5	169.0	156.0	156.5	156.5	156.5	156.5	156.5	157.0	158.5	161.5	167.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	183.0	157.5	157.0	156.5	156.0	156.0	157.0	157.5	161.5	165.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	165.5	163.0	157.5	156.0	156.0	156.5	161.0	164.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	176.5	166.5	156.5	157.0	156.5	158.0	163.0	164.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	176.5	167.0	159.0	155.0	158.5	160.5	162.0	161.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	165.5	167.0	162.5	156.5	159.0	160.5	160.5	159.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	165.0	159.5	164.0	165.0	158.0	159.0	159.5	158.5	157.5	156.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	163.5	161.5	158.0	161.5	165.0	160.5	158.0	159.0	158.5	157.0	155.5	155.5	0.0	0.0
5.8	0.0	0.0	153.5	162.5	161.0	157.5	160.5	165.0	166.0	162.5	160.0	158.0	157.0	155.5	155.0	157.0	0.0
5.9	0.0	153.5	157.5	160.5	158.5	157.0	157.0	164.0	167.0	162.0	160.0	159.0	158.0	156.5	156.0	158.0	160.0
6.0	0.0	156.5	156.0	157.0	157.0	155.5	155.5	164.0	168.0	164.5	162.0	159.5	158.0	157.5	157.0	156.5	160.5
6.1	162.0	154.0	154.0	156.5	156.5	155.0	155.5	163.0	167.5	170.5	164.0	160.0	159.0	158.5	157.5	157.5	159.5
6.2	162.5	153.5	153.0	154.0	154.0	153.5	154.0	158.0	167.0	169.5	168.5	160.5	158.5	158.5	158.0	158.0	159.0
6.3	0.0	155.5	153.5	152.5	152.0	152.5	153.0	153.5	165.5	169.5	172.0	166.0	159.0	158.0	157.5	157.5	164.5
6.4	0.0	161.0	155.0	152.5	151.5	150.5	151.0	152.0	160.5	171.0	176.0	169.0	160.5	160.0	159.5	160.5	0.0
6.5	0.0	0.0	164.0	152.5	151.5	150.5	150.5	152.0	154.5	164.0	176.0	174.5	164.0	161.0	162.0	0.0	0.0
6.6	0.0	0.0	0.0	160.0	152.5	150.5	150.0	150.5	151.0	164.0	168.0	176.5	170.0	165.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	160.0	159.5	154.5	152.5	154.0	162.5	166.5	175.5	177.0	181.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	158.0	160.0	153.0	159.0	162.5	167.0	175.5	184.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	163.5	162.5	159.0	160.0	163.0	167.5	178.5	185.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.05 l/s S = 0.0054 beta = 13.68 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	155.5	146.0	145.5	153.0	162.0	165.0	168.0	168.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	156.0	149.0	149.0	156.0	162.5	166.0	164.5	164.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	151.0	148.0	155.5	156.5	161.5	163.0	163.5	160.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	148.0	150.5	149.5	156.0	158.0	160.0	160.5	161.0	157.5	157.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	148.0	147.0	150.5	150.0	159.5	157.5	158.5	158.5	162.0	158.0	157.5	156.0	0.0	0.0
1.0	0.0	0.0	150.5	148.0	147.0	147.0	151.5	161.5	159.5	158.5	158.5	157.5	156.5	156.5	156.5	154.5	0.0
1.1	0.0	0.0	154.5	150.0	148.5	149.5	149.0	152.0	163.5	162.0	159.5	157.5	156.5	156.5	155.5	156.0	155.5
1.2	0.0	153.0	151.0	150.0	149.5	149.5	154.0	162.0	161.5	159.0	158.5	158.5	156.0	154.5	155.0	155.0	154.5
1.3	0.0	156.0	152.0	152.0	151.0	149.0	158.5	161.0	160.5	159.0	157.0	156.0	155.5	154.0	154.5	154.5	154.5
1.4	153.5	154.0	154.0	154.0	151.5	152.0	159.5	161.0	158.0	157.0	156.0	156.0	154.5	152.5	153.0	153.5	154.0
1.5	0.0	153.5	155.0	156.0	151.0	155.5	158.5	158.0	157.0	156.5	156.0	155.5	153.0	152.0	152.5	153.0	157.5
1.6	0.0	0.0	159.0	150.5	154.0	156.5	157.5	157.5	156.0	155.0	155.0	153.5	153.0	152.5	153.0	155.0	0.0
1.7	0.0	0.0	0.0	157.5	154.5	155.5	156.5	156.0	155.0	154.5	154.0	154.5	153.0	152.5	156.5	0.0	0.0
1.8	0.0	0.0	0.0	0.0	156.5	156.0	157.0	155.5	155.0	153.0	154.0	154.5	153.5	156.0	166.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	171.0	158.5	158.0	155.5	154.5	153.5	154.5	154.5	156.0	165.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	166.5	158.5	155.5	154.5	154.0	154.5	155.5	166.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	174.0	161.0	156.0	155.0	154.5	155.0	159.0	166.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	169.0	162.0	156.5	155.5	155.5	156.0	159.5	162.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	166.0	162.5	157.0	156.0	156.0	157.0	158.5	159.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	165.5	164.5	161.0	157.5	155.5	156.0	157.0	159.0	158.5	159.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	163.0	162.0	162.5	161.0	159.0	156.0	156.0	156.5	158.5	157.5	158.5	156.0	0.0	0.0
2.6	0.0	0.0	161.0	161.5	161.5	161.0	160.0	157.0	154.5	154.5	156.0	157.0	157.0	157.0	156.5	0.0	0.0
2.7	0.0	0.0	159.0	160.0	160.0	160.0	158.0	156.0	154.0	154.5	155.0	156.5	157.0	156.5	157.0	159.0	0.0
2.8	0.0	158.5	158.5	160.5	160.0	159.5	156.5	154.5	153.0	154.0	155.0	156.5	156.5	156.5	158.0	154.0	153.5
2.9	159.0	157.5	158.0	159.0	158.0	158.0	156.0	154.5	153.0	154.0	156.0	157.0	155.5	156.0	156.5	155.0	155.5
3.0	161.5	158.5	158.5	158.5	157.5	157.5	157.0	155.5	153.0	153.5	156.5	157.5	155.5	156.0	155.5	154.5	156.0
3.1	0.0	160.0	157.5	159.0	157.5	156.5	156.0	155.5	155.0	154.5	157.0	158.0	157.0	156.0	156.0	154.5	157.5
3.2	0.0	0.0	160.0	159.0	158.5	157.5	157.0	157.5	156.5	156.0	158.0	159.0	157.0	155.0	155.0	156.5	0.0
3.3	0.0	0.0	0.0	162.5	159.0	159.0	158.5	158.5	158.0	158.5	159.0	161.0	159.0	156.0	156.0	0.0	0.0
3.4	0.0	0.0	0.0	170.5	162.5	158.5	159.0	159.0	158.5	158.5	161.0	163.0	159.0	157.0	163.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	168.5	162.0	161.0	160.5	159.5	160.0	160.5	165.0	160.5	162.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	167.0	162.0	161.0	160.5	161.0	162.5	167.0	163.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	171.0	164.5	161.5	161.5	161.0	162.5	168.5	168.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	167.0	164.0	161.0	161.0	161.0	162.5	167.0	166.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	158.5	164.0	161.0	161.0	160.5	161.5	163.0	166.5	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	159.5	157.5	161.5	161.5	161.5	162.0	162.5	163.5	165.5	164.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	153.0	155.0	156.0	156.5	158.0	161.5	161.5	161.5	162.0	163.5	164.0	0.0	0.0	0.0
4.2	0.0	0.0	158.0	153.0	155.5	155.0	156.0	157.5	158.5	160.0	161.5	162.5	163.5	164.0	164.0	0.0	0.0
4.3	0.0	156.5	157.5	153.0	153.5	154.0	155.0	156.0	157.5	158.5	161.0	162.0	162.5	163.5	164.5	161.5	0.0
4.4	0.0	156.5	154.0	153.5	154.5	154.0	155.0	155.5	156.5	157.5	158.5	161.0	163.0	165.0	165.5	165.0	159.0
4.5	157.5	158.5	155.0	153.5	153.5	154.0	154.5	155.0	156.0	156.5	158.0	159.5	161.0	164.0	165.5	166.0	164.5
4.6	0.0	159.5	156.0	154.5	154.5	154.0	154.0	154.5	156.0	156.5	158.0	159.0	159.5	161.5	165.5	169.5	170.0
4.7	0.0	161.5	156.5	155.0	154.5	154.0	153.5	153.5	154.5	155.5	156.5	159.5	160.0	162.5	166.5	170.5	172.5
4.8	0.0	185.0	162.5	156.5	156.0	155.0	154.5	154.0	155.0	156.0	158.0	159.5	161.0	162.0	167.5	182.5	0.0
4.9	0.0	0.0	161.0	160.0	159.0	157.5	155.0	155.0	154.0	154.5	155.5	157.5	159.5	170.5	188.5	202.0	0.0
5.0	0.0	0.0	0.0	160.5	161.5	158.0	157.5	155.5	155.0	154.0	154.5	157.5	170.5	189.0	199.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	165.0	160.5	158.5	157.5	158.0	159.5	166.0	175.0	186.0	194.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	165.5	157.5	156.0	163.5	165.0	169.0	173.5	185.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	172.0	160.5	163.5	163.0	165.5	167.5	170.0	177.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	172.0	165.0	163.0	165.5	165.5	163.0	164.0	170.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	170.5	165.0	163.5	164.5	163.5	161.0	161.5	163.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	172.5	167.0	163.0	163.5	161.5	161.0	160.0	160.5	161.0	158.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	172.0	168.5	164.5	161.5	161.5	161.0	160.5	159.0	159.0	159.5	157.5	157.0	0.0	0.0
