6689b 6689a
6690

6689a 6689b 6690

Form 504

U. S. COAST AND GEODETIC SURVEY

DEPARTMENT OF COMMERCE

DESCRIPTIVE REPORT

Type of Survey Topographic
6689a&b

Field No. ..... Office No. 6690 -

LOCALITY

State Washington

General locality East Side

Locality Northern Puget Sound Swinomish Slough

1989

CHIEF OF PARTY

Robert W. Knox

LIBRARY & ARCHIVES

DATE .....

B-1870-1 (1)++

6689
6690

a & b

6689
6690

Form 504
Rev. April 1935

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY

DESCRIPTIVE REPORT

Topographic / ~~*Hydrographic*~~ } *Sheet No.* "I"*"J"*"K"

T-6689a
T-6689b
T-6690

U. S. COAST & GEODETIC SURVEY
LIBRARY AND ARCHIVES
MAR 18 1940

Acc. No. [redacted]

State Washington

LOCALITY

East Side Northern Puget Sound

Swinomish Slough

1939.

CHIEF OF PARTY

Robert W. Knox

U. S. GOVERNMENT PRINTING OFFICE

Form 537a
Ed. Nov. 1929

DEPARTMENT OF COMMERCE
U.S. COAST AND GEODETIC SURVEY

REG. NO.

TOPOGRAPHIC TITLE SHEET

The Topographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

Field No. "I" T6689a

REGISTER NO. T-6689a

State Washington

General locality East Side of Fidalgo Island East Side Northern Puget Sound

Locality South End of Swinomish Slough

Scale 1:5,000 Date of survey July & August, 19 39.

Vessel U.S.C. & G.S.S. EXPLORER

Chief of party Robert W. Knox

Surveyed by Harold J. Oliver

Inked by Harold J. Oliver

Heights in feet above M.H.W. to ground ~~xxxxxxxxxxxxxx~~ ~~contours~~ Approximate contour, ~~xxxxxxx~~ interval 50 feet

Instructions dated April 12, ~~and June 24,~~ 19 39.

Remarks:

GPO

Form 537a
Ed. Nov. 1929

DEPARTMENT OF COMMERCE
U.S. COAST AND GEODETIC SURVEY

REG. NO.

TOPOGRAPHIC TITLE SHEET

The Topographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

Field No. "J"

REGISTER NO. T-6689b T6689b

State Washington

General locality East Side Northern Puget Sound Fidalgo Island

Locality Central Part of Swinomish Slough

Scale 1:5,000 Date of survey August, 1939.

Vessel U.S.C. & G.S.S. EXPLORER

Chief of party Robert W. Knox

Surveyed by Harold J. Oliver

Inked by Harold J. Oliver

Heights in feet above M.H.W. to ground ~~to tops of trees~~

~~Contours~~, Approximate contour, ~~Form lines~~ interval 50 feet

Instructions dated April 12, and June 24, 1939.

Remarks:

gpo

Form 537a
Ed. Nov. 1929

DEPARTMENT OF COMMERCE
U.S. COAST AND GEODETIC SURVEY

REG. NO.

TOPOGRAPHIC TITLE SHEET

The Topographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

Field No. "K"

REGISTER NO. T-6690 T6690

State Washington

General locality East Side Northern Puget Sound Of Fidalgo Island

Locality Swinomish Slough Northeast End of

Scale 1:5,000 Date of survey Aug. & Sept., 1939.

Vessel U.S.C. & G.S.S. EXPLORER

Chief of party Robert W. Knox

Surveyed by Harold J. Oliver

Inked by Harold J. Oliver

Heights in feet above M.H.W. to ground ~~to tops of trees~~

~~Contours~~ Approximate contour, ~~Form line~~ interval 50 feet

Instructions dated April 12, ~~and June 24,~~ 1939.

Remarks:

apc

DESCRIPTIVE REPORT

TO ACCOMPANY

TOPOGRAPHIC SHEETS

T-6689a, T-6689b, and T-6690

U.S.C. & G.S.S. EXPLORER

PROJECT HT-233

1 9 3 9

- o -

Robert W. Knox, Chief of Party, C. & G. S.

DESCRIPTIVE REPORT

TO ACCOMPANY

TOPOGRAPHIC SHEETS

T-6689a, T-6689b, and T-6690

U.S.C. & G.S.S. EXPLORER

PROJECT HT-233

1 9 3 9

AUTHORITY:

These surveys were accomplished in accordance with the Director's instructions dated April 12, 1939, and "Interpretation of Instructions", dated June 24, 1939.

LIMITS AND SCALE:

These three sheets of topographic surveys extend from the south entrance of Swinomish Slough, in Latitude 48°22.3', between Longitude 122°29.0' and 122°31.0', and extend northward through the Slough and include the Railway Bridge at the north entrance to Swinomish Slough in Latitude 48°27.5'.

The most southern sheet, T-6689a, shows Sullivan Slough from its southern end to the county road near LaConner and a portion of the entrance to the North Fork of the Skagit River.

All three sheets were on a scale of 1:5,000.

CONTROL:

The control consisted of second order triangulation stations, both main scheme and intersection. The triangulation was executed during the field season of 1939, and is computed on the North American 1927 Datum.

Supplementary control was obtained by recovering, connecting to triangulation, and adjusting a U. S. Engineer's Corps traverse on the east side of Swinomish Slough. Connections were made at triangulation station "OFFSET - 1939", "SWIN - 1939", and "B109 + 89.0 - 1939", "B81 + 20.8","B25 + 19.4", and "B3 + 20.8".

The distances and angles were taken from the U. S. Engineer's computations of their traverse. A blue print of their survey is forwarded with the field sheets. B.P.'s 34356 to 34370, inc.

The geodetic position of common points to traverse and triangulation was determined. A ploygon closure was made between U.S.E. "315 + 00.0", near "OFFSET", and U.S.E. "B109 + 89.0", using the observed angles from the U. S. Engineer's computations, 1939 observations by this party, and inverse computations between U.S.E. "315 + 00.0", and U.S.E. "109 + 89.0". A correction of twenty-six seconds per angle was then applied to reduce the closure to zero. Using the corrected angles and the distance from the U. S. Engineer's computations, geodetic computations were made for the points on the Engineer's traverse. A point connection was made at triangulation station "SWIN-1939", near "188 + 00.0", on the Engineer's traverse. At this point the divergence from the triangulation was 2.74 meters in Longitude and 0.04 meter in Latitude. Using 3871 meters as the length of traverse this would give a probable accuracy of one part in 1400. This error was distributed through the traverse proportionally to the accumulated distance along the traverse. Using the same azimuth the computations were continued to U.S.E. "109 + 89.0" 1939. The divergence there was 1.52 meters in Latitude and 0.89 meters in Longitude. Using the hypotenuse or 1.57 meters and the distance of 2381 the probable accuracy is 1 part in 1500. This error was also adjusted proportionally to the accumulated distance along the traverse. It is believed that after the adjustment a better probable accuracy was obtained. Every opportunity was taken to check the location of these marks and no excessive errors were noted during the progress of the topography. The computations herewith indicated are attached to this report. From U.S.E. "B109 + 89" to U.S.E. "B3 + 20.8", a slightly different method of adjustment was used. The polygon closure was determined as before and gave a total correction of 1'38" or about 9" per angle. The inverse distance between the stations was computed from both the U. S. Engineer's coordinates and the Coast and Geodetic Survey's geodetic positions, showming a discrepancy of 5.8 feet. This error was then distributed throughout the traverse proportionally to the length and angle the several tangents comprising the traverse makes with respect to the inverse azimuth between the tie points. After the geographic positions had been computed and the d.m's and d.p's determined, a straight line adjustment of the latter was made to eliminate the remaining discrepancies.

All of the points computed were not used in the control for the sheets. Descriptions are enclosed on Form 524, of all those points which were used and which were so marked that they may be recovered.

SURVEY METHODS AND PARTY ORGANIZATION:

The work on these sheets was accomplished by a topographer and two or sometimes three men with a skiff and outboard motor operating

from various locations convenient to highway connections.

The usual plane-table survey methods were used in the surveys on this sheet. Plane-table positions were determined by traverse and checked by resection and three point fixes. Traverses were extended as follows on Sheet T-6689a. From "OFFSET - 1939", southward through "The Hole in the Wall", to Swinomish Slough Beacon 1, and U.S.E. Monument No.3 and from Monument No. 3 around the east end of McGlinn Island to "OFFSET 1939". From "OFFSET", northwest along the treeline to U. S. E. "278 + 80.6". From U.S.E. "296 + 39.2", to "SULLIVAN - 1939", via signal "Teed", and from "SULLIVAN", around Bald Island and north along east side of Sullivan Slough to LaConner Pioneer Monument 1939, and from signal "Teed", along the west side of Sullivan Slough to LaConner Pioneer Monument. From Pioneer Monument to U.S.E. "278+ 80.6", via Maple street and also via U.S.E. "252 + 19.1". From U.S. E. "278 + 80.6", along the west side of the Slough to signal "Barn", and from U.S.E. "252 + 19.1" to signal "Barn". At signal "Barn" a tie was effected to a traverse from "SWIN-1939", on Sheet T-6689b to signal "Barn". A discrepancy of two meters was adjusted proportionally between the two sheets. On sheet T-6689b a traverse was extended along the east side of the slough northward to signal "Flag". The position of signal "Flag", and signal "Set", were determined by cuts from U.S.E. "109 + 89.0" and resection from the plane-table set-ups at those points.

The positions of "~~Barn~~ Flag" and "Set, were transferred to sheet T-6690 from sheet T-6689b, and their positions checked by three point fixes and found to be satisfactory. From signal "Set", a traverse was run west along the dike and north along the treeline to "DELLA-1939". From signal "Set" to Signal "DELLA", along the west side of Swinomish Slough. From signal "~~Barn~~ Flag" to signal "DELLA", via Padilla Bay Radio Pole with branches up Higgins Slough and Blind Slough. The positions of Padilla Bay Radio Pole, U.S.E. "B3 + 20.8", and the lights on the bridge towers were computed after the topography had been completed. A field examination was made with the locations of the signals on the sheet. The only discrepancy found was 2.5 meters in Latitude at Padilla Bay Flag Pole. This discrepancy was adjusted by swinging the highway about the point where the traverse up Blind Slough joined the traverse along the highway. The detail in Telegraph Slough was adjusted to reconcile this divergance. No discrepancies other than those mentioned were observed.

The low water line was rodded in at low water and is the estimated mean of the lower low water.

FORM LINES:

The form lines were drawn from elevations determined by cuts to identifiable and strategic points. Cuts were also taken to ridge lines and changes in gradient.

The elevations indicated on these sheets are ground elevations. The elevations were determined by observing the ground level or estimating the ground level at the base of the trees at the time of reading the vertical angles. In some cases the top of the ridge fell off the sheet and the vegetation made it impossible to identify points between the cliff line and the top of the ridge. Wherever possible cuts to the tops of the ridge were taken and intersected off the sheet and the elevations used to extend the contours to the limits of the sheet. Where it was practical to obtain elevations only along the beach those contours adjacent to the beach were the only ones indicated.

GENERAL DESCRIPTION OF TOPOGRAPHIC FEATURES:

The area covered by this survey is of delta formation. Marsh covers the level low lands and the fast land rises abruptly from the marsh. The line between the marsh and rocky higher land is definite and abrupt. Much of the low land has been diked and drained. The surface water flowing into shallow drainage ditches and escapes at low water through tide gates which prevent the salt water from flowing in at high water.

The fast land is covered with a heavy growth of coniferous and diciduous trees. In those places where the original growth still stands the predominant vegetation is tall pines and fir. In the places where the original timber has been cut the vegetation is predominantly deciduous trees and brush with some tall snags of the old growth rising to a considerable height above the general level of the vegetation.

In general Swinomish Slough is now a dredged channel through the marsh. The dikes along both sides of the channel serve to maintain the channel and protect the adjacent areas from tidal inundation. The slough improvement was started in 1890 by the U. S. Engineering Department and has been dredged from time to time since then. The later ones of which occurred in 1931, 1936-37, 1938, and 1939-40. The cause for the silting and shoaling of the channel was believed to be due to the flood waters of the North Fork of the Skagit River backing up into the slough. In 1938 a rock levee was constructed outside the Hole in the Wall from McGlinn Island to Goat Island. The levee starts from Monument No. 3 on McGlinn Island. The loca-

tion of the levee and its connection with Goat Island is shown on sheet T-6687. It is believed by the U. S. Engineer's that this protective work and the present dredging operations will serve to establish channel of an effective depth of 12 feet through Swinomish Slough. This route from Skagit to Padilla Bay would be much shorter and safer than the alternate route through Deception Pass.

The shore line varies from extensive tide flats to abrupt cliffs. At the south entrance to Swinomish Slough the "Hole in the Wall", is a rock chasm. Northward through the slough the shore line is a marsh berm about five feet above low water and covered by two to three feet at high water. The dikes are in general the highwater line.

The marsh between McGlinn and Bald Island is subject to overflow from the Skagit River and strewn with drift and large tree stumps. Both sides of the channel from the "Hole in the Wall", to rocky bluffs at the south end of LaConner are piled high with driftwood and tree stumps. The driftwood and stumps are an accumulation from floods and dredging spoils. Ever effort was made to locate all of the piles adjacent to navigational areas and any which may appear on previous surveys either by this Bureau or any other bureau and do not appear on this survey probably do not exist.

No effort was made to indicate all of the detail which might have been shown on a scale of 1:5,000. Only those features were located which appeared most desirable or which were convenient to plane-table set-ups and which might later be used for the control of photographic surveys referred to in paragraph nine of the Instructions.

A contract for dredging to be completed in early 1940 is in progress under the supervision of the U. S. Engineers. It is likely that portions of the topographic features may be considerably changed by the dredging operations. Since this work is for clearing and maintaining the channel it is likely that most of the changes will occur in areas where spoils are deposited rather than by the widening or changing of the channel.

MAGNETIC MERIDIANS:

One declinatoire observation was made. Magnetic declination of 23°30' was observed at triangulation station "SULLIVAN 1939", on August 8, 1939, at 12:40 P.M., 135th Meridian time. The observation was made with Declinatoire No. 182, which had an index ~~error~~ Correction of plus eighteen minutes on May 3, 1939, at 2:45 P.M., at Lincoln Park Magnetic Station, Seattle, Washington. No other declinatoire observations were made on these sheets due to the presence of local attraction at triangulation stations. A power line of temporary character extends along the west side of the slough and fences extend parallel

On T-6689a

Declination normal.

to the dikes on the east side of the slough. The power line on the west side of the slough was installed to supply electricity to the dredge which is working in the channel.

JUNCTIONS:

On the south, Sheet T-6689a made a point tie with sheet T-6687, at Swinomish Slough Beacon 1 and U.S.E. Monument No. 3. The topographic detail made a satisfactory junction in the field and no adjustment was necessary. Also joins form lines of T-6684b on southwest.

On the east, Sheet T-6689a, made a tie with Sheet T-6685b, on the dike east of Bald Island. The detail made a satisfactory junction and no adjustment was necessary. Sheet T-6689a, made a tie with Sheet T-6689b, the adjustment in this connection was taken up under "Survey Methods and Party Organization". Sheet T-6689b made a tie with sheet T-6690, at signal "Flag", and signal "Set". No adjustment was necessary in the detail. Sheet T-6690 made a point tie with Sheet T-6691 at Padilla Bay Flag Pole, and the east end of the draw span of the railway bridge over Swinomish Slough. The detail made a satisfactory junction in the field and no adjustment was necessary. On the west, sheet T-6690 made point ties with sheet T-6692 at U.S.E. "B3 + 20.8", the west end of the trestle of the highway bridge, and the south end of a culvert at the west end of the sheet. A satisfactory junction was made in the field with the topographic detail and no adjustment was necessary.

BRIDGES:

Three draw bridges cross the channel of Swinomish Slough as follows:

1. In Latitude 48°~~24.1~~ 23.5' at LaConner, Washington, a highway bridge with a swing span. The dredged channel is on the east side of the center pier. There is a horizontal clearance of 97 feet. When closed there is a vertical clearance of 18.2 feet at M.L.W., and 6.7 feet clearance at M.H.W. There is a small boat passage on the east side of the east pier with a horizontal clearance of about 25 feet and a vertical clearance of about 10.0 feet at M.H.W. Small boats which might not clear the bridge at high water are routed through this passage by the bridge tender. The bridge is hand operated and opens quite slowly. It should be approached at reduced speed making full allowance for the current and signaling for an open bridge at some distance.