5.8	0.0	0.0	171.0	169.5	167.0	163.0	162.5	161.5	161.0	159.0	158.5	158.0	158.5	156.5	155.0	159.0	0.0
5.9	0.0	173.0	171.5	167.5	164.5	163.5	163.5	162.0	160.5	158.5	158.0	157.0	156.5	155.5	155.5	156.5	162.5
6.0	0.0	173.5	170.5	166.5	164.5	164.5	164.0	160.5	159.0	158.5	158.0	157.5	156.0	154.5	157.0	156.5	163.5
6.1	177.0	173.5	169.5	169.0	168.5	166.0	161.5	159.0	158.5	158.5	159.0	156.0	155.5	156.5	158.5	156.5	164.5
6.2	186.5	174.5	171.5	167.5	167.5	161.5	160.0	159.5	159.0	158.5	158.0	157.0	156.0	157.0	158.0	157.0	162.0
6.3	0.0	186.5	169.5	164.0	163.0	161.0	159.5	158.5	158.5	158.0	156.0	154.0	155.0	157.0	158.5	159.0	165.0
6.4	0.0	0.0	187.0	169.0	161.0	160.0	160.0	159.5	159.5	157.5	153.5	153.5	154.5	156.0	158.5	164.0	0.0
6.5	0.0	0.0	198.0	180.0	163.5	162.5	161.5	160.5	159.0	153.5	153.5	154.0	155.0	159.5	174.5	0.0	0.0
6.6	0.0	0.0	0.0	197.5	186.0	166.0	162.5	161.0	157.5	156.0	156.0	158.5	162.5	161.0	163.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	196.0	178.5	164.0	162.0	159.5	156.5	161.0	165.0	159.0	161.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	192.0	176.0	162.0	160.0	159.5	163.5	167.0	171.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	191.5	178.5	167.5	161.0	159.5	165.5	171.0	185.5	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 1.52 l/s S = 0.0054 beta = 12.20 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	162.0	156.5	155.0	155.5	157.0	158.5	171.0	178.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	160.5	158.0	156.0	155.5	156.0	163.5	169.5	172.5	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	157.5	158.5	155.5	156.0	158.0	163.0	165.5	166.5	166.5	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	154.0	156.5	157.0	155.5	155.5	159.0	162.5	163.5	162.0	163.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	149.5	153.5	156.0	156.5	155.5	155.5	158.5	162.0	162.5	160.0	161.0	162.5	0.0	0.0
1.0	0.0	0.0	148.5	148.5	153.5	154.5	155.5	156.0	156.5	159.5	161.5	162.0	161.0	159.0	160.0	159.0	0.0
1.1	0.0	152.0	147.0	152.0	151.0	154.0	153.5	156.0	156.5	159.0	162.0	162.5	160.5	159.5	159.5	159.0	158.5
1.2	0.0	149.5	147.5	149.0	152.5	152.5	156.0	156.5	157.5	160.5	162.0	161.5	160.5	159.0	159.0	159.0	159.0
1.3	149.5	149.5	148.5	148.0	151.5	150.5	156.0	157.0	158.0	160.0	161.5	161.0	160.5	159.0	158.5	158.5	159.0
1.4	150.5	154.0	155.0	149.0	147.0	149.0	154.5	158.0	159.0	161.5	160.5	160.5	160.0	159.0	158.0	158.0	158.5
1.5	0.0	154.0	150.5	147.0	146.0	147.5	152.5	160.0	160.5	161.5	161.5	160.0	160.0	158.5	157.5	158.0	164.0
1.6	0.0	0.0	155.0	148.5	146.5	147.5	155.5	159.5	161.5	161.5	160.5	160.5	160.0	158.5	156.5	163.0	0.0
1.7	0.0	0.0	0.0	152.5	148.0	148.5	154.0	160.5	162.0	161.5	161.0	161.0	160.0	159.0	164.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	151.0	149.0	155.0	160.5	162.5	161.0	161.0	160.5	161.5	164.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	0.0	153.0	157.5	161.5	162.5	161.0	162.0	163.0	165.5	170.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	157.0	158.5	162.0	162.0	162.0	163.5	164.5	169.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	159.5	161.0	162.0	163.0	163.5	165.5	166.5	167.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	159.5	161.5	163.0	163.5	164.5	165.0	164.0	165.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	159.0	162.0	162.5	163.5	165.0	163.5	162.0	160.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	157.0	159.5	162.0	162.5	163.5	163.5	162.5	160.5	160.0	159.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	156.5	156.5	160.0	162.0	161.5	161.5	162.5	162.5	159.5	158.0	157.5	0.0	0.0	0.0
2.6	0.0	0.0	0.0	155.0	156.5	159.5	161.0	161.0	160.5	159.5	157.5	157.0	156.0	155.0	154.0	0.0	0.0
2.7	0.0	0.0	152.5	153.5	157.0	159.5	160.5	160.0	159.0	158.0	158.0	156.0	154.5	154.0	153.0	151.5	0.0
2.8	0.0	155.0	152.0	153.5	157.5	159.0	160.0	159.5	159.0	157.5	155.5	155.0	154.0	152.5	152.5	152.5	153.0
2.9	164.0	152.0	151.0	154.5	157.5	159.0	160.0	159.0	156.5	156.5	155.0	154.0	152.5	152.0	152.5	154.0	153.0
3.0	167.5	153.5	152.0	155.5	157.0	159.5	161.0	156.5	156.0	157.0	155.5	155.0	153.0	152.5	153.5	153.0	152.5
3.1	0.0	160.0	153.5	156.0	156.5	157.0	156.5	156.5	156.0	156.5	155.5	154.0	152.5	152.0	152.5	153.5	155.0
3.2	0.0	0.0	166.5	155.5	157.5	157.5	156.0	155.5	156.0	156.5	155.5	155.0	154.0	153.5	152.5	151.5	0.0
3.3	0.0	0.0	0.0	163.0	157.0	156.5	157.0	157.5	156.5	156.5	156.5	155.0	154.0	153.5	153.0	0.0	0.0
3.4	0.0	0.0	0.0	173.5	164.5	158.5	157.0	157.5	156.0	156.5	157.5	156.5	156.5	154.5	162.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	175.0	161.0	158.0	158.0	161.0	157.0	158.5	158.0	157.0	162.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	172.5	162.5	159.0	159.0	158.0	159.0	160.5	163.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	179.5	168.5	161.5	161.0	159.0	160.0	161.5	167.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	173.0	169.5	163.5	160.0	159.0	160.0	162.0	162.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	165.5	164.5	164.0	160.5	158.5	159.0	158.5	158.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	161.5	161.5	164.0	162.0	159.0	158.5	158.5	158.0	157.5	155.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	160.5	159.5	160.5	160.5	160.5	159.5	158.0	157.5	156.5	156.0	155.0	150.5	0.0	0.0
4.2	0.0	0.0	157.5	158.5	158.0	160.0	160.0	160.0	157.5	157.5	156.5	156.0	155.0	152.5	149.0	0.0	0.0
4.3	0.0	155.5	157.5	157.0	157.5	160.0	160.5	159.5	158.0	157.5	156.5	156.0	154.0	152.0	147.5	147.5	0.0
4.4	0.0	155.5	156.0	156.5	157.5	158.5	159.5	159.0	158.5	157.0	156.0	156.0	153.5	152.0	148.5	149.5	150.0
4.5	155.0	156.0	156.0	156.0	157.0	158.5	159.0	158.5	158.5	158.0	156.5	156.5	154.0	152.0	150.0	148.0	150.5
4.6	0.0	156.5	156.5	156.0	157.0	158.0	158.5	158.0	158.0	157.0	157.5	156.5	153.5	150.5	150.0	149.5	153.5
4.7	0.0	155.5	154.5	155.0	156.0	158.5	159.0	158.5	158.0	157.5	158.0	157.5	154.0	150.5	150.5	150.0	157.0
4.8	0.0	0.0	156.0	155.5	155.5	157.5	159.5	159.5	158.5	158.0	159.5	158.0	155.0	151.0	152.5	154.5	0.0
4.9	0.0	0.0	165.5	156.5	155.5	157.0	159.5	160.0	159.5	160.0	160.0	159.0	156.5	152.0	154.5	0.0	0.0
5.0	0.0	0.0	0.0	164.5	157.5	156.5	158.5	159.5	160.5	160.5	161.0	160.5	158.0	154.0	164.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	164.0	158.5	157.5	159.0	159.5	160.5	161.0	162.5	159.5	163.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	163.0	160.0	158.5	160.0	161.0	163.5	164.5	163.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	161.5	162.5	160.0	159.5	162.0	164.5	165.0	166.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	158.5	162.0	161.5	160.0	161.0	164.0	165.0	165.5	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	156.0	160.0	161.5	161.5	162.0	163.5	165.0	163.0	161.5	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	152.5	155.5	158.0	160.5	159.0	160.5	161.5	162.5	162.5	160.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	151.0	151.0	153.0	155.5	159.0	160.5	160.5	161.0	161.0	161.5	160.5	158.0	0.0	0.0
5.8	0.0	0.0	153.0	151.0	150.5	152.0	155.0	159.0	160.0	160.5	161.0	160.5	160.5	160.5	157.5	155.0	0.0
5.9	0.0	151.0	153.5	150.0	150.5	151.0	152.0	156.0	160.5	160.5	161.0	160.5	160.0	160.5	159.0	155.0	156.0
6.0	0.0	150.5	154.5	150.5	150.5	150.5	151.5	153.5	159.5	161.5	161.5	162.0	161.0	161.5	161.5	156.5	154.0
6.1	0.0	151.0	155.5	151.0	151.0	151.5	152.5	153.0	155.0	161.5	161.5	161.5	165.5	161.0	161.5	158.0	154.0
6.2	157.5	151.0	155.0	150.5	150.5	151.0	152.5	153.0	154.5	155.5	158.5	161.5	161.5	162.0	161.5	160.0	155.5
6.3	0.0	153.5	154.0	150.0	150.0	150.0	151.0	152.5	153.0	155.0	157.5	160.5	161.5	160.5	160.0	160.0	160.5
6.4	0.0	0.0	153.0	153.0	150.0	150.0	151.0	152.0	153.0	154.0	156.5	159.5	162.0	163.5	161.5	163.0	0.0
6.5	0.0	0.0	0.0	155.5	150.0	149.5	150.0	151.5	153.0	154.0	157.0	160.0	163.0	164.0	166.0	0.0	0.0
6.6	0.0	0.0	0.0	159.0	155.0	150.5	150.0	151.0	153.0	155.0	157.5	161.0	165.0	172.5	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	161.0	154.5	151.0	150.5	153.5	155.0	157.5	162.0	174.5	188.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	166.0	158.5	152.5	153.5	155.5	161.0	173.5	187.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	160.5	161.0	157.0	154.0	158.0	168.5	176.5	184.5	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 2.02 l/s   S = 0.0054   beta = 10.84   epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	172.5	164.5	161.5	160.5	161.5	165.0	172.5	180.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	170.5	166.0	163.0	162.5	163.5	168.0	172.0	176.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	165.5	164.0	167.0	163.0	165.0	167.0	167.0	167.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	164.0	164.0	162.5	165.0	163.5	167.0	165.0	164.5	164.0	164.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	160.5	162.0	162.0	163.0	162.0	162.0	164.5	165.5	163.0	162.5	162.5	163.5	0.0	0.0
1.0	0.0	0.0	158.5	160.5	161.0	161.5	162.5	166.5	162.0	163.5	163.5	163.5	162.5	162.5	160.5	159.0	0.0
1.1	0.0	157.5	158.0	159.0	159.5	160.5	162.0	162.5	163.5	164.0	165.5	163.5	161.5	159.5	159.0	159.5	158.0
1.2	0.0	158.0	157.5	159.0	159.5	161.5	163.0	163.0	163.0	162.0	163.5	162.5	160.5	160.0	159.0	158.0	159.5
1.3	158.5	157.0	157.5	157.5	159.5	160.5	163.5	163.5	163.5	163.0	164.0	162.5	161.0	159.0	158.0	158.0	160.0
1.4	159.5	156.5	156.5	157.5	159.5	160.0	161.5	161.5	161.5	161.0	163.5	162.0	160.0	159.0	158.0	159.0	160.0
1.5	0.0	157.5	155.5	156.5	159.0	161.0	161.0	161.5	161.0	160.5	164.0	161.5	159.0	159.0	158.5	159.0	165.0
1.6	0.0	0.0	156.0	156.5	159.0	160.5	161.5	162.5	161.5	164.0	165.5	162.0	160.5	159.0	159.0	162.0	0.0
1.7	0.0	0.0	0.0	156.5	158.0	160.0	162.0	162.5	161.5	162.0	162.5	162.0	160.5	159.0	165.0	0.0	0.0
1.8	0.0	0.0	0.0	0.0	159.5	160.0	162.0	163.0	163.5	165.5	164.5	163.0	161.5	165.5	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	166.5	162.5	163.0	164.0	164.0	165.5	166.5	163.0	168.0	171.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	167.5	165.0	164.5	165.0	167.5	170.5	168.0	173.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	170.0	168.5	167.0	166.5	169.5	170.0	170.5	173.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	168.0	168.5	167.5	168.0	170.5	170.0	170.0	169.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	0.0	166.0	167.0	169.5	168.5	170.5	171.0	169.0	166.0	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	163.5	165.0	167.0	167.0	169.0	171.5	168.0	166.0	164.0	164.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	162.0	162.5	165.0	165.0	171.5	168.0	168.5	171.5	165.5	163.5	163.0	0.0	0.0	0.0
2.6	0.0	0.0	159.0	160.5	162.0	165.0	165.5	165.0	165.5	166.0	166.5	163.5	162.5	161.5	160.5	0.0	0.0
2.7	0.0	155.5	160.0	160.0	161.5	163.0	166.0	165.5	166.5	168.5	166.0	162.5	162.0	161.0	160.5	158.0	0.0
2.8	0.0	157.5	159.0	159.5	160.5	163.0	164.0	163.5	165.5	167.0	164.0	161.5	159.0	158.0	156.0	156.5	156.0
2.9	157.5	156.0	155.5	158.5	161.0	162.5	164.0	164.0	163.0	166.0	164.0	161.5	159.5	156.0	155.0	155.0	155.5
3.0	158.5	155.5	156.0	159.0	162.0	163.0	163.5	165.0	166.0	165.5	162.0	160.0	158.5	157.0	156.0	155.5	156.0
3.1	0.0	157.0	157.5	160.0	162.0	162.5	163.0	163.5	164.5	165.0	161.5	160.0	157.0	156.0	156.0	155.0	158.5
3.2	0.0	0.0	157.5	161.0	162.5	163.5	166.0	163.5	162.5	163.0	161.5	159.5	158.0	156.5	156.5	157.5	0.0
3.3	0.0	0.0	0.0	164.0	164.5	164.0	165.0	164.0	163.5	162.5	161.5	160.5	158.5	157.5	157.5	0.0	0.0
3.4	0.0	0.0	0.0	169.0	166.0	167.5	168.5	163.5	162.0	163.5	162.0	161.0	160.0	161.0	169.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	174.5	170.0	167.0	163.0	163.5	163.5	162.5	161.5	162.5	169.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	178.5	170.0	166.0	167.0	165.0	163.5	165.0	169.5	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	187.0	173.0	166.5	167.0	164.5	166.0	167.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	181.0	172.5	166.5	168.5	164.5	166.5	165.5	0.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	172.5	170.0	169.0	165.0	163.5	164.5	164.0	160.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	168.0	168.5	169.5	154.0	168.5	166.0	161.0	161.0	158.5	157.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	164.0	166.5	168.0	169.5	170.0	165.0	162.0	160.0	159.5	158.0	156.0	0.0	0.0	0.0
4.2	0.0	0.0	163.0	163.0	164.5	166.0	167.5	166.0	163.5	160.0	159.5	159.0	157.0	156.5	155.0	0.0	0.0
4.3	0.0	0.0	157.5	162.5	163.0	165.0	167.5	166.5	163.5	163.0	160.5	158.5	156.0	155.5	154.0	154.5	0.0
4.4	0.0	159.5	161.0	163.5	164.5	165.0	166.0	161.5	162.0	162.5	160.0	157.5	156.0	155.0	154.5	154.0	154.5
4.5	158.0	159.5	162.0	165.0	164.5	164.0	161.5	160.5	162.0	161.0	159.0	157.5	156.0	155.0	154.0	154.0	156.0
4.6	158.5	160.0	162.5	165.0	166.0	164.0	163.5	162.0	160.0	159.0	158.5	158.0	156.0	155.0	155.0	154.0	157.0
4.7	0.0	160.0	163.5	166.5	166.0	163.5	161.5	161.5	159.5	160.5	159.0	158.0	156.5	155.0	155.5	155.0	160.0
4.8	0.0	162.5	165.0	167.0	168.0	163.5	160.5	162.0	163.0	160.5	160.5	158.5	157.0	156.0	156.5	158.5	0.0
4.9	0.0	0.0	167.0	169.5	170.5	162.0	161.0	163.0	162.0	161.0	160.5	159.0	157.0	156.5	159.0	0.0	0.0
5.0	0.0	0.0	0.0	172.5	177.0	165.0	161.5	160.5	162.0	162.5	160.5	159.5	157.5	159.5	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	183.0	173.5	162.5	162.0	162.5	162.0	161.0	159.5	161.5	165.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	186.0	168.5	165.5	160.0	163.0	161.0	161.5	166.5	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	191.0	178.0	164.5	161.0	161.0	162.0	164.5	167.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	186.0	177.0	170.0	162.0	161.5	163.5	164.0	164.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	174.0	173.5	169.5	163.0	163.0	164.0	162.0	160.0	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	172.0	168.5	171.0	167.0	164.0	161.0	161.0	159.5	158.5	158.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	168.5	168.5	167.0	170.0	168.0	164.0	160.5	161.0	159.0	158.5	157.5	156.0	0.0	0.0
5.8	0.0	0.0	164.5	166.0	165.5	165.0	167.0	164.0	161.5	159.0	158.0	158.5	158.5	157.0	156.0	157.0	0.0
5.9	0.0	159.0	163.0	164.5	165.0	166.0	165.0	163.0	161.5	159.5	159.5	161.0	156.5	156.5	156.0	155.5	160.0
6.0	0.0	159.0	163.0	164.0	165.0	166.0	165.0	162.5	159.5	158.5	158.0	161.0	157.5	157.5	156.5	156.0	158.0
6.1	156.5	159.0	162.5	164.0	166.5	166.0	164.0	159.5	160.0	161.0	157.5	159.5	161.0	158.0	156.0	156.0	158.5
6.2	158.5	159.0	161.5	164.0	166.0	165.5	160.0	158.5	159.5	159.5	159.0	158.5	159.5	159.0	156.5	156.0	158.0
6.3	0.0	158.5	160.0	164.0	166.5	165.5	159.5	159.0	162.5	158.5	158.0	157.0	158.5	156.0	157.0	155.5	161.0
6.4	0.0	0.0	160.5	165.0	166.5	165.0	159.5	158.5	159.0	156.5	157.5	157.5	157.0	160.0	156.5	159.0	0.0
6.5	0.0	0.0	162.0	166.0	169.0	166.0	158.0	158.5	158.0	157.5	157.5	158.0	157.5	158.5	160.5	0.0	0.0
6.6	0.0	0.0	0.0	168.5	173.0	167.5	160.0	158.0	159.0	158.0	158.0	159.0	159.5	162.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	178.5	173.5	161.0	159.5	160.0	160.0	159.5	160.5	164.0	169.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	180.5	167.5	159.5	160.0	159.5	161.5	164.5	169.0	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	187.0	173.0	161.5	160.0	161.5	163.5	167.0	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 2.53 l/s S = 0.0054 beta = 8.79 epsilon = 0.375