2. In Latitude 48°27.3', a highway lift span with a horizontal

clearance of 100 feet. When closed the lift has a vertical clearance of 24 feet at M.L.W., and 14 feet at M.H.W. When open it has a clearance of 87 feet at M.L.W., and 77 feet at M.H.W. Boats with a height of this amount should not attempt to pass through Swinomish Slough. U.S.E. Bridge Book lists this as a swing bridge. Accept survey.

3. In Latitude 48°27.5' the Great Northern Railway swing span. It has a horizontal clearance of 94 feet. When closed it has a vertical clearance of 16 feet at M.L.W., and 6 feet at M.W.H.

This bridge is hand operated and should be approached at reduced speed making full allowance for the current and slow operation of the bridge. Four long blasts is the signal for opening all the bridges in the slough.

COMPARISON WITH PREVIOUS WORK:

An accurate comparison with Chart No. 6380 was impossible due to the difference in scale.

The topographic survey of the southern end of Swinomish Slough which borders on Skagit Bay was made on Sheet No. 2108 in 1892 on a scale of 1:4,800. The topography and hydrography of this area was accomplished on the same sheet.

A comparison was made between the current survey and the previous survey. The unchangeable areas appear to be identical, both in configuration and in position. There has been so much change by dredging and diking that it is impossible to make a complete comparison.

The topographic survey of the north end of the Slough, bordering on Padilla Bay, was made on Sheet No. 1747 in 1886, on a scale of 1:10,000. Several point comparisons were made at location which could be identified on both sheets and the unchangeable areas appear to be the same both in configuration and position. There has been so much change in the marsh areas due to diking and dredging that any comparison of those areas is doubtful. And since a detailed comparison would have served no useful navigational purpose it was not attempted.

Some topography and hydrography has been extended in a recent survey by the U. S. Engineering Department. Blueprints of this work are forwarded with the topographic sheets. A comparison was made with this work insofar as possible without constructing a datum on the blueprints. Considering the difference in scale and the distortion of the blueprint paper the topographic detail agreed quite closely.

It is to be noted that on sheet T-6689a in Latitude 48°25.2' the pipe line crossing is now about 65 meters north of the location indicated by the U. S. Engineers.

SIGNALS:

Since the hydrography for most of this area was dependent upon the current dredging operations only a few signals were established on the south end of Sheet T-6689a, and in Sullivan Slough.

Those signals on rocky cliffs were whitewashes on rocks. Those signals along the slough were flags nailed to driftwood or uprooted and overturned stumps.

The following is a list of signals outside the high water line:

TOPOGRAPHIC

Name	Description
LaConner Range Front	White square day mark with red vertical stripe on skeleton structure.
Swinomish Slough Beacon 2	Red diamond day mark on pile.
Swinomish Slough Beacon 4	Red diamond day mark on pile.
Swinomish Slough Beacon 8	Red diamond day mark on pile.
Tum	Flag on stump.

TRIANGULATION

Name	Description
Swinomish Slough Beacon 3, 1939	Red diamond day mark on pile.
Swinomish Slough Beacon 10, 1939	Red diamond day mark on pile.
Swinomish Slough Beacon 12, 1939	Red diamond day mark on pile.
Swinomish Slough Beacon 14, 1939	Red diamond day mark on pile.
Swinomish Slough Beacon 16, 1939	Red diamond day mark on pile.

The following is a list of signals for which descriptions on form No. 524 are furnished:

U.S.E. Mon. 3	U.S.E. 278 + 80.6
Swinomish Slough Beacon 1	U.S.E. 263 + 27.2
Hole in the Wall Light	U.S.E. 54 + 01.9
Whiz Cannery Chimney	U.S.E. 252 + 91.1
Power Pole	U.S.E. 243 + 35.9
Indian Church Cupola	U.S.E. 205 + 87.4
Totem Pole	U.S.E. 188 + 00.0
Lumber Mill Chimney	U.S.E. 186 + 68.8
Shingle Mill Chimney	U.S.E. 150 + 10.7
Swinomish Slough Beacon 2	U.S.E. 136 + 49.9
Swinomish Slough Beacon 4	U.S.E. 131 + 82.5
LaConner Range Front	U.S.E. B101 + 74.5
Swinomish Slough Beacon 8	U.S.E. B62 + 38.8
U.S.E. 315 + 00.0	U.S.E. B53 + 03.6
U.S.E. 296 + 39.2	U.S.E. B3 + 20.8
U.S.E. 288 + 50.9	Various

Sufficient rod readings were taken on houses to determine size and shape. Fence lines indicated were also rodded in. It is believed this detail is of sufficient accuracy to be used for photographic or hydrographic surveys.

Signals "Old", "Tip", and "Yel", shown on Sheet T-6690 were located on field sheet T-6691, and description on form No. 524 are forwarded with the descriptive report for that sheet.

AIDS TO NAVIGATION AND PERMANENT LAND MARKS TO CHARTS:

The above subject is taken up in a separate report by the Chief of Party. Chart Letter 172 of 1940.

GEOGRAPHIC NAMES:

The following names were taken from chart No. 6380:

Swinomish Slough	Sullivan Slough
McGlinn Island	Fidalgo Island
LaConner	Telegraph Slough
North Fork, Skagit River	

The following are names in local use and are also recognized by the U. S. Engineers:

Hole in the Wall	Pioneer Park

Swinomish Indian Reservation	Bald Island
Swinomish Indian Village	Higgens Slough
Old Channel	Blind Slough

The following name is of recognized permanency:

Skagit County, Washington.

STATISTICS:

	Sheet T6689a	Sheet T6689b	Sheet T6690
Statute miles of shoreline	25.8	6.6	15.5
Statute miles of dikes	5.4	3.7	13.1
Statute miles of railroads			1.8
Statute miles of roads	7.2	0.5	4.2
Statute miles of fresh water marsh line	0.7	0.9	6.5
Area, in square statute miles	3.1	1.4	3.7

Respectfully submitted,

Harold J. Oliver

Harold J. Oliver,
Jr. H. & G. Engr.

APPROVED AND FORWARDED:

Robert W. Knox

Robert W. Knox,
Chief of Party, C. & G. S.

Topo only

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 24A
Rev. Oct., 1932

LIST OF DIRECTIONS

Station USE B 315 + 00 (offset, ecc) State Wash

Chief of party RWK Date _____ Computed by RWK

Observer EAD Instrument 245 Checked by RWK

U. S. GOVERNMENT PRINTING OFFICE: 1932 11—9503

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction*	Corrected direction with zero initial	Adjusted direction*
	° ′ ″	′ ″	″	° ′ ″	′ ″
SULLIVAN 1939	0 00 00.00	+07 06.0		0 00 00.00	
DELTA RK 3 1939	23 28 09.2	+01 56.0		23 22 59.2	
OFFSET 1939				59 32 28	
USE B 296 + 39.2	254 33 54.5	+05 42.1		254 32 31	
~~USE 186 + 68.8 (comp)~~				~~233 43 26~~	
DIKEN 1939	350 06 39.6	+05 09.3		350 04 42.9	
USE B 109 + 89 (comp)				253 50 33.1	
USE B 188 + 00 (comp)				261 18 39.6	

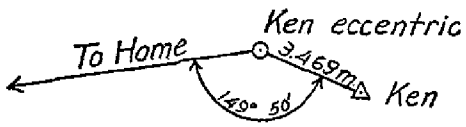
*These columns are for office use and should be left blank in the field.

Station: Ken | *State:* Maryland

Chief of party: C. V. H. | *Date:* 1917 | *Computed by:* O. P. S.

Observer: C. V. H. | *Instrument:* No. 168 | *Checked by:* W. F. R.

OBSERVED STATION	Observed direction			Eccentric reduction		Sea level reduction	Corrected direction with zero initial			Adjusted direction	
	°	′	″	′	″	″	°	′	″	′	″
Chevy	0	00	00.00	−	7.31		0	00	00.00		
Tank west of △ Dulce	29	03	37.0	−1	09.8		29	02	34.5		
Ken (center), 3.469 meters	176	42									
Forest Glen standpipe	313	24	53.0	+3	01.2		313	28	01.5		
Home	326	31	30.21	+	31.93		326	32	09.45		
Bureau of Standards, wireless pole	352	17	20.8	+	5.7		352	17	33.8		
Reno	357	28	48.63	−	1.16		357	28	54.78		
Reference mark, 16.32 m	358	31	20								



This form, with the first three and fifth columns properly filled out and checked, must be furnished by field parties. *To be acceptable it must contain every direction observed at the station.*

It should be used for observations with both repeating and direction theodolites.

The directions at only one station should be placed on a page.

If a repeating theodolite is used, do not abstract the angles in tertiary triangulation. The local adjustment corrections (to close horizon only) are to be written in the Horizontal Angle Record, and the List of Directions is to be made from that record directly.

Choose as an initial for Form 24A some station involved in the local adjustment, and preferably one which has been used as an initial for a round of directions on objects not in the main scheme. Use but one initial at a station. Call the direction of the initial 0° 00′ 00.″ 00, and by applying the corrected angles to this, fill in opposite each station its direction reckoned *clockwise* around the whole circumference regardless of the direction of graduation of the instrument. The clockwise reckoning is necessary for uniformity and to make the directions comparable with azimuths.

If a station has been occupied eccentrically, reduce to the center and enter in this form, in ink, the resulting corrections to the observed directions in the column provided for them. If an eccentric reduction is necessary, but not made in the field, leave the column blank. If the station was occupied centrally, and no eccentric reduction is required, put dashes in the column to show that no corrections are necessary.

Directions in the main scheme should be entered to hundredths of seconds in first-order triangulation; otherwise to tenths only. Points observed upon but once, direct and reverse, should be carried to tenths in first-order and second-order triangulation, and to even seconds only in third-order triangulation. In general, but two uncertain figures should be given.

It is recommended that the following simple plan of observing be used with a repeating instrument: Measure each single angle in the scheme at each station and the outside angle necessary to close the horizon. *Measure no sum angles.* Follow each measurement of every angle immediately by a measurement of its explement. Six repetitions are to constitute a measurement. The local adjustment will consist simply of the distribution of the error of closure of the horizon.

262.393 m =
2.418955

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 382
Ed. June, 1929

REDUCTION TO CENTER

Eccentric Station: U.S.E. - 315+00

Log d = 0.56277

Colog sin 1" = 5.31443

d = 3.654 meters

Sum = 5.87720

STATION	a	Log sin a	Log s (s in meters)	Log (sin a / s)	Logarithm of Reduction in Seconds	Reduction = c
	° ′					″
Center	0 00					
U.S.E. 296+39.2	74 55	9.410 63	2.41896 (75371)	6.99167 (65672)	2.86887 (53412)	+739.39 (342.07)
Diken 1939	110 28	9.971 68	3.358 23	6.61345	2.49065	+309.49
Sullivan 1939	120 21	9.935 99	3.183 77	6.75222	2.62942	+426.01
Delta Rock 3, 1939	143 49	9.771 12	3.583 51	6.18761	2.06481	+116.10
Diken		9.971 68	3.358 47	6.61321	2.49041	309.32
Delta Rock 3		9.771 12	3.583 84	6.18738	2.06458	116.00
		(1)				(2)
α USE - Diken		283-16-09.9			283 11	00.6
∠ Diken - USE 293+39.2		- 95 32 12.3			95 32	45.1
					187 38	15.5
					+5	42.1
α USE 315+00 - USE	293+39.2	187-43 57.6			187 43	57.6
α - U.S. Eng		187 37 10				
					07 06.1	
					05-42.1	
					01-23.9	
Sullivan	00 00 00.0	+ 07 06.0	07-06.0			
Delta Rock 3	23 28 09.2	+ 1-56.0	23-30 05.2			
USE 296+39.2	254 33 54.5	+ 5-42.1	254 39 36.6			
Diken	350 06 39.6	+ 5 09.3	350-11-48.9		95 32 12.3	
				Rank.		

INSTRUCTIONS

The required reduction to center is, in seconds, $c=\frac{d \sin a}{s \sin 1''}$, in which d is the distance from the eccentric station to the true station, and s is the length in meters of the line between the true stations involved, and therefore, log s is taken directly from the computation of triangle sides. a is the direction of the distant station involved, reckoned in a clockwise direction as usual, but referred to the direction from the eccentric to the true station, or center, taken as zero. This definition of a is true for the case in which the object pointed upon is eccentric, as well as for the case in which the instrument is eccentric.

Carry a to minutes only and all logarithms to five decimal places only. Do not in any case carry the derived reductions to more than two decimal places. There is no advantage in carrying them to more decimal places than the directions to which they are to be applied are carried on Form 24 A.

REDUCTIONS FOR AN ECCENTRIC INSTRUMENT

If the instrument is eccentric the first column of this form should contain the names of the stations observed from that eccentric position of the instrument.

The values in the fifth column are derived by subtracting those in the fourth column from those in the third. The values in the fourth column may need to be derived by successive approximations from the triangle side computations if the eccentric reductions are large. The values in the sixth column are obtained from those in the fifth by adding $\log\frac{d}{\sin 1''}$ derived as indicated in the heading of the form, if d is expressed in meters. If d is expressed in feet, to the other two logarithms add also 9.48402 to convert to meters. To obtain a direction as shown on Form 24 A, subtract the reduction c for the station which is the initial on Form 24 A from the reduction c for the required direction and apply the difference to the observed direction. Similarly, the correction to any angle is the difference of the reductions on this form to the two directions involved in that angle.

REDUCTIONS FOR AN ECCENTRIC OBJECT OBSERVED

If the object observed is eccentric the heading "Eccentric Station ——" should be changed to "Eccentric Observed Object at Station ——," the first column should contain the names of the stations from which this eccentric object was observed, and in each case a is the direction from the eccentric object to the distant station involved, reckoned in a clockwise direction as usual, but referred to the direction from the eccentric object to the true station, or center, taken as zero. (No distinction need be made between the direction from the eccentric object to the distant station and the direction from the true station to the distant station except when the eccentric reduction is more than one minute.) The remainder of the computation on this form is made in the manner indicated above with reference to an eccentric instrument. The reductions to directions are, however, to be applied to observed directions, at the stations named in the first column, to the eccentric object at the station named in the heading. The directions to which these reductions are to be applied are therefore found in various of the lists of directions on Form 24 A, not all in one list as is the case when the instrument is eccentric.

REDUCTION TO CENTER

Eccentric Station: Chase.

Log d = 1. 04088
Colog sin 1″ = 5. 31443
Sum = 6. 35531

d = 10. 987 *meters*

STATION	a	Log sin a	Log s (s in meters)	Log $\left(\frac{\sin a}{s}\right)$	Logarithm of Reduction in Seconds	Reduction $= c$
	° ′					″
Center	0 00					
Bossing	179 18	8. 08696	4. 49198	3. 59498	9. 95029	+ 0. 89
Central	224 27	9. 84528	4. 40254	5. 44274	1. 79805	− 62. 81
Little River	242 47	9. 94904	4. 51928	5. 42976	1. 78507	− 60. 96
Lyons, salt works	249 02	9. 97025	4. 30616	5. 66409	2. 01940	−104. 57

U. S. GOVERNMENT PRINTING OFFICE: 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 24A
Rev. Oct., 1932

LIST OF DIRECTIONS

Station SWIN 1939 *State* Washington

Chief of party R. W. Knox *Date* July 6 & 7, 1939 *Computed by* J.E.W.

Observer R.W.K. *Instrument* No. 317 *Checked by* R.W.K.

U. S. GOVERNMENT PRINTING OFFICE: 1932 11—0503

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction*	Corrected direction with zero initial	Adjusted direction*
	° ′ ″	′ ″	″	° ′ ″	′ ″
U.S.E. 109 + 89 (U.S.E. 188 + 00)	0 00 00.00			0 00 00.00	
R.M. #1 (d. 26.516m.)	131 39 14				
LAC - 1939	181 43 17.9				
U.S.E. B205 + 87.4(Azimuth)	185 22 06.5				

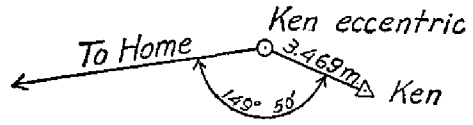
*These columns are for office use and should be left blank in the field.