x (m)	y (m) 0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	-0.03	-0.06	-0.09	-0.12	-0.15	-0.18	-0.21	-0.24
0.5	0.0	0.0	0.0	0.0	0.0	179.5	171.0	165.5	165.5	163.5	167.0	174.5	183.5	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	174.5	172.0	170.0	164.0	165.0	168.0	174.0	178.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	169.5	170.0	169.5	166.5	164.5	169.0	166.0	167.5	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	168.5	163.5	170.5	170.0	166.5	165.0	165.0	164.5	163.0	166.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	163.5	162.5	162.5	165.5	164.0	168.5	167.5	167.0	163.5	162.5	161.5	162.0	0.0	0.0
1.0	0.0	0.0	160.5	160.0	161.0	163.5	164.5	166.5	166.5	166.5	164.5	163.5	161.5	160.5	160.0	158.5	0.0
1.1	0.0	159.5	159.0	160.5	161.5	163.0	163.0	166.5	166.5	166.0	165.0	162.5	162.0	159.5	160.0	158.5	0.0
1.2	0.0	159.0	158.0	159.5	159.5	161.5	164.0	165.0	166.0	165.5	163.5	163.0	161.5	159.0	158.5	158.0	157.5
1.3	159.0	157.0	157.5	157.5	159.0	161.0	165.5	164.5	164.0	166.0	165.5	163.5	161.0	159.0	157.5	158.0	157.5
1.4	160.0	158.0	158.0	156.5	158.0	161.0	162.5	163.0	166.0	165.0	164.5	162.0	161.0	158.5	157.0	157.0	158.0
1.5	0.0	157.0	156.5	156.0	158.5	161.5	163.5	165.0	164.5	163.5	163.5	161.0	159.5	158.0	157.0	158.0	165.0
1.6	0.0	0.0	157.0	156.0	159.0	161.5	161.5	164.0	165.5	164.0	163.5	162.0	159.5	158.5	158.0	162.0	0.0
1.7	0.0	0.0	0.0	159.0	160.0	161.5	163.0	164.0	162.5	162.5	163.0	162.5	161.5	157.5	163.5	0.0	0.0
1.8	0.0	0.0	0.0	169.5	162.0	161.5	163.5	163.0	164.5	166.0	164.0	162.0	162.0	169.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	173.0	164.5	163.5	165.0	166.5	165.0	164.5	165.5	168.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	174.5	167.0	167.0	164.0	167.0	167.5	170.5	172.5	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	178.5	171.0	167.5	169.5	169.5	167.0	170.0	0.0	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	177.5	170.0	169.5	169.0	168.0	170.5	169.5	170.0	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	169.5	171.5	169.5	169.0	173.5	173.5	168.5	167.0	165.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	165.5	167.0	167.0	169.0	169.5	169.5	167.0	167.0	164.0	163.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	165.5	165.5	166.5	167.5	170.0	167.5	168.5	166.0	165.0	162.0	160.5	0.0	0.0	0.0
2.6	0.0	0.0	160.5	162.0	163.0	164.5	164.0	166.0	166.0	171.0	163.5	163.0	161.0	159.0	157.0	0.0	0.0
2.7	0.0	0.0	160.0	161.0	162.0	164.0	164.5	166.5	169.5	165.0	163.0	161.0	158.5	158.0	156.0	154.5	0.0
2.8	0.0	156.0	159.0	161.0	162.5	162.0	165.5	167.0	167.5	163.5	163.5	159.0	157.5	156.0	155.0	153.5	155.5
2.9	154.5	156.5	158.5	160.5	162.0	161.0	164.0	163.5	165.0	164.0	161.0	160.0	157.5	156.5	155.0	154.0	155.0
3.0	156.0	155.5	158.0	162.0	160.5	161.5	162.0	164.5	163.0	160.0	160.5	159.0	158.0	157.0	154.5	153.5	155.0
3.1	0.0	157.0	158.0	161.5	161.0	162.0	162.0	162.0	164.0	162.5	160.0	158.0	156.5	155.0	155.0	154.5	157.0
3.2	0.0	161.0	158.5	162.5	164.0	162.5	161.5	162.0	163.0	162.0	159.0	158.0	156.5	154.5	154.0	155.0	0.0
3.3	0.0	0.0	164.5	164.5	165.5	165.5	163.0	164.0	161.5	160.5	160.0	159.5	157.5	155.5	157.5	168.5	0.0
3.4	0.0	0.0	0.0	167.5	169.5	167.5	165.0	163.0	164.5	164.0	160.5	159.0	158.5	160.0	168.0	0.0	0.0
3.5	0.0	0.0	0.0	0.0	174.0	170.0	166.0	166.5	165.0	161.0	161.0	160.5	162.5	170.5	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	184.5	182.0	163.5	164.0	162.5	162.5	166.0	169.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	193.0	178.5	164.5	165.5	164.0	165.5	168.5	169.5	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	185.0	176.5	167.0	164.5	167.0	166.5	164.5	165.0	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	175.0	171.0	169.0	168.0	165.5	165.5	161.5	165.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	170.5	166.0	167.0	167.5	165.0	165.5	162.5	158.5	159.0	157.5	0.0	0.0	0.0
4.1	0.0	0.0	0.0	166.0	164.5	165.5	165.5	164.5	161.5	162.0	157.5	157.5	156.5	156.5	0.0	0.0	0.0
4.2	0.0	0.0	164.0	163.5	161.5	162.0	166.0	166.0	162.0	158.5	157.0	156.0	156.0	155.0	153.5	0.0	0.0
4.3	0.0	157.0	162.0	162.5	161.5	163.0	163.5	163.5	162.0	159.5	158.5	155.5	155.5	154.0	152.5	152.5	0.0
4.4	0.0	156.0	161.0	161.5	161.0	162.0	163.0	160.5	161.5	160.0	156.5	155.0	153.0	153.5	153.0	153.0	153.0
4.5	153.5	155.5	160.0	161.0	161.5	162.0	162.0	161.5	159.0	158.5	156.0	153.5	153.5	152.0	153.5	153.0	153.0
4.6	155.5	155.5	159.5	161.0	163.0	163.5	162.5	163.5	161.0	159.0	156.5	154.5	153.5	152.0	152.0	151.5	153.5
4.7	0.0	155.0	159.5	164.0	163.5	164.5	160.5	158.0	161.0	157.5	156.0	154.5	153.5	153.0	153.0	153.0	158.0
4.8	0.0	0.0	161.0	163.5	165.0	165.0	162.0	161.5	160.0	157.0	155.5	155.0	152.0	152.5	153.0	157.0	0.0
4.9	0.0	0.0	163.5	165.5	166.0	165.0	164.0	163.5	162.0	158.0	155.0	155.5	154.0	154.0	160.0	0.0	0.0
5.0	0.0	0.0	0.0	169.5	168.0	167.0	165.5	164.0	160.0	157.5	154.0	155.5	154.0	156.5	0.0	0.0	0.0
5.1	0.0	0.0	0.0	0.0	176.5	171.5	168.5	165.5	159.0	157.5	156.5	155.5	159.5	169.0	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	177.0	171.0	164.5	158.5	158.0	158.0	158.5	164.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	187.0	175.0	169.0	163.0	159.0	160.5	162.5	163.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	178.0	172.5	171.5	164.5	160.0	160.5	161.5	158.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	178.0	173.0	169.5	171.0	169.5	162.5	161.5	159.5	157.5	0.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	169.5	167.0	165.0	168.0	170.0	164.5	158.5	158.0	157.0	156.5	0.0	0.0	0.0
5.7	0.0	0.0	0.0	164.0	163.5	161.0	162.5	167.0	166.5	167.0	160.0	157.0	155.5	155.5	154.0	0.0	0.0
5.8	0.0	0.0	158.5	160.5	159.0	157.5	160.5	164.5	164.5	164.5	163.0	160.5	156.0	156.0	154.0	152.0	0.0
5.9	0.0	157.0	160.0	160.0	159.5	158.5	160.0	166.0	163.5	162.5	159.5	157.0	154.5	153.5	153.0	153.0	0.0
6.0	0.0	158.0	159.0	159.5	158.0	158.5	161.0	165.5	164.0	161.0	159.0	157.0	155.5	154.0	153.0	152.5	154.0
6.1	153.0	157.5	159.5	159.5	159.5	160.0	161.0	161.5	161.5	161.5	160.5	155.5	153.5	153.5	153.0	153.0	154.0
6.2	154.5	156.5	159.0	159.0	158.0	158.5	161.0	164.0	160.5	158.5	157.0	154.0	154.5	152.0	151.0	150.5	154.5
6.3	0.0	156.5	158.0	160.0	159.5	160.5	161.0	162.5	160.0	159.5	155.5	154.0	153.5	151.5	151.0	151.5	156.0
6.4	0.0	159.0	158.5	159.0	160.0	159.5	161.5	161.0	159.0	159.0	154.0	154.0	152.5	153.5	150.5	154.0	0.0
6.5	0.0	0.0	160.5	161.0	162.0	161.5	162.0	162.0	159.5	159.5	155.0	152.0	151.5	152.0	153.5	0.0	0.0
6.6	0.0	0.0	0.0	164.0	164.0	163.0	163.0	163.5	162.0	157.0	153.5	152.0	153.0	155.5	165.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	172.5	167.0	165.0	164.0	163.0	158.5	154.5	154.0	158.5	164.0	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	172.0	166.0	166.5	164.0	159.5	155.0	158.5	162.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	181.0	180.5	172.0	167.0	164.5	162.5	164.0	0.0	0.0	0.0	0.0	0.0

Sediment Bed Elevation Measurements (mm)

Q = 3.29 l/s S = 0.0054 beta = 7.93 epsilon = 0.375

x (m)	y (m)																
	0.24	0.21	0.18	0.15	0.12	0.09	0.06	0.03	0.00	−0.03	−0.06	−0.09	−0.12	−0.15	−0.18	−0.21	−0.24
0.5	0.0	0.0	0.0	0.0	0.0	179.5	172.5	164.0	161.5	164.5	172.5	174.0	180.0	0.0	0.0	0.0	0.0
0.6	0.0	0.0	0.0	0.0	0.0	175.5	177.0	171.5	163.5	169.0	177.5	174.0	175.0	0.0	0.0	0.0	0.0
0.7	0.0	0.0	0.0	0.0	0.0	167.0	174.5	172.0	169.5	171.5	171.0	168.5	167.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.0	162.0	166.0	170.5	174.0	169.0	168.0	170.5	164.0	164.5	163.5	0.0	0.0	0.0
0.9	0.0	0.0	0.0	160.5	161.5	160.0	169.0	174.5	173.0	170.0	168.5	162.0	160.5	161.0	161.5	0.0	0.0
1.0	0.0	0.0	157.5	158.0	160.0	160.5	166.0	171.5	171.0	169.0	166.5	161.5	161.5	161.5	163.5	0.0	0.0
1.1	0.0	153.5	154.5	157.5	159.0	161.0	167.5	168.5	170.5	166.5	162.5	162.0	159.0	159.5	161.5	159.0	0.0
1.2	0.0	153.5	155.0	155.5	159.5	162.0	165.0	167.0	168.0	170.0	165.5	163.5	159.5	159.5	159.5	161.0	158.0
1.3	0.0	154.5	154.0	155.0	157.0	160.5	164.0	163.0	163.5	166.0	163.5	160.0	160.5	159.0	158.5	158.5	158.5
1.4	157.0	154.0	155.5	155.0	157.0	159.5	160.0	163.0	161.5	163.5	165.0	162.5	158.5	157.0	158.0	156.0	158.0
1.5	0.0	154.0	154.5	156.0	156.5	160.0	160.0	160.5	163.5	161.0	163.0	161.5	160.5	156.5	156.5	156.0	163.5
1.6	0.0	0.0	156.0	156.0	157.5	160.0	161.5	162.0	161.5	163.5	162.0	161.0	159.0	155.5	156.0	162.5	0.0
1.7	0.0	0.0	0.0	157.5	159.0	161.0	162.5	164.0	168.5	166.5	161.0	161.0	158.5	157.5	163.5	0.0	0.0
1.8	0.0	0.0	0.0	171.0	168.0	162.5	161.5	164.5	165.5	162.5	162.5	162.0	163.0	167.0	0.0	0.0	0.0
1.9	0.0	0.0	0.0	0.0	176.0	165.5	163.0	164.5	168.0	167.0	164.5	165.0	171.0	175.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	179.0	168.0	167.5	166.0	167.0	169.5	175.5	179.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.0	0.0	173.5	175.5	168.0	172.0	167.5	175.5	174.5	177.5	0.0	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	171.5	176.0	177.0	171.0	171.5	173.0	174.5	170.5	0.0	0.0	0.0	0.0
2.3	0.0	0.0	0.0	0.0	167.5	166.5	171.0	177.5	178.0	176.0	171.5	167.5	166.5	0.0	0.0	0.0	0.0
2.4	0.0	0.0	0.0	0.0	165.5	164.0	170.0	176.5	172.0	174.5	172.0	166.5	164.5	162.5	0.0	0.0	0.0
2.5	0.0	0.0	0.0	161.5	163.0	163.5	167.5	171.5	173.0	175.5	169.5	165.0	163.0	160.5	0.0	0.0	0.0
2.6	0.0	0.0	157.5	159.5	160.5	162.0	167.5	168.5	174.5	171.0	164.5	161.5	161.5	159.5	157.5	0.0	0.0
2.7	0.0	157.5	156.5	157.0	157.0	161.0	163.5	165.0	167.5	169.5	165.0	161.5	162.5	161.5	156.5	154.5	0.0
2.8	0.0	153.5	155.0	157.5	158.0	159.0	160.0	161.5	165.5	165.5	161.5	167.5	162.5	158.0	159.0	159.0	153.5
2.9	156.0	154.5	154.5	157.5	159.0	160.0	162.5	162.0	161.5	163.5	164.0	162.0	160.0	157.5	160.0	157.5	156.0
3.0	157.0	153.5	154.0	156.5	159.0	160.0	163.5	166.5	166.0	164.0	161.0	161.0	158.0	156.0	152.5	154.0	154.0
3.1	0.0	153.5	155.0	156.0	158.5	161.5	163.0	162.5	161.5	163.0	160.5	159.0	156.0	155.0	154.0	154.0	158.0
3.2	0.0	168.0	157.0	157.0	158.5	160.5	163.0	162.0	161.5	161.0	161.0	160.5	157.5	155.5	156.0	159.5	0.0
3.3	0.0	0.0	0.0	164.0	161.0	161.5	162.5	166.5	163.5	162.0	161.0	160.0	159.0	157.0	161.0	0.0	0.0
3.4	0.0	0.0	0.0	178.0	168.5	163.0	161.5	166.5	164.5	162.5	163.5	160.0	160.0	166.0	174.5	0.0	0.0
3.5	0.0	0.0	0.0	0.0	182.0	169.5	162.5	165.0	166.0	161.0	161.5	162.0	170.0	177.0	0.0	0.0	0.0
3.6	0.0	0.0	0.0	0.0	0.0	178.0	170.5	163.0	170.0	166.5	165.0	171.0	180.0	0.0	0.0	0.0	0.0
3.7	0.0	0.0	0.0	0.0	0.0	185.5	171.5	165.0	164.5	169.0	172.0	175.5	0.0	0.0	0.0	0.0	0.0
3.8	0.0	0.0	0.0	0.0	0.0	182.5	175.5	172.0	171.0	170.0	175.0	169.0	166.5	0.0	0.0	0.0	0.0
3.9	0.0	0.0	0.0	0.0	0.0	171.0	171.5	176.0	175.5	171.0	169.0	164.5	162.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	165.0	165.0	170.0	177.0	173.0	169.0	167.0	162.5	162.0	162.0	0.0	0.0	0.0
4.1	0.0	0.0	0.0	161.5	163.0	164.0	165.0	169.0	173.0	171.5	163.0	159.5	158.0	159.5	0.0	0.0	0.0
4.2	0.0	0.0	159.5	159.0	161.0	164.0	168.5	166.5	169.5	166.5	165.0	160.5	156.5	156.5	156.0	0.0	0.0
4.3	0.0	155.5	158.0	158.0	159.0	160.0	162.5	168.0	169.0	165.5	163.5	159.5	156.5	155.0	154.0	152.0	0.0
4.4	0.0	157.0	155.5	160.0	158.5	159.5	163.0	163.5	167.0	168.0	162.5	158.5	156.5	155.0	156.0	153.0	151.0
4.5	156.5	156.5	157.0	158.0	159.5	161.5	161.5	161.5	163.0	160.0	157.5	156.0	157.0	153.0	155.0	153.5	151.5
4.6	159.0	157.0	156.5	160.0	158.5	159.0	161.5	162.5	160.5	163.0	160.5	158.0	157.0	155.5	155.5	154.5	152.5
4.7	0.0	153.5	152.5	153.5	160.0	160.5	151.0	160.0	159.5	162.0	159.0	158.5	157.0	156.5	155.5	154.0	155.0
4.8	0.0	163.5	154.0	156.0	157.5	161.0	162.5	162.0	161.5	161.0	160.5	160.0	158.0	158.0	158.5	158.5	0.0
4.9	0.0	0.0	163.5	156.5	155.5	160.5	159.5	160.0	160.5	162.5	163.5	160.0	160.5	160.0	164.0	172.0	0.0
5.0	0.0	0.0	0.0	164.5	159.0	158.0	159.5	160.5	164.5	162.5	162.0	164.5	165.5	170.5	182.5	0.0	0.0
5.1	0.0	0.0	0.0	0.0	173.0	162.0	159.0	158.5	161.5	161.0	167.5	167.0	174.0	186.5	0.0	0.0	0.0
5.2	0.0	0.0	0.0	0.0	0.0	171.5	164.0	159.5	162.0	162.5	161.5	176.5	191.0	0.0	0.0	0.0	0.0
5.3	0.0	0.0	0.0	0.0	0.0	168.5	163.5	160.0	168.0	173.0	184.0	184.0	192.5	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	0.0	165.5	165.0	167.5	166.0	169.5	173.0	187.0	186.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	162.5	163.0	166.0	163.5	170.5	176.5	178.5	178.0	171.0	0.0	0.0	0.0
5.6	0.0	0.0	0.0	0.0	158.5	160.0	160.0	163.5	165.0	166.5	172.0	174.0	171.5	168.0	0.0	0.0	0.0
5.7	0.0	0.0	0.0	159.0	157.5	157.5	158.5	158.5	164.0	166.5	168.5	169.0	170.5	164.0	163.5	0.0	0.0
5.8	0.0	0.0	154.0	158.0	157.5	157.5	157.0	159.0	161.0	163.5	164.5	166.5	168.0	165.0	161.0	156.5	0.0
5.9	0.0	154.0	156.5	157.5	156.0	157.0	159.0	163.0	162.0	163.0	165.5	163.0	168.0	164.0	159.0	158.0	0.0
6.0	0.0	154.5	154.5	155.0	156.5	157.0	158.5	163.0	163.5	162.5	163.0	164.0	163.0	159.0	155.5	155.0	154.0
6.1	154.0	156.5	157.0	158.5	156.5	159.0	161.0	160.5	159.5	159.5	162.0	162.5	160.0	158.5	157.5	155.5	155.5
6.2	156.0	156.5	157.0	156.5	157.0	157.5	160.0	161.0	164.0	161.0	160.0	161.0	156.5	156.0	156.0	155.0	155.5
6.3	0.0	155.5	154.0	155.0	153.0	156.5	159.5	161.5	161.5	158.5	159.0	156.5	157.0	157.0	156.0	156.0	158.0
6.4	0.0	160.0	155.0	153.5	154.5	156.0	158.0	160.0	159.0	162.0	160.0	158.0	159.5	158.5	158.5	161.5	0.0
6.5	0.0	0.0	162.5	154.5	153.5	156.5	156.5	158.0	160.0	156.5	159.5	160.0	160.0	159.5	167.5	0.0	0.0
6.6	0.0	0.0	0.0	162.5	157.0	156.0	161.5	158.0	159.5	162.0	160.5	159.5	161.0	174.0	0.0	0.0	0.0
6.7	0.0	0.0	0.0	0.0	167.5	158.0	157.0	160.0	161.0	162.5	162.0	163.0	178.5	192.5	0.0	0.0	0.0
6.8	0.0	0.0	0.0	0.0	0.0	164.0	161.5	159.0	162.0	164.0	165.0	179.0	193.5	0.0	0.0	0.0	0.0
6.9	0.0	0.0	0.0	0.0	0.0	169.0	166.0	161.5	166.5	163.0	175.0	185.0	0.0	0.0	0.0	0.0	0.0

APPENDIX II

Raw Measurements of the Water Surface and Bed Elevation for the Experiments Performed in Channel 2

Q = 1.03 l/s S = 0.0041 beta = 11.79 epsilon = 0.150

x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)
0.0	−140	157.0	172.0	2.1	−190	159.0	167.0	4.2	−170	162.0	162.0
0.0	−110	156.0	165.0	2.1	−160	158.0	169.0	4.2	−140	161.0	161.0
0.0	0	155.0	158.0	2.1	0	156.0	158.0	4.2	0	161.5	173.5
0.0	110	156.5	160.0	2.1	160	159.0	169.0	4.2	140	164.0	169.0
0.0	140	156.0	165.0	2.1	190	159.5	173.5	4.2	170	164.5	169.5
0.2	−150	156.5	174.0	2.2	−200	158.5	165.5	4.4	−150	165.5	167.5
0.2	−120	157.5	174.5	2.2	−170	158.5	167.5	4.4	−120	161.5	162.0
0.2	0	158.5	164.0	2.2	0	156.5	157.5	4.4	0	162.0	168.5
0.2	120	156.0	163.5	2.2	170	159.5	165.5	4.4	120	164.0	173.5
0.2	150	156.5	163.0	2.2	200	158.5	168.0	4.4	150	164.5	172.5
0.3	−170	158.5	161.5	2.5	−190	158.5	167.5	4.6	−140	166.5	168.5
0.3	−140	157.0	163.0	2.5	−160	158.5	173.5	4.6	−110	165.5	167.5
0.3	0	158.0	165.5	2.5	0	159.0	162.0	4.6	0	162.5	169.0
0.3	140	157.0	162.5	2.5	160	159.0	168.0	4.6	110	164.5	176.0
0.3	170	158.0	161.5	2.5	190	160.0	172.5	4.6	140	164.5	184.0
0.5	−190	158.0	164.5	2.7	−170	160.5	174.5	4.8	−150	166.0	177.5
0.5	−160	156.5	164.0	2.7	−140	160.5	164.0	4.8	−120	164.5	175.0
0.5	0	157.0	164.5	2.7	0	159.5	176.5	4.8	0	162.5	171.0
0.5	160	158.0	168.0	2.7	140	160.5	163.0	4.8	120	165.0	175.0
0.5	190	158.5	163.0	2.7	170	160.0	169.5	4.8	150	165.5	177.0
0.6	−200	158.0	166.0	3.0	−150	157.5	169.5	5.0	−170	166.0	188.0
0.6	−170	156.5	161.0	3.0	−120	159.0	170.0	5.0	−140	165.5	174.5
0.6	0	156.5	164.0	3.0	0	158.0	170.5	5.0	0	164.0	173.0
0.6	170	158.0	170.0	3.0	120	159.0	173.5	5.0	140	164.5	172.5
0.6	200	158.0	164.5	3.0	150	159.5	165.5	5.0	170	166.0	167.0
0.8	−190	157.5	164.0	3.2	−140	157.5	166.5	5.2	−190	168.0	183.5
0.8	−160	157.0	164.5	3.2	−110	158.0	165.0	5.2	−160	168.5	184.5
0.8	0	156.5	159.5	3.2	0	158.0	172.5	5.2	0	166.0	167.0
0.8	160	159.0	162.5	3.2	110	158.5	165.0	5.2	160	166.5	171.0
0.8	190	158.5	169.0	3.2	140	165.5	159.0	5.2	190	168.0	172.5
1.1	−170	158.0	165.5	3.3	−150	157.5	160.5	5.4	−200	167.5	196.5
1.1	−140	159.5	166.5	3.3	−120	158.5	163.5	5.4	−170	167.5	185.5
1.1	0	157.5	170.5	3.3	0	158.0	177.5	5.4	0	165.0	166.0
1.1	140	157.5	167.5	3.3	120	160.0	162.0	5.4	170	166.0	169.0
1.1	170	157.5	171.5	3.3	150	161.5	164.5	5.4	200	167.5	168.0
1.3	−150	158.5	163.0	3.5	−170	158.5	161.5	5.6	−190	166.5	186.0
1.3	−120	159.0	161.0	3.5	−140	158.5	164.5	5.6	−160	166.5	185.5
1.3	0	158.0	170.5	3.5	0	158.5	165.5	5.6	0	166.5	172.0
1.3	120	158.0	170.5	3.5	140	161.0	167.0	5.6	160	163.0	164.0
1.3	150	157.5	170.5	3.5	170	162.0	184.5	5.6	190	165.5	167.0
1.5	−140	160.5	167.0	3.7	−190	161.5	169.0	5.9	−170	167.5	182.0
1.5	−110	160.0	168.5	3.7	−160	161.0	164.5	5.9	−140	166.5	178.0
1.5	0	159.0	169.0	3.7	0	158.5	164.5	5.9	0	167.0	168.5
1.5	110	159.5	171.0	3.7	160	163.0	171.0	5.9	140	164.5	165.0
1.5	140	160.0	170.5	3.7	190	163.0	176.0	5.9	170	165.0	166.0
1.7	−150	159.5	170.0	3.9	−200	163.5	173.5	6.1	−150	168.0	179.0
1.7	−120	158.5	170.5	3.9	−170	162.5	168.5	6.1	−120	167.5	177.5
1.7	0	158.0	172.0	3.9	0	162.0	165.0	6.1	0	168.5	173.0
1.7	120	159.5	168.0	3.9	170	164.5	177.5	6.1	120	166.0	166.0
1.7	150	160.5	168.5	3.9	200	164.5	180.0	6.1	140	166.0	166.5
1.9	−170	158.5	163.5	4.0	−190	162.5	171.5	6.3	−140	169.5	177.0
1.9	−140	158.0	167.5	4.0	−160	163.0	164.0	6.3	−110	168.0	180.0
1.9	0	157.0	172.5	4.0	0	161.0	168.5	6.3	0	168.0	176.5
1.9	140	158.0	173.5	4.0	160	165.0	168.5	6.3	110	166.0	166.5
1.9	170	158.0	173.0	4.0	190	165.0	176.0	6.3	140	168.5	168.5