Station: Ken | *State:* Maryland

Chief of party: C. V. H. | *Date:* 1917 | *Computed by:* O. P. S.

Observer: C. V. H. | *Instrument:* No. 168 | *Checked by:* W. F. R.

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction	Corrected direction with zero initial	Adjusted direction
	° ′ ″	′ ″	″	° ′ ″	′ ″
Chevy	0 00 00.00	− 7.31		0 00 00.00	
Tank west of △ Dulce	29 03 37.0	−1 09.8		29 02 34.5	
Ken (center), 3.469 meters	176 42				
Forest Glen standpipe	313 24 53.0	+3 01.2		313 28 01.5	
Home	326 31 30.21	+ 31.93		326 32 09.45	
Bureau of Standards, wireless pole	352 17 20.8	+ 5.7		352 17 33.8	
Reno	357 28 48.63	− 1.16		357 28 54.78	
Reference mark, 16.32 m	358 31 20				



This form, with the first three and fifth columns properly filled out and checked, must be furnished by field parties. *To be acceptable it must contain every direction observed at the station.*

It should be used for observations with both repeating and direction theodolites.

The directions at only one station should be placed on a page.

If a repeating theodolite is used, do not abstract the angles in tertiary triangulation. The local adjustment corrections (to close horizon only) are to be written in the Horizontal Angle Record, and the List of Directions is to be made from that record directly.

Choose as an initial for Form 24a some station involved in the local adjustment, and preferably one which has been used as an initial for a round of directions on objects not in the main scheme. Use but one initial at a station. Call the direction of the initial 0° 00′ 00.″ 00, and by applying the corrected angles to this, fill in opposite each station its direction reckoned *clockwise* around the whole circumference regardless of the direction of graduation of the instrument. The clockwise reckoning is necessary for uniformity and to make the directions comparable with azimuths.

If a station has been occupied eccentrically, reduce to the center and enter in this form, in ink, the resulting corrections to the observed directions in the column provided for them. If an eccentric reduction is necessary, but not made in the field, leave the column blank. If the station was occupied centrally, and no eccentric reduction is required, put dashes in the column to show that no corrections are necessary.

Directions in the main scheme should be entered to hundredths of seconds in first-order triangulation; otherwise to tenths only. Points observed upon but once, direct and reverse, should be carried to tenths in first-order and second-order triangulation, and to even seconds only in third-order triangulation. In general, but two uncertain figures should be given.

It is recommended that the following simple plan of observing be used with a repeating instrument: Measure each single angle in the scheme at each station and the outside angle necessary to close the horizon. *Measure no sum angles.* Follow each measurement of every angle immediately by a measurement of its explement. Six repetitions are to constitute a measurement. The local adjustment will consist simply of the distribution of the error of closure of the horizon.

Topo only

Pg 10
Vol 7

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 24A
Rev. Oct., 1932

LIST OF DIRECTIONS

Swin RM No 1, which is

Station USE B 188+00 State Washington

Chief of party R.W.K Date 7-5-39 Computed by RWK.

Observer R.W.K Instrument 245 Checked by JEW

U. S. GOVERNMENT PRINTING OFFICE: 1932 11—9503

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction*	Corrected direction with zero initial	Adjusted direction*
	° ′ ″	′ ″	″	° ′ ″	′ ″
USE B 205+~~00~~ 87.4	0 00 00.00			0 00 00.00	
Swin d= 26.516 m	124 02 10				
USE B 315+00 (comp)	11 ~~30~~ 28 ~~42~~ 34				

359 60
124 02 10
235 58

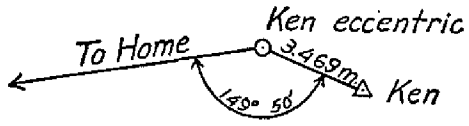
*These columns are for office use and should be left blank in the field.

Station: Ken | *State:* Maryland

Chief of party: C. V. H. | *Date:* 1917 | *Computed by:* O. P. S.

Observer: C. V. H. | *Instrument:* No. 168 | *Checked by:* W. F. R.

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction	Corrected direction with zero initial	Adjusted direction
	° ′ ″	′ ″	″	° ′ ″	′ ″
Chevy	0 00 00.00	− 7.31		0 00 00.00	
Tank west of △ Dulce	29 03 37.0	−1 09.8		29 02 34.5	
Ken (center), 3.469 meters	176 42				
Forest Glen standpipe	313 24 53.0	+3 01.2		313 28 01.5	
Home	326 31 30.21	+ 31.93		326 32 09.45	
Bureau of Standards, wireless pole	352 17 20.8	+ 5.7		352 17 33.8	
Reno	357 28 48.63	− 1.16		357 28 54.78	
Reference mark, 16.32 m	358 31 20				



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DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 24A
Rev. Oct., 1932

LIST OF DIRECTIONS

Station U.S.E. 109 + 89 *State* Washington

Chief of party R. W. Knox *Date* July 10 - Sept. 5, 1939 *Computed by* R.W.K.-J.E.W.

Observer R.W.K. & J.E.W. *Instrument* No. 317 *Checked by* H.J.O.-R.W.K.

U. S. GOVERNMENT PRINTING OFFICE: 1932 11—9503

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction*	Corrected direction with zero initial	Adjusted direction*
	° ′ ″	′ ″	″	° ′ ″	′ ″
PETH - 1939	0 00 00.00			0 00 00.00	
SWIN - 1939	98 47 17.2				
U.S.E. B315 + 00 (Comp.)	110 24 47.8				
U.S.E. (Azimuth)B131+82.5	119 18 06.9				

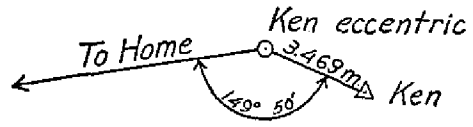
*These columns are for office use and should be left blank in the field.

Station: Ken *State:* Maryland

Chief of party: C. V. H. *Date:* 1917 *Computed by:* O. P. S.

Observer: C. V. H. *Instrument:* No. 168 *Checked by:* W. F. R.

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction	Corrected direction with zero initial	Adjusted direction
	° ′ ″	′ ″	″	° ′ ″	′ ″
Chevy	0 00 00.00	− 7.31		0 00 00.00	
Tank west of △ Dulce	29 03 37.0	−1 09.8		29 02 34.5	
Ken (center), 3.469 meters	176 42				
Forest Glen standpipe	313 24 53.0	+3 01.2		313 28 01.5	
Home	326 31 30.21	+ 31.93		326 32 09.45	
Bureau of Standards, wireless pole	352 17 20.8	+ 5.7		352 17 33.8	
Reno	357 28 48.63	− 1.16		357 28 54.78	
Reference mark, 16.32 m	358 31 20				



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DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

186+68.8

			°	′	″
α	2 Offset	to 3 Delta Rk 3	~~316~~	~~32~~	~~30.2~~
2d ∠		&	+		
α	2	to 1	172	43	49
Δα					
			180	00	00.0
α′	1	to 2	352	43	49

			°	′	″
α	3 Swin	to 2 Lac	357	08	19.2
3d ∠	@ Swin USE 188+00 &	Lac	− 50	04	04
α	3 Swim	to 1 USE 188+00	307	04	15
Δα				+	1
			180	00	00.0
α′	1 USE 188+00	to 3 Swin	127	04	16

First Angle of Triangle

	°	′	″			°	′	″
φ	48	22	40.034	2 Offset	λ	122	30	20.659
Δφ			117	d: 3.654 m.	Δλ			0.022
φ′	48	22	40.151	1 USE 315+00	λ′	122	30	20.681

	°	′	″			°	′	″
φ	48	24	36.918	3 Swin	λ	122	29	36.548
Δφ			−0.518	d: 26.516 m	Δλ			01.029
φ′	48	24	36.400	1 USE 188+00	λ′	122	29	35.519

	Logarithms
s	0.562 768
Cos α	9.996 495
B	8.510 207
h	9.069 470
s²	1.125 5
Sin²α	7.988 3
C	1.454 9
h²	
D	

Values in seconds		
1st term	−0.1173	
2d term	+	−
3d term	+	
−Δφ	−0.1173	

½(φ+φ′)	°	′	″
	48	22	40.04

	Logarithms	Values in seconds
s	0.562 768	
Sin α	9.102 229	
A′	8.508 904	
Sec φ′	0.177 691	
Δλ	8.351 592	022471
Sin ½(φ+φ′)		
−Δα		−

	Logarithms
s	1.423 508
Cos α	9.780 175
B	8.510 205
h	9.713 888
s²	2.847 0
Sin²α	9.803 9
C	1.455 4
	4.106 3
h²	
D	

Values in seconds		
1st term	+0.5175	
2d term	+	−
3d term	+	
−Δφ	+0.5175	

½(φ+φ′)	°	′	″
	48	24	36.6

	Logarithms	Values in seconds
s	1.423 508	
Sin α	9.901 944	
A′	8.508 903	
Sec φ′	0.177 968	
Δλ	−0.023 23	−1.0288
Sin ½(φ+φ′)	9.873 85 x²	
−Δα	9.896 174	−1

11—0362 U. S. GOVERNMENT PRINTING OFFICE 1936

Comp Rock.
Hgd

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 758

Angles

LIST OF PRELIMINARY-GRID-AZIMUTHS

(815400)

State Washington Locality Snoqualmie Pass Line Offset - 109+89.0

U.S. GOVERNMENT PRINTING OFFICE 11-11719

From station—	To station—	Preliminary azimuth	Correction for closure	Corrected azimuth
		° ' "	' "	° ' "
	109+89			187 02 00
@ 315+00 1860.8 567.17		00 41 58	— 26	00 41 - 32
2.753 713	296+39.2			
∠ 296+39.2	788.3 ft 240.27 M.	199 07 40	- 26	199 - 07 - 14 °
	2.380 700 L09			
∠ 289+50.9	970.3 295.75 491.50	202 44 40	-26	202 44 - 14 °
	2.470 925			
∠ 278+80.6	211.7 64.53	195 10 40	-26	195 10 - 14 ° (4)
	1.809 762			(5)
∠ 276+68.9	1341.7 408.95	146 39 20	-26	146 38 - 54
	2.611 660			
∠ 263+27.2	925.3 282.03	179 58 20	-26	179 57 -54 (6)
	2.450 295			(7)
∠ 254+01.9	110.8 33.77	149 00 00	-26	148 - 59 - 34
	1.528 531			(8)
∠ 252+91.1	955.2 291.14	181 45 30	-26	181 - 45 - 04
	2.464 102			
∠ 243+35.9	856.0 260.91	174 29 30	-26	174 - 29 - 04 (9)
	2.416 491			(10)
∠ 234+79.9	1538.8 469.03	184 58 40	-26	184 58 - 14
	2.671 201			
∠ 219+41.1	1353.7 412.61	187 35 00	-26	187 34 - 34 (11)
	2.615 540			(12)
∠ 205+87.4 544.80 5999	1918.6 584.79	173 58 40	-26	173 58 - 14
	2.767 000			
186+68.8				

Exterior ∡ N(360) − N−2(180) = 2 angles in Polygon
N = Number of sides. (2)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 758

Angles

LIST OF PRELIMINARY ~~GRID-AZIMUTHS~~

State ..... Locality ..... Line .....

U. S. GOVERNMENT PRINTING OFFICE 11—11710

From station—	To station—	Preliminary azimuth ° ′ ″	Correction for closure ′ ″	Corrected azimuth ° ′ ″
∠ 186 + 68.8	3658.1 1114.99 3.047 271	157 04 00	−26	157 03 34 (14)
∠ 150 + 10.7	1360.8 414.77 2.617 807	198 27 20	−26	198 26 − 54 (15)
∠ 136 + 49.9	467.4 142.46 2.153 693	181 09 00	−25	181 − 08 − 35 (16)
∠ 131 + 82.5 109+89	2193.5 668.58 2.825 153	196 10 20	−25	196 − 09 − 55 (17)
∠ 109 + 89.0	315+00	351 06 41	−25	351 − 06 − 16
∠ Sum		3052 480 − 439 439″	439	3051 532 480
∠				
∠				
∠				
∠				
∠				

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 758

Adjustment of Traverse G.P.s

~~LIST OF PRELIMINARY GRID AZIMUTHS~~

State _____ Locality Swinomish Slough. Line offset to 188+00

U. S. GOVERNMENT PRINTING OFFICE 11 11719

From station	To station	Preliminary azimuth	Correction for closure	Corrected azimuth
station	Distance M.	Accumulated dist.	Accumulated Correction to φ	Accumulated Correction to λ
∠ 315+00	00	00	00	00
296+39.2	567.17	567.17	00	.020
288+50.9	240.27	807.44	00	.028
∠ 278+80.6	295.75	1103.19	00	.038
277+68.9	64.53	1167.72	00	.040
263+27.2	408.95	1576.67	-.001	.054
∠ 254+01.9	282.03	1858.70	.001	.064
252+91.1	33.77	1892.47	.001	.065
243+35.9	291.14	2183.61	.001	.075
∠ 234+79.9	260.91	2444.52	.001	.084
219+41.1	469.03	2913.55	.001	.100
205+87.4	412.61	3326.16	.001	.114
∠ 188+00.0	544.80	3870.96	-0.002	+.133
			.0000344 Factor	
			188+00 to 109+89.0	
∠ 188+00	00	00	00	00
186+68.8	39.99	39.99	-.001	00
150+10.7	1114.99	1154.98	-.024	+009
∠ 136+49.9	414.77	1569.75	-032	+012
131+82.5	142.46	1712.21	-035	+014
109+89.0	668.58	2380.79	-.049	+.019
∠		Factor	.0000206	.00000798
∠				
∠				
∠				

0.06 Meters

274 Meters

1.52 M.

0.39 M.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 315+00	to 3 109+89	187	02	~~26~~ 00
2d ∠		&	+	41	32
α	2 315+00	to 1 296+39.2	187	43	~~58~~ 32
Δα					+03
			180	00	00.0
α′	1	to 2	07	43	35

			°	′	″
α	3	to 2			
3d ∠		&	−07	43	35
α	3	to 1			
Δα					
			180	00	00.0
α′	1	to 3			

First Angle of Triangle

	°	′	″			°	′	″
φ	48	22	40.152	2 315+00	λ	122	30	20.681
Δφ		+	18.195	567.18 M.	Δλ		−	03.705
φ′	48	22	58.347	1 296+39.2	λ′	122	30	16.976

	°	′	″			°	′	″
φ				3	λ			
Δφ					Δλ			
φ′				1	λ′			

	Logarithms	Values in seconds
s	2.753 713	58.347
Cos α	9.996 ~~033~~ 040	+1802.27
B	8.510 208	−(51.06)
h	1.259 9~~54~~ 61	1st term ″ 18.1951
s²	5.507 43	
Sin² α	8.257 79	
C	1.45 497	
	5.72 019	2d term +
h²		
D		
		3d term +
		−Δφ −18.195

	°	′	″
½(φ+φ′)	48	22	49.25

	Logarithms	Values in seconds
s	2.753 713	16.996
Sin α	9.128 ~~894~~ 490	+349.71
A′	8.508 904	−(884.85)
Sec φ′	0.177 733	
Δλ	0.568 ~~884~~ 889	−3.70 ~~89~~ 54 ″
Sin ½(φ+φ′)	9.873 652	
−Δα	0.442 492	2.77

	Logarithms	Values in seconds
s	2.753 713	+020
Cos α	9.996 03~~2~~ 9	
B	8.510 207	
h	1.259 95~~2~~ 9	1st term ″ 181950
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.753 713	
Sin α	9.128 ~~940~~ 537	
A′	8.508 904	
Sec φ′	0.177 691	
Δλ	0.568 845	3.70 55 ″
Sin ½(φ+φ′)	9.873 653	
−Δα	0.442 498	2.77

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 296+39.2	to 3 315+00	07	43	35
2d ∠		&	+199	07	14
α	2	to 1	206	50	49
Δα				+	04
			180	00	00.0
α′	1	to 2	26	50	53