Q = 1.51 l/s   S = 0.0041   beta = 9.78   epsilon = 0.150

x(m)	y(mm)	OW(mm)	OS(mm)
0.0	−140	156.0	177.0
0.0	−110	154.5	174.0
0.0	0	153.5	159.0
0.0	110	154.5	161.0
0.0	140	155.5	163.0
0.2	−150	156.0	195.0
0.2	−120	155.5	183.5
0.2	0	154.5	159.0
0.2	120	155.0	161.0
0.2	150	156.5	161.5
0.3	−170	157.5	171.0
0.3	−140	156.5	177.5
0.3	0	155.0	158.5
0.3	140	156.5	161.5
0.3	170	157.0	162.0
0.5	−190	158.5	163.5
0.5	−160	158.0	166.0
0.5	0	155.0	157.5
0.5	160	157.0	160.5
0.5	190	157.5	160.5
0.6	−200	157.5	165.5
0.6	−170	157.0	167.0
0.6	0	157.5	163.0
0.6	170	157.0	161.5
0.6	200	158.0	160.0
0.8	−190	156.0	173.0
0.8	−160	157.0	174.0
0.8	0	156.0	160.5
0.8	160	157.5	161.5
0.8	190	158.5	161.5
1.1	−170	157.0	176.0
1.1	−140	157.5	169.5
1.1	0	156.5	161.5
1.1	140	158.5	176.0
1.1	170	158.0	185.5
1.3	−150	158.0	177.5
1.3	−120	157.5	172.0
1.3	0	157.0	170.5
1.3	120	159.0	170.0
1.3	150	159.5	169.0
1.5	−140	160.5	175.5
1.5	−110	159.5	172.5
1.5	0	159.5	176.5
1.5	110	160.5	162.5
1.5	140	160.5	163.5
1.7	−150	160.0	169.5
1.7	−120	160.5	170.5
1.7	0	159.0	170.5
1.7	120	161.5	169.0
1.7	150	160.5	164.5
1.9	−170	160.5	167.0
1.9	−140	159.5	167.5
1.9	0	157.5	171.5
1.9	140	158.5	159.0
1.9	170	161.0	161.5

x(m)	y(mm)	OW(mm)	OS(mm)
2.1	−190	158.0	171.0
2.1	−160	158.0	172.5
2.1	0	159.0	167.5
2.1	160	162.0	167.0
2.1	190	162.0	174.5
2.2	−200	158.0	171.0
2.2	−170	159.5	171.5
2.2	0	159.0	174.5
2.2	170	161.5	168.5
2.2	200	160.5	171.5
2.5	−190	158.0	179.5
2.5	−160	157.5	173.0
2.5	0	158.0	163.0
2.5	160	161.0	170.0
2.5	190	162.0	168.0
2.7	−170	159.0	174.0
2.7	−140	159.0	170.5
2.7	0	158.5	170.0
2.7	140	161.0	186.5
2.7	170	162.0	180.0
3.0	−150	158.0	170.5
3.0	−120	157.5	168.0
3.0	0	157.0	173.0
3.0	120	159.5	181.0
3.0	150	159.5	189.5
3.2	−140	158.0	166.5
3.2	−110	157.5	168.0
3.2	0	156.5	169.5
3.2	110	159.5	170.5
3.2	140	160.0	170.5
3.3	−150	158.5	166.0
3.3	−120	157.5	168.0
3.3	0	157.0	166.0
3.3	120	159.5	182.0
3.3	150	159.5	184.0
3.5	−170	157.0	166.5
3.5	−140	156.5	166.5
3.5	0	157.0	181.0
3.5	140	159.5	172.5
3.5	170	160.0	168.0
3.7	−190	158.0	163.5
3.7	−160	157.0	164.0
3.7	0	157.0	175.0
3.7	160	161.5	165.5
3.7	190	161.0	173.0
3.9	−200	159.5	180.0
3.9	−170	159.0	171.5
3.9	0	157.5	159.0
3.9	170	162.0	172.5
3.9	200	162.0	184.5
4.0	−190	160.5	182.0
4.0	−160	159.0	172.0
4.0	0	159.0	161.5
4.0	160	161.0	177.5
4.0	190	161.5	168.5

x(m)	y(mm)	OW(mm)	OS(mm)
4.2	−170	159.0	179.0
4.2	−140	158.5	176.5
4.2	0	159.5	172.5
4.2	140	161.0	167.0
4.2	170	162.0	166.0
4.4	−150	158.5	184.0
4.4	−120	158.5	183.0
4.4	0	160.0	163.0
4.4	120	160.0	166.0
4.4	150	160.0	168.5
4.6	−140	159.5	182.0
4.6	−110	158.5	175.0
4.6	0	160.5	168.5
4.6	110	160.0	168.5
4.6	140	160.5	171.0
4.8	−150	159.0	174.0
4.8	−120	158.5	178.5
4.8	0	161.5	171.5
4.8	120	161.5	164.0
4.8	150	161.5	168.0
5.0	−170	159.5	171.0
5.0	−140	159.0	173.0
5.0	0	160.5	167.0
5.0	140	162.0	173.0
5.0	170	162.5	173.0
5.2	−190	161.0	167.5
5.2	−160	160.0	169.5
5.2	0	161.0	174.0
5.2	160	163.5	174.5
5.2	190	164.0	188.0
5.4	−200	160.0	168.0
5.4	−170	159.5	167.0
5.4	0	159.0	169.5
5.4	170	162.5	186.0
5.4	200	163.0	186.0
5.6	−190	159.5	168.5
5.6	−160	158.5	164.5
5.6	0	158.0	165.0
5.6	160	162.5	183.0
5.6	190	162.5	182.5
5.9	−170	159.5	170.0
5.9	−140	158.5	165.5
5.9	0	158.0	168.0
5.9	140	161.5	180.5
5.9	170	161.0	180.0
6.1	−150	159.5	171.0
6.1	−120	159.5	167.5
6.1	0	158.5	170.5
6.1	120	161.0	175.0
6.1	140	160.5	174.5
6.3	−140	161.0	174.0
6.3	−110	160.0	170.0
6.3	0	158.5	175.0
6.3	110	161.5	183.5
6.3	140	161.0	186.5