			°	′	″
α	3	to 2			
3d ∠		&		−	
α	3	to 1	26	50	53
Δα					
			180	00	00.0
α′	1	to 3			

First Angle of Triangle

	°	′	″			°	′	″
φ	48	22	58.347	2 296+39.2	λ	122	30	16.978
Δφ		+	06.940		Δλ		−	05.276
φ′	48	23	05.287	1 288+50.9	λ′	122	30	11.702

	°	′	″			°	′	″
φ	48	23	06.287	3	λ			
Δφ					Δλ			
φ′				1	λ′			

	Logarithms	Values in seconds
s	2.380 700	05.287 + 163.3 −(1690.02)
Cos α	9.950 438	
B	8.510 207	
h	0.841 377	1st term 69404
s²		
Sin² α		
C		
		2d term +
h³		
D		
		3d term +
		−Δφ −

	°	′	″	+.028
½(φ+φ′)	48	23	05.817	

	Logarithms	Values in seconds
s	2.380 700	11.730 +341.36 −(993.29)
Sin α	9.654 810	
A′	8.508 903	
Sec φ′	0.177 783	
Δλ	0.722 114	5.2750
Sin ½(φ+φ′)	9.873 677	
−Δα	0.595 791	−3.948

	Logarithms	Values in seconds
s	2.380 700	
Cos α	9.950 438	
B	8.510 207	
h	0.841 345	1st term 6.9398
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

½(φ+φ′)		
	Logarithms	Values in seconds
s	2.380 700	
Sin α	9.654 887	
A′	8.508 904	
Sec φ′	0.177 736	
Δλ	0.722 227	5.2750
Sin ½(φ+φ′)		
−Δα		

11—9362 U. S. GOVERNMENT PRINTING OFFICE. 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 288+50.9	to 3 296+39.2	26	50	53
2d ∠		&	+202	44	14
α	2	to 1	229	35	07
Δα				+	08
			180	00	00.0
α′	1	to 2	49	35	15

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	49	35	15
Δα					
			180	00	00.0
α′	1	to 3			

First Angle of Triangle

	°	′	″			°	′	″
φ	48	23	06.287	2 288+50.9	λ	122	30	11.702
Δφ		+	06.207		Δλ		−	10.944
φ′	48	23	18.494	1 278+80.6	λ′	122	30	00.758

	°	′	″			°	′	″
φ	48	23	11.494	3	λ	122	30	00.758
Δφ		−	06.207		Δλ		+	10.944
φ′	48	23	06.287	1	λ′	122	30	11.702

	Logarithms
s	2.470 925
Cos α	9.811 788
B	8.510 207
h	0.792 918
s²	4.942
Sin² α	9.763
C	1.455
	6.160
h²	
D	

Values in seconds	
	11.494
	+355.04
	−(1498.29)
1st term	−6.207
2d term	+ .0001
3d term	+
−Δφ	−6.207

	°	′	″
½(φ+φ′)	48	23	09.390

	Logarithms	Values in seconds
s	2.470 925	00.796
Sin α	9.881 643	+16.37
A′	8.508 904	−(1218.11)
Sec φ′	0.177 768	
Δλ	1.039 194	10.944
Sin ½(φ+φ′)	9.873 690	
−Δα	0.912 884	−8.183

	Logarithms
s	2.470 925
Cos α	9.811 788
B	8.510 207
h	0.792 899
s²	4.942
Sin² α	9.763
C	1.455
	6.160
h²	
D	

Values in seconds	
1st term	+6.207
2d term	+ .0001
3d term	+
−Δφ	6.207

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.470 925	
Sin α	9.881 658	
A′	8.508 903	
Sec φ′	0.177 753	
Δλ	1.039 192	10.944
Sin ½(φ+φ′)		
−Δα		

11—0362 U. S. GOVERNMENT PRINTING OFFICE: 1929

(4)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

		°	′	″
α	2 278+80.6 to 3 288+50.9	49	35	15 47
2d ∠	&	+195	10	14
α	2 to 1	244	45	29
Δα			+	02
		180	00	00.0
α′	1 to 2	64	45	31

		°	′	″
α	3 to 2			
3d ∠	&	−		
α	3 to 1	64	45	31
Δα			−	02
		180	00	00.0
α′	1 to 3	244	45	29

First Angle of Triangle

	°	′	″			°	′	″
φ	48	23	12.493	2 278+80.6	λ	122	30	00.252
Δφ		+	00.891		Δλ		−	02.837
φ′	48	23	13.385	1 276+68.9	λ′	122	29	57.921

	°	′	″			°	′	″
φ	48	23	12.385	3	λ	122	29	57.921
Δφ		−	0.891		Δλ		−	02.837
φ′	48	23	11.493	1	λ′	122	30	00.758

	Logarithms
s	1.809 762
Cos α	9.629 860 443
B	8.510 207
h	9.949 829
s²	
Sin² α	
C	
h³	
D	

Values in seconds	
12.385	
	+382.56
	−(1470.77)
1st term	.890 86
2d term	+
3d term	+
−Δφ	

	°	′	″	+.040
½(φ+φ′)	48	23	12.938	

	Logarithms	Values in seconds
s	1.809 762	57.961
Sin α	9.956 428	+119254 −(41.94)
A′	8.508 903	
Sec φ′	0.177 770	
Δλ	0452851	−2.8369
Sin ½(φ+φ′)	9.873 696	
−Δα	0.326 549	−2.12

	Logarithms
s	1.809 762
Cos α	9.629 851 734
B	8.510 207
h	9.949 820
s²	
Sin² α	
C	
h³	
D	

Values in seconds	
1st term	.89064
2d term	+
3d term	+
−Δφ	

	°	′	″
½(φ+φ′)	48	23	12.938

	Logarithms	Values in seconds
s	1.809 762	
Sin α	9.956 428	
A′	8.508 903	
Sec φ′	0.177 768	
Δλ	0.452851	2.8369
Sin ½(φ+φ′)	9.873 696	
−Δα	0.326 547	2.121

11—9362 U. S. GOVERNMENT PRINTING OFFICE: 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

		°	′	″
α	2 276+68.9 to 3 278+80.6	64	45	31 ~~57~~
2d ∠	&	+146	38	54
α	2 to 1	211	24	25
Δα			+	08
		180	00	00.0
α′	1 to 2	31	24	33

		°	′	″
α	3 to 2			
3d ∠	&	−		
α	3 to 1	31	24	33
Δα				−08
		180	00	00.0
α′	1 to 3	211	24	25

FIRST ANGLE OF TRIANGLE

	°	′	″			°	′	″
φ	48	23	12.385	2 276+68.9	λ	122	29	57.921 ~~913~~
Δφ		+	11.299		Δλ		−	10.358
φ′	48	23	23.684	1 263+27.2	λ′	122	29	47.563

	°	′	″			°	′	″
φ	48	23	23.684	3	λ	122	29	47.563
Δφ		−	11.298		Δλ			10.358
φ′	48	23	12.385	1	λ′	122	29	57.921

	Logarithms	Values in seconds
s	2.611 660	−001 23.683
Cos α	− 9.931.197 ~~164~~	+ 731.53
B	8.510 207	−(1121.80)
h	1.053 064	1st term − 11.2996 ~~11.2988~~
s²	5.223	
Sin² α	9.432	
C	1.455	
	6.110	2d term + .00013
h²	2.106	
D	2.390	
	4.497	3d term +
		−Δφ −11.2995

	°	′	″	+054
½(φ+φ′)	48	23	19.034	

	Logarithms	Values in seconds
s	2.611 660	47.617
Sin α	− 9.716 932	+979.61
A′	8.508 903	−(254.76)
Sec φ′	0.177 797	
Δλ	1.015 292	−10.3584 ~~10.3605~~
Sin ½(φ+φ′)	9.873 708	
−Δα	0.889 000	−7.764

	Logarithms	Values in seconds
s	2.611 660	
Cos α	+ 9.931 195 ~~154~~	
B	8.510 207	
h	1.053 062	1st term + 11.2984
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ +

	°	′	″
½(φ+φ′)	48	23	19.03

	Logarithms	Values in seconds
s	2.611 660	
Sin α	+ 9.716 960	
A′	8.508 903	
Sec φ′	0.177 770	
Δλ	1.015 293	10.3584 ~~10.3605~~
Sin ½(φ+φ′)	9.873 708	
−Δα	0.889 090	7.746

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

		°	′	″			°	′	″
α	2 263+27.2 to 3 276+68.9	31	24	33 39	α	3 to 2			
2d ∠	&	+179	57	54	3d ∠	&	−		
α	2 to 1	211	22	27	α	3 to 1	31	22	32
Δα			+	05	Δα			−	05
		180	00	00.0			180	00	00.0
α′	1 to 2	31	22	32	α′	1 to 3	211	22	27

First Angle of Triangle

		°	′	″			°	′	″
φ	48	23	24.683 4	2 263+27.2	λ	122	29	47.563 6	
Δφ		+	07.796		Δλ		−	07.137	
φ′	48	23	31.480 1	1 254+01.9	λ′	122	29	40.426	

		°	′	″			°	′	″
φ	48	23	31.480	3	λ	122	29	40.426	
Δφ		−	07.796		Δλ			07.137	
φ′	48	23	24.684	1	λ′	122	29	47.563	

	Logarithms	Values in seconds
s	2.450 195	31.481 −.001
Cos α	9.931 349 316	+972.41 −(880.91)
B	8.510 207	
h	0.891851	1st term − 7.795 06
s²	4.900	
Sin² α	9.433	
C	1.455	
	5.788	2d term +
h²		
D		
		3d term +
		−Δφ −

	°	′	″ +.064			
½(φ+φ′)	48	23	28.58			
		Logarithms	Values in seconds 40.490			
s		2.450 295	+832.96 −(401.36)			
Sin α		9.716 525 616				
A′		8.508903				
Sec φ′		0.177815				
Δλ		0.853538	7.138 74			
Sin ½(φ+φ′)		9.873726				
−Δα		0.727264	− 5.338			

	Logarithms	Values in seconds
s	2.450 295	
Cos α	9.931 349 42	
B	8.510 207	
h	0.891844	1st term 07.794 55
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ +

	°	′	″	
½(φ+φ′)				
	Logarithms	Values in seconds		
s	2.450 295			
Sin α	9.716 542			
A′	8.508 903			
Sec φ′	0.177 797			
Δλ	0.853537	+ 7.138 74		
Sin ½(φ+φ′)	9.873 726			
−Δα	0.727263	5.338		

11—9362 U. S. GOVERNMENT PRINTING OFFICE, 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

		°	′	″			°	′	″
α	2 254+01.8 to 3 363+27.2	31	22	32 / 58	α	3 to 2			
2d ∠	&	+148	59	34	3d ∠	&	−		
α	2 to 1	180	22	06	α	3 to 1	00	22	06
Δα				00	Δα				00
		180	00	00.0			180	00	00.0
α′	1 to 2	00	22	06	α′	1 to 3	180	22	06

First Angle of Triangle

	°	′	″			°	′	″		°	′	″		°	′	″
φ	48	23	38.480	2 254+01.9	λ	122	29	40.426	φ	48	23	33.573	3	λ	122	29	40.416
Δφ		+	01.093		Δλ		−	0.010	Δφ		−	1.093		Δλ		+	0.010
φ′	48	23	38.573	1 152+91.1	λ′	122	29	40.416	φ′	48	23	32.478	1	λ′	122	29	40.426

	Logarithms	Values in seconds
s	1.528 531	32.572 (−.091)
Cos α	9.999 991	+1006.12
B	8.510 206	−(847.21)
h	0.038 728	1st term ″ 1.0932
s^2		
$\sin^2\alpha$		
C		
		2d term +
h^3		
D		
		3d term +
		−Δφ −

	°	′	″	+.065	Logarithms	Values in seconds
½(φ+φ′)	48	23	33.02			
s					1.528 531	
Sin α					7.808 115	+832.77
A′					8.508 903	−(401.54)
Sec φ′					0.177 81.8	
Δλ					8.023 367	″ −0.01055
$\sin\frac{1}{2}(\phi+\phi')$					9.873 734	
−Δα					7.899 101	0.008

	Logarithms	Values in seconds
s	1.528 531	
Cos α	9.999 991	
B	8.510 206	
h	0.038 728	1st term ″ 1.0932
s^2		
$\sin^2\alpha$		
C		
		2d term +
h^3		
D		
		3d term +
		−Δφ

	°	′	″	Logarithms	Values in seconds
½(φ+φ′)					
s				1.528 531	
Sin α				7.808 115	
A′				8.508 903	
Sec φ′				0.177 815	
Δλ				8.023 364	″ 0.010553
$\sin\frac{1}{2}(\phi+\phi')$				9.873 734	
−Δα				7.90	.008

11—9362 U. S. GOVERNMENT PRINTING OFFICE. 1929

(8)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 252+91.1	to 3 254+01.9	00	22	06 ~~32~~
2d ∠		&	+181	45	04
α	2	to 1	182	07	10
Δα					00
			180	00	00.0
α′	1	to 2	02	07	10

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	02	07	10
Δα					00
			180	00	00.0
α′	1	to 3	182	07	10

FIRST ANGLE OF TRIANGLE

	°	′	″			°	′	″
φ	48	23	32.573	2 252+91.1	λ	122	29	40.416 ~~403~~
Δφ		+	09.419		Δλ		−	0.523
φ′	48	23	41.992	1 243+35.9	λ′	122	29	39.893

	°	′	″			°	′	″
φ	48	23	41.992	3	λ	122	29	39.893 ~~878~~
Δφ		−	09.419		Δλ		+	0.523
φ′	48	23	32.573	1	λ′	122	29	40.416

	Logarithms	Values in seconds
s	2.464 102	41.991
Cos α −	9.999 703	+ 1297.05
B	8.510 206	−(556.28)
h	0.974 011	1st term − 9.4191 ″
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)	48	23	38.28 +.075

	Logarithms	Values in seconds
s	2.464 102	39.968
Sin α −	8.568000	+822.17
A′	8.508903	−(41207)
Sec φ′	0.177840	
Δλ	9.718845	−.52 ~~520~~ 341
Sin ½(φ+φ′)	9.873744	
−Δα	9.592589	.392

	Logarithms	Values in seconds
s	2.464 102	
Cos α +	9.999703	
B	8.510206	
h	0.974011	1st term 9.4191 ″
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.464 102	
Sin α +	8.568000	
A′	8.508903	
Sec φ′	0.177818	
Δλ	9.718823	.52 ~~517~~ 339
Sin ½(φ+φ′)	9.873744	
−Δα	9.592567	3927

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 243 + 35.9	to 3 252 + 91.1	02	07	~~36~~ 10
2d ∠		&	+ 174	29	04
α	2	to 1	176	36	14
Δα				−	01
			180	00	00.0
α′	1	to 2	356	36	13

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	356	36	13
Δα					01
			180	00	00.0
α′	1	to 3	176	36	

First Angle of Triangle

	°	′	″			°	′	″
φ	48	23	~~48~~ 1.99~~2~~ 2	2 243 + 35.9	λ	122	29	39.8~~78~~ 93
Δφ		+	08.432		Δλ		+	00.751
φ′	48	23	~~51~~ 50.424	1 234 + 79.9	λ′	122	29	40.644

	°	′	″			°	′	″
φ	48	23	50.42~~2~~ 4	3	λ	122	29	40.644
Δφ		−	08.432		Δλ		−	7.751
φ′	48	23	42.992	1	λ′	122	29	39.893

	Logarithms	Values in seconds
s	2.416 491	−.001 50.423
Cos α −	9.999 2~~40~~ 37	+ 1557.51
B	8.510 206	−(295.82)
h	0.925 934	1st term − 8.4321″
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ −

	°	′	″
½(φ+φ′)	48	23	47.20 +.084

	Logarithms	Values in seconds
s	2.416 491	40.728
Sin α +	8.772 605	+837.81
A′	8.508 903	−(396.53)
Sec φ′	0.177 857	
Δλ	9.875 856	+.75137″
Sin ½(φ+φ′)	9.873 760	
−Δα	9.749 616	+5.[illegible]

	Logarithms	Values in seconds
s	2.416 491	
Cos α +	9.999 23~~9~~ 6	
B	8.510 206	
h	0.925 933	1st term 8.4321″
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ +

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.416 491	
Sin α −	8.772 640	
A′	8.508 903	
Sec φ′	0.177 840	
Δλ	9.875 874	.75141″
Sin ½(φ+φ′)	9.873 760	
−Δα	9.749 634	.561

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

		°	′	″
α	2 2 3 4 + 7 9 . 9 to 3 2 4 3 + 3 5 . 9	356	36	13
2d ∠	&	+184	58	14
α	2 to 1	181	34	27
Δα			+	00
		180	00	00.0
α′	1 to 2	01	34	27

		°	′	″
α	3 to 2			
3d ∠	&	−		
α	3 to 1	01	34	27
Δα				00
		180	00	00.0
α′	1 to 3	181	34	

First Angle of Triangle

	°	′	″			°	′	″
φ	48	23	5X 42 2	2 2 3 4 + 7 9 . 9	λ	122	29	40.644
Δφ		+	15.179		Δλ		−	0.626
φ′	48	24	05.602	1 2 1 9 + 4 1 . 1	λ′	122	29	40.018

	°	′	″			°	′	″
φ	48	24	06.601	3	λ	122	29	40.018
Δφ		−	15.179		Δλ		+	0.626
φ′	48	23	51.422	1	λ′	122	29	40.644

	Logarithms	Values in seconds
s	2.671 201	05.602 −401
Cos α	9.999 836	+ 173.03
B	8.510 206	−(1680.30)
h	1.181 243	1st term + 15.179
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ −

	°	′	″	+.100
½(φ+φ′)	48	23	58.01	

	Logarithms	Values in seconds
s	2.671 201	40.118
Sin α	8.438 873	+825.19
A′	8.508 903	−(408.96)
Sec φ′	0.177 898	
Δλ	9.796 870	.62643
Sin ½(φ+φ′)	9.873 781	
−Δα	9.670 651	46844

	Logarithms	Values in seconds
s	2.671 201	
Cos α	9.999 835	
B	8.510 206	
h	1.181 242	1st term + 15.179
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.671 201	
Sin α	8.438 873	
A′	8.508 903	
Sec φ′	0.177 854	
Δλ	9.796 831	0.62637
Sin ½(φ+φ′)	9.873 781	
−Δα	9.670 612	468 5

11—9362 U. S. GOVERNMENT PRINTING OFFICE 1925

(11)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 219+41.1	to 3 234+79.7	01	34	27
2d ∠		&	+187	34	34
α	2	to 1	189	09	01
Δα				+	02
			180	00	00.0
α′	1	to 2	9	09	03

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	09	09	03
Δα				−	02
			180	00	00.0
α′	1	to 3	189	09	01

First Angle of Triangle

	°	′	″			°	′	″
φ	48	24	05.603	2 219+41.1	λ	122	29	40.088
Δφ		+	13.188		Δλ		− 0	03.190
φ′	48	24	18.791	1 205+87.4	λ′	122	29	36.828

	°	′	″			°	′	″
φ	48	24	18.791	3	λ	122	29	36.828
Δφ		−	13.188		Δλ		+	3.190
φ′	48	24	05.603	1	λ′	122	29	40.018

	Logarithms	Values in seconds
s	2.615540	− .001 18.790
Cos α −	9.994438	+ 580.40 −(1272.93)
B	8.510205	
h	1.120183	1st term − 13.188 ″
s²	5.230	
Sin² α	8.402	
C	1.455	
	5087	2d term +
h²		
D		
		3d term +
		−Δφ −

	°	′	″
½(φ+φ′)	48	24	13.195 +.114

	Logarithms	Values in seconds
s	2.615540	36.942
Sin α −	9.201464	+ 759.78 −(474.23)
A′	8.508903	
Sec φ′	0.177925	
Δλ	0.503832	− 3.1903 ″
Sin ½(φ+φ′)	9.873808	
−Δα	0.377640	2.38

	Logarithms	Values in seconds
s	2.615540	
Cos α +	9.994437	
B	8.510205	
h	1.120182	1st term + 13.188 ″
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.615540	
Sin α +	9.201490	
A′	8.508903	
Sec φ′	0.177893	
Δλ	0.503826	3.1902 ″
Sin ½(φ+φ′)	9.873808	
−Δα	0.377634	2.38

20587.4
18800.0
1787.4 ft.
18800.0
20587.4

542.5451
2.2555
544.8006 - M.
2.736237

03-07-44
124-02.0
127-09-54
04-16
05-38

12

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 205+87.4	to 3 (100) 219+41.1	09	09	03
2d ∠		&	+173	58	14
α	2	to 1	183	07	17
Δα				+	01
			180	00	00.0
α′	1 188+00	to 2 250+87.4	03	07	18

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	03	07	18
Δα				−	01
			180	00	00.0
α′	1	to 3	183	07	17

First Angle of Triangle

Check Position

	°	′	″			°	′	″
	48	24	36.400			122	29	35.519
φ	48	24	18.791	2 205+87.4	λ	122	29	36.828
Δφ		+	17.611		Δλ			01.442
φ′	48	24	36.402	1 188+00	λ′	122	29	35.386

	°	′	″			°	′	″
φ	48	24	36.402	3	λ	122	29	35.386
Δφ		−	17.611		Δλ		+	01.442
φ′	48	24	18.791	1	λ′	122	29	36.828

	Logarithms	Values in seconds
s	2.736237	36.400
Cos α	9.999135 5	+ 1124.36 −(728.97)
B	8.510205	
h	1.245797	1st term 17.6114
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)	48	24	27.594

	Logarithms	Values in seconds
s	2.736237	35.519
Sin α	8.736010	+730.45 −(503.46)
A′	8.508903	
Sec φ′	0.177966	
Δλ	0.159116	1.4425
Sin ½(φ+φ′)	9.873836	
−Δα	0.032952	1.079

	Logarithms	Values in seconds
s	2.736237	
Cos α	9.999354	
B	8.510205	
h	1.245796	1st term 17.6114
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
½(φ+φ′)	48	24	27.594

	Logarithms	Values in seconds
s	2.736237	
Sin α	8.736049	
A′	8.508903	
Sec φ′	0.177925	
Δλ	0.159112	1.4425
Sin ½(φ+φ′)	9.873836	
−Δα	0.033320	1.081

519
384
135

Take New Position and use Same Azimuth.
188+00
186+68.8
131.2

37.92888
0.06096
37.98984

39.99
1.601951

Assume 188+00 is on line between 205+87.4 and 186+68.8

(13)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 188+00	to 3 205+87.4	03	07	18
2d ∠		&	+180		
α	2	to 1	183	07	18
Δα					—
			180	00	00.0
α′	1	to 2	03	07	18

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	03	07	18
Δα					—
			180	00	00.0
α′	1	to 3			18

First Angle of Triangle

	°	′	″			°	′	″
φ	48	24	36.400	2 188+00	λ	122	29	35.519
Δφ		+	1.293		Δλ		−	0.106
φ′	48	24	37.693	1 186+68.8	λ′	122	29	35.413

	°	′	″			°	′	″
φ	48	24	37.693	3	λ	122	29	35.413
Δφ		−	01.293		Δλ		+	0.106
φ′	48	24	36 H00	1	λ′	122	29	35.519

	Logarithms
s	1.601.951
Cos α	9.999 358 4
B	8.510205
h	0.111510
s²	
Sin² α	
C	
h²	
D	

Values in seconds: −001, 37.692, +1164.26, −(689.08)

		″
1st term	−	1.29273
2d term	+	
3d term	+	
−Δφ		

½(φ+φ′)	° 48	′ 24	″ 37.04	000
	Logarithms		Values in seconds	
s	1.601 951		35.413	
Sin α	8.736049		+728.27	
A′	8.508903		−(505.73)	
Sec φ′	0.177970			″
Δλ	9.024873		.10589	
Sin ½(φ+φ′)	9.873854			
−Δα	8.898727		.0−	

	Logarithms
s	1.601 951
Cos α	9.999 354
B	8.510 205
h	0.111510
s²	
Sin² α	
C	
h²	
D	

Values in seconds

		″
1st term		1.2928
2d term	+	
3d term	+	
−Δφ		

½(φ+φ′)	°	′	″
	Logarithms		Values in seconds
s	1.601 951		
Sin α	8.736049		
A′	8.508903		
Sec φ′	0.177967		
Δλ	9.024870		″ .10589
Sin ½(φ+φ′)	9.873854		
−Δα	8.89		—

11—9362 U. S. GOVERNMENT PRINTING OFFICE 1935

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 186+68.8	to 3 2057+87.4	03	07	18
2d ∠		&	+157	03	3.4
α	2	to 1	160	10	52
Δα				−	14
			180	00	00.0
α′	1	to 2	340	10	38

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	340	10	38
Δα				−1	14
			180	00	00.0
α′	1	to 3	160	10	52

First Angle of Triangle

	°	′	″			°	′	″
φ	48	24	37.693	2 186+68.8	λ	122	29	35.413
Δφ		+	33960		Δλ		+	18.386
φ′	48	25	11.653	1 150+10.7	λ′	122	29	53.799

	°	′	″			°	′	″
φ	48	25	11.653	3	λ	122	29	53.799
Δφ		−	33959		Δλ		−	18.386
φ′	48	24	37.694	1	λ′	122	29	35.413

	Logarithms
s	3.047 271
Cos α	9.973 483
B	8.510 205
h	1.530 969
s²	6.094
Sin² α	9.060
C	1.455
	6.609
h²	3.062
D	2.390
	5.452

Values in seconds	
	−.024
	11.629
	+359.21
	−(149413)
1st term	+ 339.604
2d term	+ .0004
3d term	+
−Δφ	−33.9597

	°	′	″ +.009
½(φ+φ′)	48	24	54.673

	Logarithms	Values in seconds
s	3.047 271	53.808
Sin α	+ 9.530 261	+1106.35
A′	8.508 903	−(127.31)
Sec φ′	0.178 050	
Δλ	1.264 485	+18.386
Sin ½(φ+φ′)	9.873 887	
−Δα	1.138 372	+13.752

	Logarithms	Values in seconds
s	3.047 271	
Cos α	+ 9.973 472	
B	8.510 204	
h	1.530 947	
s²	6.094	
Sin² α	9.060	
C	1.455	
	6.609	
h²		
D		

	Values in seconds
1st term	+ 339.588
2d term	+ .0004
3d term	+
−Δφ	−33.9588

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	3.047 271	
Sin α	− 9.530 343	
A′	8.508 903	
Sec φ′	0.177 970	
Δλ	1.264 487	−18.386
Sin ½(φ+φ′)	9.873 887	
−Δα	1.138 374	13.75

11—0362 U. S. GOVERNMENT PRINTING OFFICE 1975

(15)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 150 + 10.7	to 3 186 + 68.8	340	10	~~48~~ 3
2d ∠		&	+ 198	26	54
α	2	to 1	178	37	32
Δα					0
			180	00	00.0
α′	1	to 2	358	37	32

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	358	37	32
Δα					
			180	00	00.0
α′	1	to 3	178	37	41

First Angle of Triangle

	°	′	″				°	′	″
φ	48	25	11.653	2 150 − 10.7	λ	122	29	53.799
Δφ		+	13.424		Δλ			+ 0.484
φ′	48	25	25.077	1 136 + 49.9	λ′	122	29	54.283

	°	′	″			°	′	″
φ	48	25	25.077	3	λ	122	29	54.283
Δφ		−	13.424		Δλ		−	0.484
φ′	48	25	11.653	1	λ′	122	29	53.799

	Logarithms
s	2.617 807
Cos α −	9.999 870
B	8.510 204
h	1.127 881
s²	5.236
Sin² α	6.755
C	1.455
	3.446
h²	
D	

Values in seconds	
−.032	
25.045	
+ 773.68	
−(1079.71)	
1st term	13.424″
2d term	+
3d term	+
−Δφ	−

	°	′	″
½(φ+φ′)	48	25	18.365 +.012

	Logarithms	Values in seconds
s	2.617 807	54.295
Sin α +	8.379 963	+1116.30
A′	8.508903	−(117.29)
Sec φ′	0.178082	
Δλ	9.684755	0.48390″
Sin ½(φ+φ′)	9.873 931	
−Δα	9.558686	.360

	Logarithms
s	2.617 807
Cos α +	9.999 870
B	8.510204
h	1.127881
s²	
Sin² α	
C	
h²	
D	

Values in seconds	
1st term	+13.424″
2d term	+
3d term	+
−Δφ	+

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.617 807	
Sin α −	8.379 963	
A′	8.508902	
Sec φ′	0.178050	
Δλ	9.684722	.48386″
Sin ½(φ+φ′)	9.873 931	
−Δα	9.558653	.36

(16)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

		°	′	″
α	2 136+49.9 to 3 150+19.7	358	57	32 58
2d ∠	&	+181	08	35
α	2 to 1	179	46	07
Δα				00
		180	00	00.0
α′	1 to 2	359	46	07

		°	′	″
α	3 to 2			
3d ∠	&	−		
α	3 to 1	359	46	07
Δα				
		180	00	00.0
α′	1 to 3			

First Angle of Triangle

	°	′	″			°	′	″
φ	48	25	25.077	2 136+49.9	λ	122	29	54.283
Δφ		+	04.612		Δλ		+	0.028
φ′	48	25	29.689	1 131+82.5	λ′	122	29	54.311

	°	′	″			°	′	″
φ	48	25	29.689	3	λ	122	29	54.361
Δφ		−	04.612		Δλ		−	0.028
φ′	48	25	25.077	1	λ′	122	29	54.283

	Logarithms	Values in seconds
s	2.153 693	29.654 −.035
Cos α	9.999 996	+915.97
B	8.510 204	−(937.35)
h	0.663 893	
s²		1st term −4.6120
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″ +.014	Logarithms	Values in seconds
½(φ+φ′)	48	25	27.383		
s				2.153 693	54.325
Sin α				7.606 219	+116.87
A′				8.508 902	−(116.68)
Sec φ′				0.178 093	
Δλ				8.446 907	.027 98
Sin ½(φ+φ′)				9.873 948	
−Δα				8.320 855	—

	Logarithms	Values in seconds
s	2.153 693	
Cos α	9.999 996	
B	8.510 204	
h	0.663 893	1st term 4.6120
s²		
Sin² α		
C		
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″	Logarithms	Values in seconds
½(φ+φ′)					
s				2.153 693	
Sin α				7.606 219	
A′				8.508 903	
Sec φ′				0.178 082	
Δλ				8.446 897	.027 98
Sin ½(φ+φ′)				9.873	
−Δα				8.306	

11—9362 U. S. GOVERNMENT PRINTING OFFICE 1926

Azimuth 109+89.0 to 315+00 = 07-02-26 computed.
+ 131+82.5 to 315+00 = 351-06-16 ← adjusted angle. See Page 2
Azimuth 109+89.0 to 131+82.5 = 155 6-40

(17)

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2 131+82.5	to 3 136+49.8	359	46	~~33~~ 07
2d ∠	&		+ 196	09	55
α	2 131+82.5	to 1 109+89.0	195	56	02
Δα				+	07
			180	00	00.0
α′	1 109+89.0	to 2 131+82.5	15	56	09

			°	′	″
α	3	to 2			
3d ∠	&		−		
α	3	to 1	15	56	09
Δα				−	07
			180	00	00.0
α′	1	to 3	15	56	02

First Angle of Triangle

48 25 50.453 122 29 45.402

φ	48	25	29.689	2 131+82.5	λ	122	29	54.331
Δφ		+	20.813	−.049	Δλ		−	08.928
φ′	~~48~~	~~25~~	~~50.502~~	1 109+89.0	λ′	~~122~~	~~29~~	~~45.383~~ +.019

φ	48	25	50.502	3	λ	122	29	45.383
Δφ		−	20.813		Δλ		+	08.928
φ′	48	25	29.689	1	λ′	122	29	54.311

	Logarithms	Values in seconds
s	2.825 153	~~+.049~~ ~~50.453~~ +1558.43 (294.89)
Cos α	9.982985	
B	8.510 204	
h	1.318342	
s²		
Sin² α		
C		
h²		
D		
1st term		20.813
2d term	+	
3d term	+	
−Δφ		

	°	′	″	+.019
½(φ+φ′)	48	25	40.096	

	Logarithms	Values in seconds
s	2.825 153	45.402 +933.32 (300.08)
Sin α	9.458 587	
A′	8.508 902	
Sec φ′	0.178 142	
Δλ	0.950 784	− 8.928 6
Sin ½(φ+φ′)	9.873 971	
−Δα	0.824 755	6.680