Q = 2.02 l/s S = 0.0041 beta = 9.83 epsilon = 0.150

x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)
0.0	−140	152.5	183.5	2.1	−190	155.5	164.5	4.2	−170	156.5	160.0
0.0	−110	153.5	175.5	2.1	−160	154.5	167.0	4.2	−140	156.0	158.5
0.0	0	155.0	159.5	2.1	0	153.5	163.0	4.2	0	153.5	161.0
0.0	110	153.0	161.5	2.1	160	155.0	161.5	4.2	140	153.5	179.5
0.0	140	153.0	163.5	2.1	190	155.5	162.0	4.2	170	154.0	191.0
0.2	−150	154.5	180.0	2.2	−200	155.0	164.5	4.4	−150	155.5	161.5
0.2	−120	154.0	177.0	2.2	−170	155.5	166.5	4.4	−120	155.0	160.5
0.2	0	151.0	158.0	2.2	0	153.0	166.5	4.4	0	152.5	161.5
0.2	120	153.5	162.5	2.2	170	155.5	166.0	4.4	120	155.5	176.5
0.2	150	153.5	161.5	2.2	200	155.0	171.5	4.4	150	157.0	180.0
0.3	−170	155.0	175.0	2.5	−190	154.5	169.0	4.6	−140	155.5	163.5
0.3	−140	154.5	176.0	2.5	−160	155.0	165.0	4.6	−110	155.0	160.5
0.3	0	152.0	160.5	2.5	0	153.5	166.0	4.6	0	154.0	163.0
0.3	140	154.0	162.0	2.5	160	156.0	159.5	4.6	110	154.5	173.0
0.3	170	155.5	162.0	2.5	190	156.0	162.5	4.6	140	155.5	179.0
0.5	−190	154.5	170.0	2.7	−170	157.5	171.0	4.8	−150	156.5	165.5
0.5	−160	155.5	171.0	2.7	−140	154.5	164.5	4.8	−120	155.0	165.5
0.5	0	154.0	160.5	2.7	0	154.0	163.0	4.8	0	156.0	168.0
0.5	160	154.5	160.0	2.7	140	157.0	176.5	4.8	120	156.5	173.0
0.5	190	155.5	159.5	2.7	170	156.0	173.5	4.8	150	156.5	177.5
0.6	−200	154.5	168.5	3.0	−150	152.0	168.0	5.0	−170	157.0	163.0
0.6	−170	155.0	168.5	3.0	−120	153.0	166.0	5.0	−140	156.5	166.0
0.6	0	153.0	163.0	3.0	0	153.0	164.5	5.0	0	155.0	167.0
0.6	170	154.0	158.5	3.0	120	154.0	174.5	5.0	140	156.0	170.5
0.6	200	154.5	157.5	3.0	150	155.0	180.5	5.0	170	157.5	168.0
0.8	−190	154.5	168.0	3.2	−140	154.5	164.5	5.2	−190	157.5	162.0
0.8	−160	155.5	166.5	3.2	−110	151.5	163.5	5.2	−160	157.0	164.5
0.8	0	154.0	160.5	3.2	0	154.5	165.5	5.2	0	156.5	168.0
0.8	160	154.0	157.5	3.2	110	155.5	172.0	5.2	160	158.5	167.0
0.8	190	155.0	158.0	3.2	140	156.0	180.5	5.2	190	159.5	166.0
1.1	−170	155.5	173.5	3.3	−150	154.5	162.0	5.4	−200	157.0	162.0
1.1	−140	155.5	170.5	3.3	−120	153.5	162.5	5.4	−170	156.5	162.5
1.1	0	153.5	163.0	3.3	0	153.0	167.0	5.4	0	154.5	165.5
1.1	140	154.5	156.5	3.3	120	154.0	171.0	5.4	170	158.0	167.0
1.1	170	155.5	157.5	3.3	150	155.0	176.5	5.4	200	158.5	165.5
1.3	−150	156.0	183.0	3.5	−170	153.0	158.5	5.6	−190	156.5	163.0
1.3	−120	156.0	174.5	3.5	−140	157.5	163.5	5.6	−160	156.0	163.0
1.3	0	153.0	162.5	3.5	0	155.5	166.5	5.6	0	154.0	162.5
1.3	120	156.5	172.5	3.5	140	155.0	169.0	5.6	160	157.5	169.0
1.3	150	156.0	171.5	3.5	170	156.5	170.5	5.6	190	156.5	168.0
1.5	−140	157.5	180.0	3.7	−190	155.0	157.5	5.9	−170	156.0	173.5
1.5	−110	158.0	176.0	3.7	−160	154.5	158.5	5.9	−140	156.5	167.0
1.5	0	155.0	165.5	3.7	0	154.5	166.0	5.9	0	156.5	162.5
1.5	110	156.0	165.0	3.7	160	156.5	167.5	5.9	140	159.0	169.5
1.5	140	156.5	170.0	3.7	190	157.0	169.0	5.9	170	158.5	171.0
1.7	−150	156.0	173.5	3.9	−200	157.0	158.5	6.1	−150	157.0	182.0
1.7	−120	156.5	178.5	3.9	−170	155.5	158.0	6.1	−120	156.0	174.5
1.7	0	155.0	162.5	3.9	0	153.0	165.5	6.1	0	156.0	163.0
1.7	120	157.0	166.0	3.9	170	155.5	174.0	6.1	120	157.0	171.5
1.7	150	157.5	167.0	3.9	200	157.0	179.5	6.1	140	156.5	170.5
1.9	−170	155.5	169.5	4.0	−190	157.0	159.0	6.3	−140	158.0	172.0
1.9	−140	156.0	173.0	4.0	−160	156.0	158.0	6.3	−110	156.0	171.0
1.9	0	154.0	164.5	4.0	0	155.0	164.0	6.3	0	156.5	170.5
1.9	140	155.5	174.0	4.0	160	156.5	173.5	6.3	110	158.5	171.5
1.9	170	155.0	173.5	4.0	190	158.5	179.0	6.3	140	157.0	168.0

Q = 2.02 l/s S = 0.0041 beta = 8.53 epsilon = 0.150

x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)
0.0	−140	156.0	171.0	2.1	−190	156.0	186.0	4.2	−170	154.0	164.5
0.0	−110	155.0	167.5	2.1	−160	155.5	175.0	4.2	−140	155.0	165.0
0.0	0	153.5	172.5	2.1	0	152.5	161.0	4.2	0	153.5	175.5
0.0	110	154.5	169.0	2.1	160	153.5	162.5	4.2	140	154.5	172.0
0.0	140	154.0	174.5	2.1	190	153.5	161.0	4.2	170	155.0	169.0
0.2	−150	155.0	169.0	2.2	−200	156.0	175.0	4.4	−150	154.0	167.0
0.2	−120	155.5	167.5	2.2	−170	155.5	170.5	4.4	−120	153.5	169.5
0.2	0	154.0	172.5	2.2	0	153.0	162.5	4.4	0	154.0	158.5
0.2	120	155.0	167.0	2.2	170	154.0	161.5	4.4	120	155.5	174.5
0.2	150	155.5	167.0	2.2	200	154.5	160.5	4.4	150	154.0	176.5
0.3	−170	157.0	163.0	2.5	−190	156.5	183.0	4.6	−140	153.5	170.0
0.3	−140	155.0	165.5	2.5	−160	155.0	188.5	4.6	−110	153.5	166.0
0.3	0	155.0	174.5	2.5	0	153.5	163.0	4.6	0	153.5	160.0
0.3	140	155.5	166.5	2.5	160	153.5	160.0	4.6	110	154.0	184.5
0.3	170	156.0	165.0	2.5	190	154.0	160.5	4.6	140	153.5	184.0
0.5	−190	156.0	162.0	2.7	−170	156.0	171.5	4.8	−150	154.0	168.5
0.5	−160	155.5	160.5	2.7	−140	155.5	170.5	4.8	−120	153.5	167.0
0.5	0	154.0	172.0	2.7	0	153.5	164.5	4.8	0	154.0	169.0
0.5	160	155.0	162.5	2.7	140	154.5	160.0	4.8	120	154.5	169.5
0.5	190	155.5	162.0	2.7	170	155.0	162.5	4.8	150	155.5	175.5
0.6	−200	156.5	177.0	3.0	−150	155.5	172.5	5.0	−170	154.5	164.5
0.6	−170	154.5	166.5	3.0	−120	155.0	182.5	5.0	−140	154.0	165.5
0.6	0	153.0	168.5	3.0	0	152.0	182.0	5.0	0	155.5	170.5
0.6	170	154.0	162.5	3.0	120	153.5	160.0	5.0	140	155.0	171.0
0.6	200	154.5	160.5	3.0	150	154.5	165.0	5.0	170	154.5	170.0
0.8	−190	155.5	175.5	3.2	−140	153.5	173.5	5.2	−190	156.0	163.0
0.8	−160	154.0	171.0	3.2	−110	152.5	171.0	5.2	−160	156.0	165.0
0.8	0	152.5	166.0	3.2	0	152.5	174.0	5.2	0	156.0	168.0
0.8	160	153.5	160.5	3.2	110	155.0	167.0	5.2	160	157.0	167.5
0.8	190	154.5	161.5	3.2	140	153.5	174.5	5.2	190	157.5	167.0
1.1	−170	155.5	169.5	3.3	−150	153.0	185.5	5.4	−200	155.5	165.0
1.1	−140	156.0	171.5	3.3	−120	154.0	174.5	5.4	−170	156.0	165.5
1.1	0	153.0	166.0	3.3	0	152.0	169.5	5.4	0	155.0	167.0
1.1	140	153.5	161.5	3.3	120	153.5	173.5	5.4	170	155.0	180.0
1.1	170	154.0	162.5	3.3	150	156.0	178.0	5.4	200	155.5	178.0
1.3	−150	156.0	177.0	3.5	−170	154.5	165.5	5.6	−190	154.0	169.5
1.3	−120	157.0	168.5	3.5	−140	153.5	168.5	5.6	−160	154.0	165.5
1.3	0	153.5	165.5	3.5	0	152.5	161.0	5.6	0	153.5	157.0
1.3	120	155.0	165.5	3.5	140	154.5	175.5	5.6	160	154.0	177.5
1.3	150	154.0	170.5	3.5	170	156.0	169.5	5.6	190	154.5	193.5
1.5	−140	155.5	176.0	3.7	−190	154.0	169.0	5.9	−170	154.5	174.5
1.5	−110	156.0	180.0	3.7	−160	152.5	179.0	5.9	−140	154.5	177.0
1.5	0	154.0	167.5	3.7	0	153.5	168.0	5.9	0	155.5	159.0
1.5	110	154.5	171.0	3.7	160	157.0	164.0	5.9	140	155.0	172.5
1.5	140	153.0	174.0	3.7	190	156.5	177.0	5.9	170	155.5	177.5
1.7	−150	155.0	179.5	3.9	−200	155.0	166.5	6.1	−150	154.5	180.5
1.7	−120	154.5	179.5	3.9	−170	153.5	165.5	6.1	−120	155.5	170.5
1.7	0	153.5	164.5	3.9	0	154.0	165.5	6.1	0	155.5	168.5
1.7	120	154.5	170.0	3.9	170	155.5	170.0	6.1	120	154.5	168.0
1.7	150	153.0	169.0	3.9	200	157.5	166.0	6.1	140	155.5	174.5
1.9	−170	155.5	187.0	4.0	−190	154.0	168.5	6.3	−140	156.5	169.0
1.9	−140	153.5	181.0	4.0	−160	154.5	163.5	6.3	−110	156.0	167.5
1.9	0	152.5	168.0	4.0	0	155.5	163.5	6.3	0	154.0	175.0
1.9	140	154.0	166.0	4.0	160	157.0	169.5	6.3	110	156.0	166.5
1.9	170	155.0	165.5	4.0	190	156.0	167.5	6.3	140	156.0	167.5