	Logarithms	Values in seconds
s	2.825 153	
Cos α	9.982 981	
B	8.510 208	
h	1.318 337	
s²		
Sin² α		
C		
h²		
D		
1st term	+	20.813
2d term	+	
3d term	+	
−Δφ	+	

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	2.825 153	
Sin α	9.438 631	
A′	8.508 902	
Sec φ′	0.178 093	
Δλ	0.950 779	8.928 5
Sin ½(φ+φ′)	9.873 971	
−Δα	0.824 750	6.680

11—9362 U. S. GOVERNMENT PRINTING OFFICE 1931

Use 48-25-50.445 +1558.2 −(295.1)

122+29-45.403 +933.32 −(300.08)

Later Position of 109+89.0 after recomputation of triangulation. Traverse was not readjusted for this Difference but smaller error absorbed in last computation between 131+82.5 and 109+89.0

Topo Only

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 25
Ed. Jan., 1929

COMPUTATION OF TRIANGLES

State: _____

11—9121

NO.	STATION	OBSERVED ANGLE	CORR'N	SPHER'L ANGLE	SPHER'L EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
2-3	USE 186+68.8	N	69,946.4				
1		E	61,220.1				
2							
3	Az - 188+00 = 03-05-10						
1-3	186+68.8	d =	131.2				
1-2							
2-3						Log 131.2	2.117 934
1						Log Sin 03°05'10"	8.731 079
2						Log Cos "	9.999 370
3	USE 186+68.8 : N 69,946.4 E 61,220.1					Log DE. -	0.849 013 = -7.06 ft
1-3		- 131.0	- 7.1			Log DN =	2.117 304 = -131.01
1-2	USE 188+00.0 : N 69,815.4 E 61,213.0						
2-3	USE 188+00	N 69,815.4			E	61,213.0	
1	USE 315+00	N 58,029.8				58,169.5	
2			11,785.6			3,043.5	
3							
1-3							
1-2	log 11,785.6 = 4.071 351 74 x 2 =					8.142 703 48 =	138,900,407.7
	log 3,043.5 = 3.483 373 3 x 2 =					6.966 746 6	9,262,891.5
							148,163,299.2
2-3						Log d^2	8.170 7407
1						Log	4.085 3704
2						Factor	9.484 0158
3	d. Trav = 3711.05					Log d - in M.	3.569 3862
1-3	d - D = 3708.95 M. 2.10					Log d - in M. Δ	3.569 251 1
1-2							

Do not write in this margin

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

INVERSE

CHECK

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3			
2d ∠		&	+		
α	2	to 1	194	30	06.6
Δα					33.8′
			180	00	00.0
α′	1	to 2	14	30	404

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	14	30	404
Δα				−	33.8
			180	00	00.0
α′	1	to 3	194	30	06.6

First Angle of Triangle

	°	′	″			°	′	″
φ	48	22	40.151	2 USE 315+00	λ	122	30	20.681
Δφ		+1	56.249		Δλ		−0	45.162
φ′	48	24	36.400	1 USE 188+00	λ′	122	29	35.519

	°	′	″			°	′	″
φ	48	24	36.400	3 USE 188+00	λ	122	29	35.519
Δφ	−	01	56.248		Δλ		−1	45.162
φ′	48	22	40.152	1 USE 315+00	λ′	122	30	20.681

	Logarithms	Values in seconds
s	3.555 189	n
Cos α	8.510 208	
B		
h	2.065 397	1st term −116.″251
s²		
Sin² α	5.93581	
C	1.454 97	
	7.39078	2d term + 0.007′
h²		
D		
		3d term +
		−Δφ −116.249

	° ′ ″	Logarithms	Values in seconds
½(φ+φ′)	48 23 38.2		
s			
Sin α		2.967 904	n
A′		8.508 903	
Sec φ′		0.177 966	
Δλ		1.654 773′	−45.″162
Sin ½(φ+φ′)		9.873 744′	
−Δα		1.528 517	−33.76′

	Logarithms	Values in seconds
s	3.569 251	
Cos α	9.985 920	
B	8.510 205	
h	2.065376	1st term +116.″246
s²	7.1395	
Sin² α	8.7979	
C	1.4554	
	7.3928	2d term + 0.002
h²		
D		
		3d term +
		−Δφ 116.248

	° ′ ″	Logarithms	Values in seconds
½(φ+φ′)			
s		3.569 251	
Sin α		9.398 928	
A′		8.508 904	
Sec φ′		0.177 691	
Δλ		1.654 774	45.″162
Sin ½(φ+φ′)		9.873744	
−Δα		1.528518	−33.769

S sin α = 2.967 904 n′
S cos α = 3.555 189 n′
9.412 715 p.
194 30 06.56

S sin α = 2.967 904
9.398 653′
3.569 251″ = d

S cos α = 3.555 189
9.985 938′
3.569 251

11—9302 U. S. GOVERNMENT PRINTING OFFICE 1936

INVERSE Topo only CHECK.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3			
2d ∠		&	+		
α	2	to 1	07	02	26.47
Δα					26.38
			180	00	00.0
α′	1	to 2	187	02	00.09

			°	′	″
α	3	to 2			
3d ∠		&	−		
α	3	to 1	187	02	00.09
Δα					
			180	00	00.0
α′	1	to 3			

First Angle of Triangle

	°	′	″			°	′	″
φ	48	25	50.453	2 USE 109+89	λ	122	29	45.402
Δφ		− 3	10.302		Δλ		+	35.279
φ′	48	22	40.151	1 USE 315+00	λ′	122	30	20.681

	°	′	″			°	′	″
φ	48	22	40.151	3 USE 315+00	λ	122	30	20.681
Δφ		+03	10.302		Δλ			
φ′	48	25	50.453	1 USE 109+89	λ′			

	Logarithms	Values in seconds
s		
Cos α	3.769 235	p
B	8.510 204	
h	2.279 439	1st term + 190.300
s²		
Sin² α	5.72184	
C	1.45578	
	7.17762	2d term + 0.002
h²		
D	2.3898	
		3d term +
		−Δφ + 190.302

	° ′ ″	Logarithms	Values in seconds
½(φ+φ′)	48 24 15.2		
s			
Sin α		2.860 921	p
A′		8.508 904	
Sec φ′		0.177 691	
Δλ		1.547 516	+35.279
Sin ½(φ+φ′)		9.873 812	
−Δα		1.421 328	+26.38

	Logarithms	Values in seconds
s	3.772 522	
Cos α	9.996720	
B	8.510208	
h	2.279450	1st term + 190.3049
s²	7.545044	
Sin² α	8.175888	
C	1.45692	
	7.175852	2d term + 0.0015
h²	4.51	
D	2.39	
	6.95	3d term + 0.0009
		−Δφ 190.3025

	° ′ ″	Logarithms	Values in seconds
½(φ+φ′)			
s	3.772 522		
Sin α	9.087944		
A′			
Sec φ′			
Δλ			″
Sin ½(φ+φ′)			
−Δα			

11—9362 U. S. GOVERNMENT PRINTING OFFICE 1929

s sin α = 2.860 921 p
s cos α = 3.769 235 p
tan α 9.091 686 p.
α = 7 02 26.47

s sin α = 2.860 921
9.088 399
3.772 522 = s =

s cos α = 3.769 235
9.996 713
3.772 522

Topo only

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 25
Ed. Jan., 1929

COMPUTATION OF TRIANGLES

State: .....

11—9121

NO.	STATION	OBSERVED ANGLE	CORR'N	SPHER'L ANGLE	SPHER'L EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
	2-3 USE 109+89 :	N	77,	324.2			
	1	E	60,	545.1			
	2						
	3						
	1-3						
	1-2 USE 315+55.6 :	N	57	974.7			
		E	58	162.1			315+00
							α = 187° 37' 10"
	2-3 USE 315+00 :	N	58	029.8			315+55.6
	1	E	58	169.5			
	2					log 55.6 :	1.745 075
	3					log sin 7° 37' 10" :	9.122 520
	1-3					log cos do :	9.996 148
	1-2					log ΔE :	0.867 595 = +7.37 ft
						log ΔN :	1.741 223 = +55.11
	2-3 109+89	N 77 324.2	E	60	545.1		
	1 315+00	58 029.8		58	169.5		
	2	19,294.4		2	375.6		
	3						
	1-3 log 19,294.4 = 4.285 4313 x 2 =					8.570 8626	= 372,273,931.6
	1-2 log 2,375.6 = 3.375 7733 x 2 =					6.751 5466	5,643,475.3
							377,917,406.9
	2-3					log d²	= 8.577 3969
	1					log d (ft)	4.288 6984
	2					factor	9.484 0158
	3	5925.35	←			log d (m)	3.772 7142
	1-3	5922.73	← from inv.			log d	3.772 522
	1-2	diff. 2.62					

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comp Pauk
✓ HJ.O.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 24A
Rev. Oct., 1932

TOPO ONLY

LIST OF DIRECTIONS

Station U.S.E. = B 3+20.8 State WASHINGTON

Chief of party R.W. Knox Date September 6, 1939 Computed by J.E.W.

Observer R.W.K. Instrument No. 8 - 4" transit Checked by R.W.K.

U. S. GOVERNMENT PRINTING OFFICE: 1932 11—0803

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction*	Corrected direction with zero initial	Adjusted direction*
	° ′ ″	′ ″	″	° ′ ″	′ ″
DELLA - 1939	0 00 00.00			0 00 00.00	
U.S.E. B-25+19.4	48 00 49.6 (50) ✓				
Swinomish Slough Hiway Bridge East Lt.	85 15 22.9 (3) ✓				

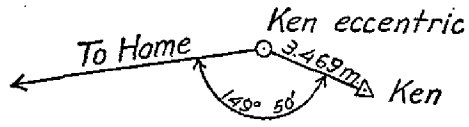
*These columns are for office use and should be left blank in the field.

Station: Ken *State:* Maryland

Chief of party: C. V. H. *Date:* 1917 *Computed by:* O. P. S.

Observer: C. V. H. *Instrument:* No. 168 *Checked by:* W. F. R.

OBSERVED STATION	Observed direction	Eccentric reduction	Sea level reduction	Corrected direction with zero initial	Adjusted direction
	° ′ ″	′ ″	″	° ′ ″	′ ″
Chevy	0 00 00.00	− 7.31		0 00 00.00	
Tank west of △ Dulce	29 03 37.0	−1 09.8		29 02 34.5	
Ken (center), 3.469 meters	176 42				
Forest Glen standpipe	313 24 53.0	+3 01.2		313 28 01.5	
Home	326 31 30.21	+ 31.93		326 32 09.45	
Bureau of Standards, wireless pole	352 17 20.8	+ 5.7		352 17 33.8	
Reno	357 28 48.63	− 1.16		357 28 54.78	
Reference mark, 16.32 m	358 31 20				



This form, with the first three and fifth columns properly filled out and checked, must be furnished by field parties. *To be acceptable it must contain every direction observed at the station.*

It should be used for observations with both repeating and direction theodolites.

The directions at only one station should be placed on a page.

If a repeating theodolite is used, do not abstract the angles in tertiary triangulation. The local adjustment corrections (to close horizon only) are to be written in the Horizontal Angle Record, and the List of Directions is to be made from that record directly.

Choose as an initial for Form 24A some station involved in the local adjustment, and preferably one which has been used as an initial for a round of directions on objects not in the main scheme. Use but one initial at a station. Call the direction of the initial 0° 00′ 00.″ 00, and by applying the corrected angles to this, fill in opposite each station its direction reckoned *clockwise* around the whole circumference regardless of the direction of graduation of the instrument. The clockwise reckoning is necessary for uniformity and to make the directions comparable with azimuths.

If a station has been occupied eccentrically, reduce to the center and enter in this form, in ink, the resulting corrections to the observed directions in the column provided for them. If an eccentric reduction is necessary, but not made in the field, leave the column blank. If the station was occupied centrally, and no eccentric reduction is required, put dashes in the column to show that no corrections are necessary.

Directions in the main scheme should be entered to hundredths of seconds in first-order triangulation; otherwise to tenths only. Points observed upon but once, direct and reverse, should be carried to tenths in first-order and second-order triangulation, and to even seconds only in third-order triangulation. In general, but two uncertain figures should be given.

It is recommended that the following simple plan of observing be used with a repeating instrument: Measure each single angle in the scheme at each station and the outside angle necessary to close the horizon. *Measure no sum angles.* Follow each measurement of every angle immediately by a measurement of its explement. Six repetitions are to constitute a measurement. The local adjustment will consist simply of the distribution of the error of closure of the horizon.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 25
Ed. Jan., 1929

Topo only

COMPUTATION OF TRIANGLES

State: _____

11—9121
U. S. GOVERNMENT PRINTING OFFICE, 1938

	NO.	STATION	OBSERVED ANGLE	CORR'N	SPHER'L ANGLE	SPHER'L EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
		2-3						2.602 272 ✓
		1 USE B 3+20.8	85 15 23 ✓					0.001 490 ✓
		2 Della	36 05 27 ✓					9.770 165 ✓
		3 Swinomish Slough Hiway Bridge E.LT	(58 39 10) ✓					9.931 473 ✓
		1-3	179 59 60 ✓					2.373927 ✓
		1-2					342.95	2.535235 (1)
		2-3						2.706 640 ✓
	c ✓	1 USE B 3+20.8	48 00 50 ✓					0.128 832 ✓
		2 Della	101 55 32 ✓					9.990 524 ✓
		3 USE B 25+19.4	(30 03 38) ✓					9.699 764 ✓
		1-3	179 59 120 ✓				669.88	2.825996
		1-2					342.95	2.535236 ✓
								✓
		2-3						
		1						
		2						
		3						
		1-3						
		1-2						
		2-3						
		1						
		2						
		3						
		1-3						
		1-2						

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DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

Topo only

25194
3208

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

use dist. 2198.6 ft = 670.13 m
C865 = 669.97

			°	′	″
α	2	to 3	35	43	00
2d ∠		&	+ 101	55	32
α	2	to 1	137	38	32
Δα					089
			180	00	00.0
α′	1	to 2	317	38	23
			48	00	50

			°	′	″
α	3	to 2	215	42	49.
3d ∠		&	− 30	03	38
α	3	to 1	185	39	11
Δα					02
			180	00	00.0
α′	1	to 3	05	39	13

First Angle of Triangle

	°	′	″			°	′	″
φ	48	27	17.828	2 Della	λ	122	30	27.882
Δφ			08.205		Δλ			11.246
φ′	48	27	26.033	1 USE B 3+20.8	λ′	122	30	39.128

	°	′	″			°	′	″
φ	48	27	04.451	3 USE B 2.5+19.4	λ	122	30	42.340
Δφ			21.582		Δλ			3.212
φ′	48	27	26.033	1 USE B 3+20.8	λ′	122	30	39.128

	Logarithms	Values in seconds
s	2.535 236	804.1 (1049.2)
Cos α	9.868 626	
B	8.510 202	
h	0.914 054	
s²	5.070 57	
Sin² α	9.658 98	
C	1.456 14	
	6 183 99	
h³		
D		

1st term	− 8.205 4
2d term	+ 0.0001
3d term	+
−Δφ	8.2053

	°	′	″
½(φ+φ′)	48	27	21.9

	Logarithms	Values in seconds
s	2.535 236	804.1 (428.8)
Sin α	9.828 504	
A′	8.508 902	
Sec φ′	0.178 369	
Δλ	1.051 011	11.2461
Sin ½(φ+φ′)	9874 161	
−Δα	0.925 077	+ 8.4

	Logarithms	Values in seconds
s	2.825 996	
Cos α	9.997 883	
B	8.510 202	
h	1.334 081	
s²	5.651 99	
Sin² α	7.987 12	
C	1.456 09	
	5095 32	
h²		
D		

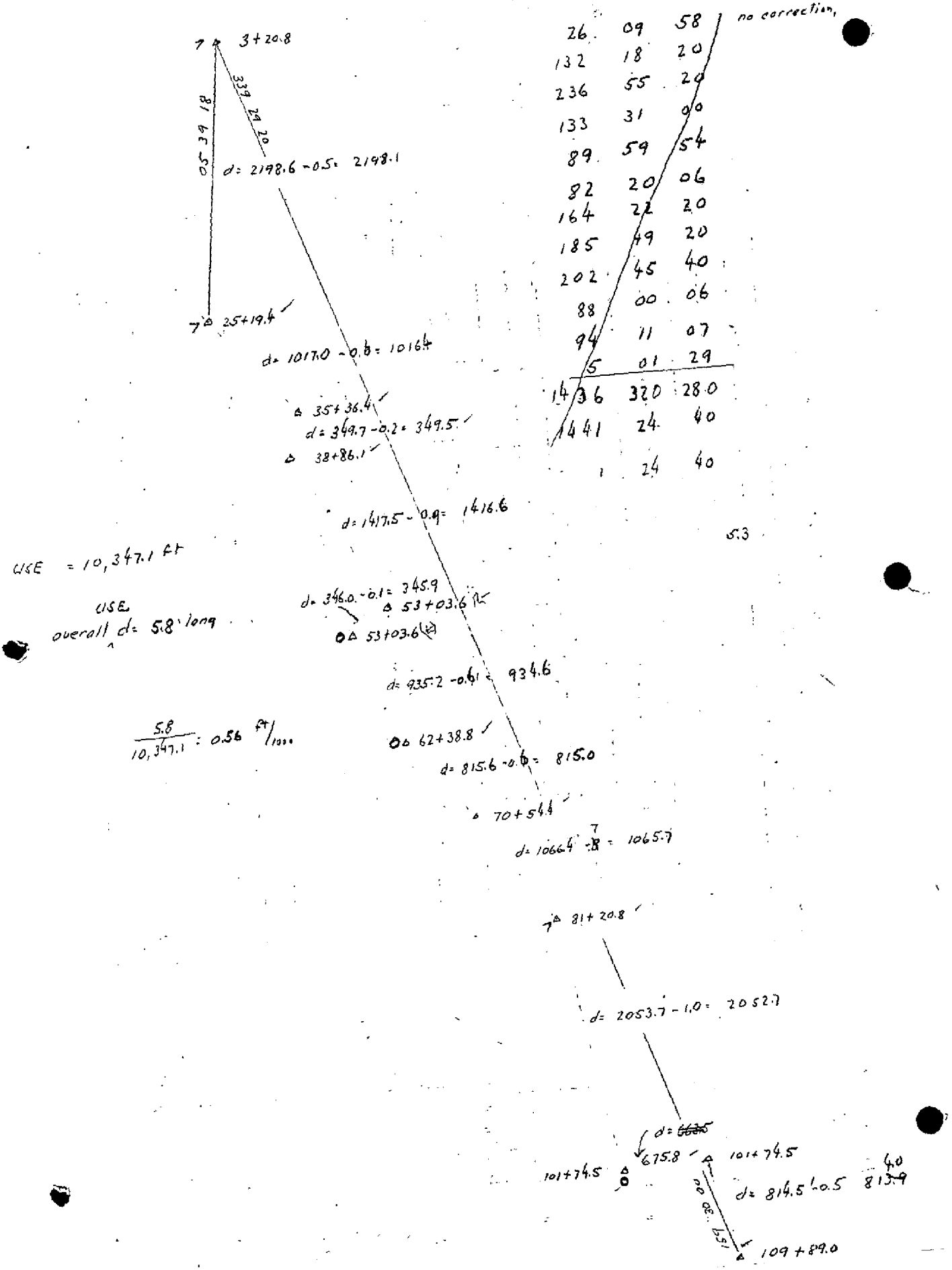
1st term	21.5815
2d term	+ —
3d term	+
−Δφ	21.5815

	°	′	″
½(φ+φ′)	48	27	15.2

	Logarithms	Values in seconds
s	2.825 996	
Sin α	8.993 456	
A′	8.508 902	
Sec φ′	0.178 369	
Δλ	0.506 723	− 3.211.6
Sin ½(φ+φ′)	9.874 148	
−Δα	0.380 894	− 2.4

11—0362 U. S. GOVERNMENT PRINTING OFFICE: 1929

Comp Rock,


3+20.8
339 29 20
05 39 18
d= 2198.6 -0.5= 2198.1
25+19.4
d= 1017.0 -0.6= 1016.4
35+36.4
d= 349.7 -0.2= 349.5
38+86.1
d= 1417.5 -0.9= 1416.6
USE = 10,347.1 FT
USE
overall d= 5.8' long
d= 346.0 -0.1= 345.9
53+03.6
53+03.6
d= 935.2 -0.6= 934.6
5.8 / 10,347.1 = 0.56 FT/1000
62+38.8
d= 815.6 -0.6= 815.0
70+54.4
d= 1066.4 -0.7= 1065.7
81+20.8
d= 2053.7 -1.0= 2052.7
d= 675.8
101+74.5
101+74.5
d= 814.5 -0.5 813.9
109+89.0
26 09 58
132 18 20
236 55 20
133 31 00
89 59 54
82 20 06
164 22 20
185 49 20
202 45 40
88 00 06
94 11 07
5 01 29
1436 320 28.0
1441 24 40
24 40
no correction
5.3

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3			
$2^d \angle$		&	+		
α	2	to 1			
$\Delta\alpha$					
			180	00	00.0
α'	1	to 2			

			°	′	″
α	3	to 2			
$3^d \angle$		&	−		
α	3	to 1			
$\Delta\alpha$					
			180	00	00.0
α'	1	to 3			

over

First Angle of Triangle

	°	′	″			°	′	″
ϕ				2	λ			
$\Delta\phi$					$\Delta\lambda$			
ϕ'				1	λ'			

	°	′	″			°	′	″
ϕ				3	λ			
$\Delta\phi$					$\Delta\lambda$			
ϕ'				1	λ'			

	Logarithms	Values in seconds
s		
$\cos\alpha$		
B		
h		1st term ″
s^2		
$\sin^2\alpha$		
C		
		2d term +
h^3		
D		
		3d term +
		$-\Delta\phi$

$\frac{1}{2}(\phi+\phi')$ ° ′ ″		
	Logarithms	Values in seconds
s		
$\sin\alpha$		
A′		
$\sec\phi'$		″
$\Delta\lambda$		
$\sin\frac{1}{2}(\phi+\phi')$		
$-\Delta\alpha$		

	Logarithms	Values in seconds
s		
$\cos\alpha$		
B		
h		1st term ″
s^2		
$\sin^2\alpha$		
C		
		2d term +
h^3		
D		
		3d term +
		$-\Delta\phi$

$\frac{1}{2}(\phi+\phi')$ ° ′ ″		
	Logarithms	Values in seconds
s		
$\sin\alpha$		
A′		
$\sec\phi'$		″
$\Delta\lambda$		
$\sin\frac{1}{2}(\phi+\phi')$		
$-\Delta\alpha$		

11—9382 U. S. GOVERNMENT PRINTING OFFICE, 1929

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DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 25
Ed. Jan., 1929

COMPUTATION OF TRIANGLES

State: .....

11-9191

U. S. GOVERNMENT PRINTING OFFICE: 1930

NO.	STATION	OBSERVED ANGLE	CORR'N	SPHER'L ANGLE	SPHER'L EXCESS	PLANE ANGLE AND DISTANCE	LOGARITHM
	2-3						
	1 USE 109 + 89	N	77,324.2			E	60,545.1
	2 USE B 3 + 20.8		87,016.7				56,923.3
	3	ΔN	9692.5			ΔE	3,621.8
	1-3						
	1-2 log ΔN =	3.986 4358 x 2	= 7.972 8716			=	93,944,564
	log ΔE =	3.558 9245 x 2	= 7.117 8490			=	13,117,438
	2-3				d^2	=	107,062,003
	1				log d^2	=	8.029 6353
	2				log d (feet	=	4.014 8176
	3				factor		9.484 0158
	1-3	3153.80			log d (meters)		3.498 8334
	1-2	3152.03			by inverse	=	3.498 590
		1.77 m					Comp Rock.
		5.8 ft.					
	2-3						
	1						
	2						
	3						
	1-3						
	1-2						
	2-3						
	1						
	2						
	3						
	1-3						
	1-2						

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DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 758

LIST OF PRELIMINARY GRID AZIMUTHS

State Washington Locality Swinomish Slough. Line

U. S. GOVERNMENT PRINTING OFFICE 11 11710

From station	To station	Preliminary azimuth	Correction for closure	Corrected azimuth
		° ′ ″	′ ″	° ′ ″
			109+89 To 131+82.5	15 56 09
∠B 109+89			∠	148 35 20 ✓
	✓	164 31 29 ✓	-0 09	164 31 20 ✓
∠B 101+74.5 (R)	814.0 ✓ 248.11	(94 11 26)		
		→ 78 42 36		
			-0 18	78 42 18 ✓
∠ ~~101+74.5~~ (L)	675.8 ~~205.98~~	(269 59 54)		
∠ 81+20.8	2052.7 ✓ 625.66			
		168 42 49	-0 27	168 42 22 ✓
∠ 70+54.4	1065.7 ~~324.8~~			
	✓	145 57 09	- 36	145 56 33 ✓
∠ 62+38.8	815.0 ✓ 248.41	~~140 07 49~~	45	140 07 04 ✓
	✓	155 45 29	- 54	155 44 35 ✓
∠ 53+03.6 (R)	934.6 ✓ 284.86	(262 20 06)		
	✓	238 05 35	- 1 03	238 04 32 ✓
∠ 53+03.6 (R)	345.9 ✓ 105.43	(89 59 54)		
	✓	148 05 29	- 01 12	148 04 17 ✓
∠ 38+86.1	1416.6 ✓ 431.78			
	✓	194 34 19	- 01 21	194 32 58 ✓
∠ 35+36.4	349.5 ✓ 106.53			
	✓	137 39 09	- 01 30	137 37 39 ✓
∠ 25+19.4	1016.4 ✓ 309.80			
	✓	185 40 49	- 01 38	185 39 11 ✓
∠ 3+20.8	2198.1 ✓ 669.98			185 39 11

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DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

INVERSE **POSITION COMPUTATION, THIRD-ORDER TRIANGULATION** CHECK

			°	′	″				°	′	″
α	2	to 3				α	3	to 2			
2d ∠		&	+			3d ∠		&	−		
α	2	to 1	159	30	00.0	α	3	to 1	339	29	19.8
Δα					40.2	Δα					
			180	00	00.0				180	00	00.0
α′	1	to 2	339	29	19.8	α′	1	to 3			

First Angle of Triangle

	°	′	″			°	′	″		°	′	″			°	′	″
φ	48	25	50.453	2 USE B 109 +89	λ	122	29	45.402	φ	48	27	26.034	3 USE B 3+20.8	λ	122	30	39.129
Δφ		+1	35.580		Δλ		+53.726		Δφ					Δλ			
φ′	48	27	26.033	1 USE B 3+20.8	λ′	122	30	39.128	φ′				1	λ′			

	Logarithms	Values in seconds
s		
Cos α	3.370 177	η
B	8.510 204	
h	1.980 38.1	1st term − 95.584
s²		
Sin² α	6.085 83	
C	1.455 78	
	7.541 84	2d term + 0.003
h²	3.9607	
D	2.3898	
	6.3505	3d term + −
		−Δφ − 95.580

	°	′	″
½(φ+φ′)	48	26	38.2

	Logarithms	Values in seconds
s		
Sin α	3.042 913	D
A′	8.508 902	
Sec φ′	0.178 369	
Δλ	1.730 184	+53.726
Sin ½(φ+φ′)	9.874 080	
−Δα	1.604 264	+40.20

	Logarithms	Values in seconds
s	3.498 594	
Cos α	9.971 556	
B	8.510 203	
h	1.980 353	1st term 95.579
s²	6.9972	
Sin² α	9.0891	
C	1.455 8	
	1.542 1	2d term + 0.003
h²		
D		
		3d term +
		−Δφ 95.582

	°	′	″
½(φ+φ′)			

	Logarithms	Values in seconds
s	3.498 594	
Sin α	9.544 550	
A′	8.508 902	
Sec φ′	0.178 142	
Δλ	1.730 198	53.727
Sin ½(φ+φ′)		
−Δα		

s sin α = 3.042 913 D
s cos α = 3.470 177 h
tan α = 9.572 736 η
159 30 00.26

s sin α = 3.042 913
sin α = 9.544 324
3.498 589

s cos α = 3.470 177
cos α = 9.971 587
s = 3.498 590

11—0362 U. S. GOVERNMENT PRINTING OFFICE, 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3			
2d ∠		&	+		
α	2	to 1	164	31	20
Δα			−	00	02
			180	00	00.0
α′	1	to 2	344	31	18

			°	′	″
α	3	to 2	344	31	18
3d ∠		&	+ 94	10	58
α	3	to 1	78	42	16
Δα			−	00	07
			180	00	00.0
α′	1	to 3	258	42	09

First Angle of Triangle

	°	′	″			°	′	″
φ	48	25	50.445	2 109+89	λ	122	29	45.403
Δφ	+	00	07 741	248.11	Δλ	+	00	03.221
φ′	48	25	58.186	1 101+74.5(R)	λ′	122	29	48.624

	°	′	″			°	′	″
φ	48	25	58.186	3 101+74.5(R)	λ	122	29	48.624
Δφ	−	00	01.306	205.98	Δλ	+	00	09.826
φ′	48	25	56.880	1 101+74.5(L)	λ′	122	29	58.450

	Logarithms	Values in seconds
s	2.394644	(56.01)
Cos α	9.983957	+1797.3
B	8.510 203	
h	0.888 804	1st term −07.7411
s²	4.78929	
Sin²α	8.85258	
C	1.45578	
	5.09765	2d term + —
h³		
D		
		3d term +
		−Δφ −07.7411

	°	′	″	Logarithms	Values in seconds
½(φ+φ′)	48	25	54.3		
s				2,394 644	(233.8) +999.5
Sin α				9.426 291	
A′				8.508 902	
Sec φ′				0.178 161	
Δλ				0.507998	+03.2210
Sin ½(φ+φ′)				9.873998	
−Δα				0.381 996	+02.4

	Logarithms	Values in seconds
s	2.313825	(96.5) +1756.9 +1756.8
Cos α	9.291968	
B	8.510 203	
h	0.115996	1st term +01.3062
s²	462765	
Sin²α	9.98301	
C	1.45578	
	606644	2d term +0.0001
h³		
D		
		3d term +
		−Δφ +01.3063

	°	′	″	Logarithms	Values in seconds
½(φ+φ′)	48	25	57.5		
s				2.313825	(31.8) +1201.5
Sin α				9.991505	
A′				8.508902	
Sec φ′				0.178158	
Δλ				0.992390	+09.8263
Sin ½(φ+φ′)				9.874004	
−Δα				0.866394	+07.4

11—9362 U. S. GOVERNMENT PRINTING OFFICE: 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″					°	′	″
α	2	to 3	258	42	09	α	3	to 2	348	42	09
2d ∠		&	+ 89	59	56	3d ∠		&	+157	14	11
α	2	to 1	168	42	13	α	3	to 1	145	56	20
Δα			−	00	04	Δα			−	00	07
			180	00	00.0				180	00	00.0
α′	1	to 2	348	42	09	α′	1	to 3	325	56	13

(+517.0) 16.738 FIRST ANGLE OF TRIANGLE (+90.7) 04.415

	°	′	″			°	′	″			°	′	″
φ	48	25	56.880	2 101 + 74.5(L)	λ	122	29	58.450	φ	48	26	16.743	3 81 + 20.8	λ	122	30	04.413
Δφ	+	00	19.863	625.66	Δλ	+	00	05.963	Δφ	+	00	08.712	324.82	Δλ	+	00	08.852
φ′	48	26	16.743	1 81 + 20.8	λ′	122	30	04.413	φ′	48	26	25.455	1 70 + 54.4	λ′	122	30	13.265

	Logarithms	Values in seconds
s	2.796 338	(1336.1)
Cos α	9.991 504	+ 517.2
B	8.510 203	+ 517.0
h	1.298 045	(1336.3)
		1st term − 19.8630
s²	5.59268	
Sin² α	8.58400	
C	1.45578	
	5.63246	2d term +
h²		
D		
		3d term +
		−Δφ −19.8630