Q = 2.50 l/s S = 0.0041 beta = 8.47 epsilon = 0.150

x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)
0.0	−140	153.0	170.5	2.1	−190	155.0	157.5	4.2	−170	154.0	165.5
0.0	−110	152.5	170.5	2.1	−160	153.0	156.5	4.2	−140	153.0	162.0
0.0	0	154.5	166.5	2.1	0	151.5	168.0	4.2	0	152.5	165.0
0.0	110	153.5	178.0	2.1	160	154.5	168.5	4.2	140	154.0	166.5
0.0	140	155.0	183.5	2.1	190	154.0	168.5	4.2	170	154.0	168.0
0.2	−150	155.0	168.0	2.2	−200	156.5	161.0	4.4	−150	152.0	178.5
0.2	−120	155.0	168.5	2.2	−170	154.0	159.0	4.4	−120	154.0	163.5
0.2	0	152.5	167.5	2.2	0	152.5	166.5	4.4	0	152.5	166.0
0.2	120	155.0	174.0	2.2	170	153.5	168.0	4.4	120	153.5	165.0
0.2	150	156.0	179.5	2.2	200	154.0	167.5	4.4	150	153.5	167.5
0.3	−170	155.0	166.5	2.5	−190	157.0	179.0	4.6	−140	153.0	181.5
0.3	−140	154.0	167.0	2.5	−160	155.0	167.5	4.6	−110	152.5	167.5
0.3	0	154.5	167.5	2.5	0	152.5	167.0	4.6	0	151.5	165.0
0.3	140	156.0	173.5	2.5	160	155.0	167.0	4.6	110	154.0	165.5
0.3	170	156.0	184.0	2.5	190	154.5	168.0	4.6	140	153.5	167.0
0.5	−190	155.0	162.0	2.7	−170	156.5	189.5	4.8	−150	151.5	185.0
0.5	−160	154.5	164.5	2.7	−140	155.5	177.0	4.8	−120	151.0	176.5
0.5	0	153.0	165.0	2.7	0	152.5	168.5	4.8	0	151.0	163.5
0.5	160	155.5	173.5	2.7	140	155.0	167.0	4.8	120	152.5	164.5
0.5	190	156.0	175.0	2.7	170	156.0	169.5	4.8	150	154.5	165.0
0.6	−200	155.0	161.0	3.0	−150	154.0	176.5	5.0	−170	153.5	180.0
0.6	−170	153.0	162.5	3.0	−120	152.5	185.5	5.0	−140	152.0	178.5
0.6	0	152.0	163.5	3.0	0	153.0	170.0	5.0	0	151.0	164.5
0.6	170	155.0	173.5	3.0	120	155.5	170.0	5.0	140	152.0	162.5
0.6	200	155.0	173.5	3.0	150	152.0	171.0	5.0	170	153.5	160.5
0.8	−190	154.0	160.5	3.2	−140	153.0	176.0	5.2	−190	153.5	176.0
0.8	−160	153.0	162.0	3.2	−110	152.5	174.0	5.2	−160	153.5	174.5
0.8	0	152.5	163.0	3.2	0	152.0	166.5	5.2	0	151.5	164.0
0.8	160	154.5	172.0	3.2	110	154.0	169.0	5.2	160	153.0	160.5
0.8	190	153.5	174.5	3.2	140	154.0	168.5	5.2	190	155.5	160.0
1.1	−170	154.0	163.5	3.3	−150	155.0	170.5	5.4	−200	153.0	176.0
1.1	−140	154.5	162.5	3.3	−120	152.5	172.0	5.4	−170	153.5	173.0
1.1	0	154.0	162.0	3.3	0	151.0	166.0	5.4	0	151.5	163.0
1.1	140	153.5	175.5	3.3	120	153.0	168.5	5.4	170	154.0	158.5
1.1	170	154.0	180.5	3.3	150	154.0	166.5	5.4	200	154.0	158.5
1.3	−150	155.5	166.5	3.5	−170	153.0	170.0	5.6	−190	151.5	188.5
1.3	−120	154.5	163.5	3.5	−140	153.0	167.0	5.6	−160	151.5	176.0
1.3	0	153.0	162.0	3.5	0	152.0	164.5	5.6	0	149.5	160.5
1.3	120	154.5	180.0	3.5	140	153.5	167.0	5.6	160	152.0	158.0
1.3	150	155.5	187.0	3.5	170	154.5	167.5	5.6	190	153.0	158.5
1.5	−140	156.0	165.0	3.7	−190	154.5	162.5	5.9	−170	151.5	185.0
1.5	−110	155.0	163.5	3.7	−160	153.0	163.0	5.9	−140	151.0	182.0
1.5	0	154.5	162.5	3.7	0	151.5	162.5	5.9	0	149.5	159.5
1.5	110	155.0	186.5	3.7	160	152.0	170.0	5.9	140	152.5	159.0
1.5	140	153.5	193.0	3.7	190	154.0	168.5	5.9	170	152.0	163.0
1.7	−150	154.0	162.0	3.9	−200	155.0	170.0	6.1	−150	152.5	190.0
1.7	−120	153.5	162.5	3.9	−170	153.5	160.5	6.1	−120	152.0	184.0
1.7	0	154.0	164.5	3.9	0	153.0	163.5	6.1	0	151.0	160.0
1.7	120	154.5	181.5	3.9	170	153.0	168.5	6.1	120	152.5	162.5
1.7	150	154.0	183.0	3.9	200	153.5	168.0	6.1	140	152.0	165.5
1.9	−170	155.0	158.5	4.0	−190	155.5	164.5	6.3	−140	153.5	180.5
1.9	−140	153.5	159.5	4.0	−160	153.5	161.0	6.3	−110	153.0	178.5
1.9	0	152.5	168.0	4.0	0	152.5	163.5	6.3	0	151.5	161.5
1.9	140	154.0	173.5	4.0	160	154.5	169.5	6.3	110	152.5	165.0
1.9	170	155.5	174.0	4.0	190	154.0	167.5	6.3	140	154.0	167.5

Q = 3.06 l/s S = 0.0041 beta = 8.38 epsilon = 0.150

x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)	x(m)	y(mm)	OW(mm)	OS(mm)
0.0	−140	147.0	164.5	2.1	−190	153.5	167.0	4.2	−170	152.0	164.0
0.0	−110	147.0	162.5	2.1	−160	151.5	165.0	4.2	−140	146.5	162.0
0.0	0	150.0	163.5	2.1	0	149.0	164.0	4.2	0	152.0	162.5
0.0	110	147.5	167.0	2.1	160	149.5	160.0	4.2	140	151.5	166.0
0.0	140	149.5	169.0	2.1	190	150.0	158.5	4.2	170	152.0	167.5
0.2	−150	150.0	161.5	2.2	−200	149.0	167.5	4.4	−150	150.5	167.0
0.2	−120	150.0	166.0	2.2	−170	149.5	168.5	4.4	−120	148.5	164.5
0.2	0	150.0	164.0	2.2	0	150.5	162.0	4.4	0	152.0	165.5
0.2	120	147.5	173.5	2.2	170	150.0	158.0	4.4	120	151.5	168.0
0.2	150	152.5	166.0	2.2	200	149.5	158.0	4.4	150	148.5	169.5
0.3	−170	149.0	161.0	2.5	−190	151.5	171.0	4.6	−140	152.5	165.5
0.3	−140	149.5	161.5	2.5	−160	150.0	169.5	4.6	−110	150.0	166.0
0.3	0	147.0	169.0	2.5	0	152.5	165.5	4.6	0	151.0	170.0
0.3	140	146.5	166.5	2.5	160	152.0	158.0	4.6	110	157.0	170.0
0.3	170	147.0	162.5	2.5	190	151.0	159.0	4.6	140	152.0	172.5
0.5	−190	150.0	157.0	2.7	−170	152.0	178.0	4.8	−150	153.5	164.0
0.5	−160	150.5	158.0	2.7	−140	154.5	171.5	4.8	−120	146.0	165.5
0.5	0	148.5	166.0	2.7	0	152.5	165.0	4.8	0	152.5	171.5
0.5	160	150.5	160.0	2.7	140	154.0	159.5	4.8	120	153.0	170.5
0.5	190	149.5	159.5	2.7	170	151.0	161.5	4.8	150	155.0	173.5
0.6	−200	149.0	158.5	3.0	−150	153.0	177.5	5.0	−170	153.0	163.5
0.6	−170	149.5	156.5	3.0	−120	153.0	177.0	5.0	−140	151.0	165.0
0.6	0	147.5	168.0	3.0	0	148.0	169.0	5.0	0	154.5	170.0
0.6	170	150.0	160.5	3.0	120	152.0	163.5	5.0	140	154.0	168.0
0.6	200	148.5	160.0	3.0	150	150.0	166.5	5.0	170	153.5	168.0
0.8	−190	149.5	159.0	3.2	−140	155.0	175.0	5.2	−190	152.5	163.5
0.8	−160	149.5	157.0	3.2	−110	151.0	171.0	5.2	−160	152.5	164.0
0.8	0	150.5	165.5	3.2	0	148.5	168.0	5.2	0	152.5	166.5
0.8	160	149.5	159.5	3.2	110	150.5	167.0	5.2	160	154.5	168.0
0.8	190	146.5	160.0	3.2	140	153.5	165.5	5.2	190	156.0	165.5
1.1	−170	149.0	169.5	3.3	−150	152.0	173.5	5.4	−200	153.0	161.0
1.1	−140	148.5	160.0	3.3	−120	150.0	169.0	5.4	−170	151.0	163.5
1.1	0	150.0	163.0	3.3	0	154.0	168.5	5.4	0	153.5	165.0
1.1	140	151.5	163.5	3.3	120	152.5	167.0	5.4	170	152.0	166.5
1.1	170	148.0	164.0	3.3	150	153.0	161.5	5.4	200	154.0	165.5
1.3	−150	150.0	176.5	3.5	−170	149.5	163.5	5.6	−190	152.0	163.5
1.3	−120	150.5	166.5	3.5	−140	148.5	163.5	5.6	−160	151.0	164.5
1.3	0	150.0	165.5	3.5	0	147.5	166.5	5.6	0	150.0	165.5
1.3	120	149.5	166.0	3.5	140	151.5	170.0	5.6	160	152.5	164.5
1.3	150	149.5	169.0	3.5	170	150.0	165.5	5.6	190	151.0	168.0
1.5	−140	152.0	179.0	3.7	−190	152.5	161.0	5.9	−170	150.5	167.0
1.5	−110	152.0	172.0	3.7	−160	156.0	166.5	5.9	−140	152.0	165.5
1.5	0	148.5	164.5	3.7	0	151.0	164.0	5.9	0	150.5	163.5
1.5	110	149.5	172.5	3.7	160	153.0	169.5	5.9	140	150.0	171.0
1.5	140	148.0	173.5	3.7	190	151.5	161.0	5.9	170	152.0	182.5
1.7	−150	148.5	172.0	3.9	−200	152.5	161.5	6.1	−150	151.0	171.0
1.7	−120	154.0	176.0	3.9	−170	154.0	162.0	6.1	−120	153.0	166.5
1.7	0	147.5	161.5	3.9	0	151.0	163.5	6.1	0	148.5	165.0
1.7	120	149.5	167.5	3.9	170	151.0	165.0	6.1	120	153.5	171.5
1.7	150	152.0	165.5	3.9	200	153.0	163.5	6.1	140	149.5	182.5
1.9	−170	151.5	167.5	4.0	−190	153.0	162.5	6.3	−140	153.5	168.0
1.9	−140	150.0	168.0	4.0	−160	150.0	163.0	6.3	−110	152.0	168.0
1.9	0	150.5	166.0	4.0	0	151.0	163.5	6.3	0	153.5	167.0
1.9	140	152.0	165.0	4.0	160	152.0	164.0	6.3	110	153.0	174.5
1.9	170	152.5	161.0	4.0	190	153.0	165.0	6.3	140	156.0	177.5