	°	′	″	Logarithms	Values in seconds
½(φ+φ′)	48	26	06.8		
s				2.796 338	(1142.6)
Sin α				9.292 000	+ 90.7
A′				8.508 902	
Sec φ′				0.178 205	
Δλ				0.775 445	+05.9627
Sin ½(φ+φ′)				9.874 021	
−Δα				0.649 466	+04.5

	Logarithms	Values in seconds
s	2.511 643	(1067.0)
Cos α	9.918 261	+ 786.3
B	8.510 203	
h	0.940 107	1st term − 08.7118
s²	5.02329	
Sin² α	9.59650	
C	1.45578	
	6.07557	2d term + 0.0001
h²		
D		
		3d term +
		−Δφ −08.7117

	°	′	″	Logarithms	Values in seconds
½(φ+φ′)	48	26	21.1		
s				2.511 643	(960.6)
Sin α				9.748 248	+ 272.7
A′				8.508 902	
Sec φ′				0.178 225	
Δλ				0.947 018	+08.8515
Sin ½(φ+φ′)				9.874 048	
−Δα				0.821 066	+ 06.6

11—9362 U. S. GOVERNMENT PRINTING OFFICE: 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3	325	56	13
2d ∠		&	+ 174	10	31
α	2	to 1	140	06	44
Δα			-	00	06
			180	00	00.0
α′	1	to 2	320	06	38

			°	′	″
α	3	to 2	320	06	38
3d ∠		&	+ 195	37	31
α	3	to 1	155	44	09
Δα			-	00	04
			180	00	00.0
α′	1	to 3	335	44	05

First Angle of Triangle

	°	′	″			°	′	″
φ	48	26	25.455	2 70 + 54.4	λ	122	30	13.265
Δφ	+	00	06.171	248.41	Δλ	+	00	07.751
φ′	48	26	31.626	1 62 + 38.8	λ′	122	30	21.016

	°	′	″			°	′	″
φ	48	26	31.626	3 62 + 38.8	λ	122	30	21.016
Δφ	+	00	08.408	284.86	Δλ	+	00	05.696
φ′	48	26	40.034	1 53 + 03.6 (4)	λ′	122	30	26.712

	Logarithms	Values in seconds
s	2.395 169	(876.4) +976.9
Cos α	9.884 966	
B	8.510 203	
h	0.790 338	1st term - 06.″1708
s²	4.78834	
Sin² α	9.61 410	
C	1.45578	
	5.85822	2d term + 0.0001
h²		
D		3d term +
		−Δφ - 06.1707

	°	′	″
½(φ+φ′)	48	26	28.5

	Logarithms	Values in seconds
s	2.395 169	(801.3) +432.0
Sin α	9.807 052	
A′	8.508 902	
Sec φ′	0.178 240	
Δλ	0.889 363	+07.″7511
Sin ½(φ+φ′)	9.874 062	
−Δα	0.763 425	+05.8

	Logarithms	Values in seconds
s	2.454 632	(616.7) +1236.6
Cos α	9.959 833	
B	8.510 202	
h	0.924 667	1st term - 08.″4075
s²	4.909 26	
Sin² α	9.227 57	
C	1.455 95	
	5.59278	2d term + —
h²		
D		3d term +
		−Δφ - 08.408

	°	′	″
½(φ+φ′)	48	26	35.8

	Logarithms	Values in seconds
s	2.454 632	(684.1) +549.2
Sin α	9.613 783	
A′	8.508 902	
Sec φ′	0.178 260	
Δλ	0.755 577	+05.″6961
Sin ½(φ+φ′)	9.874 075	
−Δα	0.629 652	+04.3

11—9362 U. S. GOVERNMENT PRINTING OFFICE, 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3	335	44	05
2d ∠		&	+ 262	19	57
α	2	to 1	238	04	02
Δα			+	00	03
			180	00	00.0
α′	1	to 2	58	04	05

			°	′	″
α	3	to 2	58	04	05
3d ∠		&	+ 89	59	45
α	3	to 1	148	03	50
Δα			−	00	08
			180	00	00.0
α′	1	to 3	328	03	42

First Angle of Triangle

	°	′	″			°	′	″
φ	48	26	40.034	2 53+03.6(L)	λ	122	30	26.712
Δφ	+	00	01.805	105.43	Δλ	−	00	04.354
φ′	48	26	41.839	1 53+03.6 (R)	λ′	122	30	22.358

	°	′	″			°	′	″
φ	48	26	41.839	3 53+03.6(R)	λ	122	30	22.358
Δφ	+	00	11.863	431.78	Δλ	+	00	11.114
φ′	48	26	53.702	1 38 + 86.1	λ′	122	30	33.472

	Logarithms	Values in seconds
s	2.022964	(5609) +1292.4
Cos α	9.723393	
B	8.510202	
h	0.256559	1st term −01.8053
s²	5.045148	
Sin² α	9.85748	
C	1.45600	
	6.29148	2d term +
h²		
D		
		3d term +
		−Δφ −01.8053

½(φ+φ′)	48 26 40.9	
	Logarithms	Values in seconds
s	2.022964	(773.4) +459.45
Sin α	9.928738	
A′	8.508902	
Sec φ′	0.178264	
Δλ	0.638868	−04.3538
Sin ½(φ+φ′)	9.874085	
−Δα	0.512953	−03.3

	Logarithms	Values in seconds
s	2.635262	(194.4) +165.19
Cos α	9.928723	
B	8.510202	
h	1.074187	1st term −11.8628
s²	5.27052	
Sin² α	9.44687	
C	1.45608	
	6.17347	2d term + 0.0001
h²		
D		
		3d term +
		−Δφ −11.8627

½(φ+φ′)	48 26 47.8	
	Logarithms	Values in seconds
s	2.635262	(5449) +6880
Sin α	9.723434	
A′	8.508902	
Sec φ′	0.178292	
Δλ	1.045890	+11.1145
Sin ½(φ+φ′)	9.874098	
−Δα	0.919988	+08.3

11—9362 U. S. GOVERNMENT PRINTING OFFICE. 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3	328	03	42
$2^d\angle$		&	+ 226	28	41
α	2	to 1	194	32	23
$\Delta\alpha$			+	00	01
			180	00	00.0
α'	1	to 2	14	32	24

			°	′	″
α	3	to 2			
$3^d\angle$		&	−		
α	3	to 1			
$\Delta\alpha$					
			180	00	00.0
α'	1	to 3			

First Angle of Triangle

	°	′	″			°	′	″
ϕ	48	26	53.702	2 38+86.1	λ	122	30	33.472
$\Delta\phi$	+	00	03.338	106.53	$\Delta\lambda$	−	00	01.301
ϕ'	48	26	57.040	1 35+36.4	λ'	122	30	32.171

	°	′	″			°	′	″
ϕ				3	λ			
$\Delta\phi$					$\Delta\lambda$			
ϕ'				1	λ'			

	Logarithms	Values in seconds (91.3)
s	2.027472	+ 1762.0
$\cos\alpha$	9.985864	
B	8.510202	
h	0.523538	1st term −03.3384
s^2	—	
$\sin^2\alpha$	—	
C	1.45612	
	—	2d term + —
h^2		
D		
		3d term +
		$-\Delta\phi$ −03.3384

	°	′	″
$\frac{1}{2}(\phi+\phi')$	48	26	55.4

	Logarithms	Values in seconds (571.6)
s	2.027472	+ 661.3
$\sin\alpha$	9.399762	
A′	8.508902	
$\sec\phi'$	0.178300	
$\Delta\lambda$	0.114436	−01.3014
$\sin\frac{1}{2}(\phi+\phi')$	9.874112	
$-\Delta\alpha$	9.988548	− 0.97

	Logarithms	Values in seconds
s		
$\cos\alpha$		
B		
h		1st term
s^2		
$\sin^2\alpha$		
C		
		2d term +
h^2		
D		
		3d term +
		$-\Delta\phi$

	°	′	″
$\frac{1}{2}(\phi+\phi')$			

	Logarithms	Values in seconds
s		
$\sin\alpha$		
A′		
$\sec\phi'$		
$\Delta\lambda$		
$\sin\frac{1}{2}(\phi+\phi')$		
$-\Delta\alpha$		

11—0362 U. S. GOVERNMENT PRINTING OFFICE. 1929

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 27
Ed. April, 1929

POSITION COMPUTATION, THIRD-ORDER TRIANGULATION

			°	′	″
α	2	to 3	14	32	24
2d ∠		&	+123	04	41
α	2	to 1	137	37	05 ✓
Δα			−	00	08
			180	00	00.0
α′	1	to 2	317	36	57 ✓

+137.5 04.451

First Angle of Triangle

+870.1 42.340

	°	′	″		°	′	″
φ	48	26	57.040	2 35 + 36.4	λ	122	30	32.171
Δφ	+	00	07.408	309.80 ✓	Δλ	+	00	10.163
φ′	48	27	04.448 ✓	1 25 + 19.4	λ′	122	30	42.334

	Logarithms	Values in seconds (1715.8) + 137.5
s	2.491 081	
Cos α	9.868 449	
B	8.510 202	
h	0.869 732	1st term −07.″4085
s²	4.98216	
Sin² α	9.65741	
C	1.45615	
	6.09572	2d term +0.0001
h²		
D		
		3d term +
		−Δφ −07.4084

	°	′	″	Logarithms	Values in seconds (3628)
½(φ+φ′)	48	26	59.3		
s				2.491 081	
Sin α				9.828 705	+870.1
A′				8.508 902	
Sec φ′				0.178 318	
Δλ				1.007 006	+10.″1626
Sin ½(φ+φ′)				9.874 119	
−Δα				0.881 125	+07.6

	Logarithms	Values in seconds
s	2.826 062	
Cos α		
B		
h		1st term ″
s²		
Sin² α		
C	1.45625	
		2d term +
h²		
D		
		3d term +
		−Δφ

	°	′	″
α	3	to 2	317	36	57
3d ∠		&	−228	01	32
α	3	to 1	185	38	29 ✓
Δα			185	39	11
			180	00	00.0
α′	1	to 3	5	39	13 (2146 s)

	°	′	″		°	′	″
φ				3 25 + 19.4	λ			
Δφ				669.98	Δλ			
φ′				1 3 + 20.8	λ′			

	Logarithms	Values in seconds
½(φ+φ′)	° ′ ″	
s	2.826 062	
Sin α		
A′		
Sec φ′		
Δλ		″
Sin ½(φ+φ′)		
−Δα		

11—9362 U. S. GOVERNMENT PRINTING OFFICE: 1929

	Remarks.	Decisions
1		484225
2		"
3		
4	Two words	483 224
5		483 225 U.S.G.B
6		483 224
7		"
8		483225
9		"
10		484224
11	~~Where?~~	483 224
12		"
13		
14		
15		
16		
17		
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19		
20		
21		
22		
23		
24		
25		
26		
27		

GEOGRAPHIC NAMES

Survey No.

T6689a

Name on Survey	On Chart No. A,	On previous survey No. B,	On U. S. quadrangle Maps C,	From local information D	On local Maps E	P. O. Guide or Map F	Rand McNally Atlas G	U. S. Light List H	K	
Fidalgo Island										1
Swinomish Indian										2
Reservation										3
~~Lacomer~~ La Conner										4
Swinomish Slough										5
Sullivan Slough										6
North Fork Skagit River										7
McGlinn Island										8
Hole In The Wall										9
Swinomish Indian Village										10
Pioneer Park										11
Bald Island										12
										13
										14
										15
										16
										17
										18
										19
										20
										21
										22
										23
										24
										25
										26
										27

Names underlined in red approved by L. Heck on 4/24/40

M 234

	Remarks.	Decisions
1		484225
2		"
3		483225 USGB
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		

M 234

GEOGRAPHIC NAMES

Survey No. T6689 b

Name on Survey	A, On Chart No.	B, On previous survey No.	C, On U. S. quadrangle Maps	D, From local information	E, On local Maps	F, P. O. Guide or Map	G, Rand McNally Atlas	H, U. S. Gen. List	K	
Fidalgo Island										1
Swinomish Indian Reservation										2
Swinomish Slough										3
										4
										5
			L. Heck		on 4/24/40					6
										7
										8
										9
										10
										11
										12
										13
										14
										15
										16
										17
										18
										19
										20
										21
										22
										23
										24
										25
										26
										27

M 234 1/2

	Remarks	Decisions
1		484225
2		"
3		
4		483225 USGB
5		484225
6		484224
7		"
8		"
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
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26		
27		

M 234

GEOGRAPHIC NAMES

Survey No. T6690

Name on Survey	On Chart No. A,	On previous survey No. B,	On U. S. quadrangle Maps C,	From local information D	On local Maps E	P. O. Guide or Map F	Rand McNally Atlas G	U. S. Light List H	K	
Fidalgo Island										1
Swinomish Indian										2
Reservation										3
Swinomish Slough										4
Old Channel										5
Blind Slough										6
Telegraph Slough										7
Higgins Slough										8
										9
										10
		Names underlined in red approved								11
		by L. Heck on 4/24/40								12
										13
										14
										15
										16
										17
										18
										19
										20
										21
										22
										23
										24
										25
										26
										27

M 234 VR

FORM M-238

MEMORANDUM

IMMEDIATE ATTENTION

SURVEY
DESCRIPTIVE REPORT
PHOTOSTAT OF

~~No. T~~ T6689a
No. T T6689b
T6690

received March 18, 1940
registered April 9, 1940
verified
reviewed
approved

This is forwarded in order that your attention may be directed to the matters as indicated below. Please initial in column 3 as an acknowledgement that your attention has been thus directed. The complete original records are available if desired. If you cannot give this your immediate attention, please initial, note, and forward to the next section marked, calling for the records at your convenience.

ROUTE		Initial	Attention called to
20			
22			
24			
25	✓	HW	Pages 4 to 7
26			
30			
40			
62			
63			
82			
83			
88			
90			

RETURN TO

82	T. B. Reed

✓ JBR

DIVISION OF CHARTS

Section of Field Records

REVIEW OF TOPOGRAPHIC SURVEY NO. 6689a&b and 6690 (1939)

Washington; Fidalgo Island; Swinomish Slough
Surveyed in July - September 1939, Scale 1:5,000
Instructions dated April 12, 1939 (EXPLORER)

Plane Table Surveys. Aluminum Mounted

Chief of Party - R. W. Knox.
Surveyed and inked by - H. J. Oliver.
Reviewed by - J. A. McCormick, November 12, 1940.
Inspected by - H. R. Edmonston.

1. Junctions with Contemporary Surveys.

T-6689a (1939), most southerly of the three surveys, joins satisfactorily with T-6684b, T-6685b and T-6687 of 1939 on the south. T-6690 (1939), most northerly, joins satisfactorily with T-6691 and T-6692 of 1939 on the north. Junctions of the three surveys with each other are also satisfactory.

2. Comparison with Prior Surveys.

T-1747 (1886) 1:20,000; T-2108 (1892) 1:4,800; T-2156 (1889) 1:20,000; T-2856 (1908) 1:20,000. H-2050 (1890) 1:20,000.

The descriptive report, page 7, states quite correctly that relatively unchangeable detail on old and new surveys is in fair agreement but that diking and dredging have caused considerable change in the marsh areas. Further comment is unnecessary here. The present group of surveys supersedes the older group in the common area.

3. Comparison with Chart 6380 (New Print of April 13, 1940)

a. Topography.

Topography charted in this area is from surveys discussed in the preceding paragraph and from various surveys of the U. S. Engineers. It should be noted here that the Engineers often use the same basic topographic survey for many channel investigations without bringing the topography up to date. The latest blueprints availabe, 34356 to 34370 of 1939, show several instances of such procedure.

b. Navigational Aids.

Charted positions of fixed aids in the area differ by small amounts from positions shown on the surveys.

4. Condition of Survey.

Satisfactory. Low water line along mud flats is shown with a dashed line.

5. Compliance with Instructions for the Project.

Satisfactory.

6. Additional Field Work Recommended.

None.

7. Superseded Surveys.

T-1747 in part
T-2108 in part
T-2156 in part
T-2856 in part
H-2050 in part

Examined and approved:

Thos. B. Reed,
Chief, Section of Field Records.

Chief, Division of Charts.

Chief, Section of Field Work.

Chief, Division of H. & T.

Applied to chart 6380 Mar. 7/41 G.R.
" " " 6300 " 20/41 "

T6690 applied to chart 6376 Aug 8, 1944 - JTW
T6689 " " " " " 9, 1944 JTW