Hydrologic Evaluation
&
Stream Restoration Recommendations
For
Indian Creek
Chicago, Illinois

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February 10, 2001

Based on survey field work
June and July 2000

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This work was funded by the North Central Experiment Station, USDA Forest Service: Research Work Unit 4902 in Evanston, IL (Managing Forest Environments for Urban Populations) and Research Work Unit 4351 in Grand Rapids, MN (Ecology and Management of Riparian and Aquatic Ecosystems).

Summary of Research Findings

- Indian Creek is fed by surface water from Wolf Lake and by groundwater from Wolf Lake, much of it going underneath Highway O and entering the bottom of the short N-S and the long E-W section of Indian Creek
- Indian Creek's bankfull flow is about 70 cubic feet per second and a new Indian Creek is designed for 80 cfs including the 12 cfs from the power plant cooling water
- Ground water also enters Hyde Lake Wetland
- About 25% of the water in Indian Creek leaves it near the SW corner of the Sulfuric Acid Plant and flows underground beneath the seawall to the Calumet River
- Several elevations in the bottom of Indian Creek are critically important to the elevation of groundwater in the area. The first two are the wash-around elevation at the Corps of Engineer's dam at Wolf Lake and the exit elevation of the Schroud culverts; both are at an elevation of 1.6 to 1.7 feet. They control the water table and Wolf Lake water level above the Schroud culverts. The second two are the scour-caused central riffle just below the 126th Street Bridge and the waste water pipe inside the old dam at the confluence of Indian Creek with the Calumet River. These points control the elevation of water in the Hyde Lake Wetland and the wetland North of the 126th Street Bridge.
- As George Roadcap has pointed out, the limestone in the slag deposits leads to high levels of carbon dioxide dissolved in the groundwater. When this is exposed to air it leaves the water and causes calcium and magnesium bicarbonate to precipitate along the edges of Indian Creek
- pH of Indian Creek water runs from 8.3 to 9.2. A bit high, but not high enough to diminish the excellent warm water and Fall, cool water fisheries in Indian Creek and Wolf Lake
- The waste water pipe at the Sulfuric Acid Plant, the Schroud culverts, and Corps of Engineer's dam are significant blocks to fish passage at average and low flows. At high flows, fish can pass these points; however, only the larger fish (salmon, carp, larger bass) are likely to have enough strength to pass through the Schroud culverts at high water. The two that remain are undersized for the 80 cfs bankfull flow leading to high in-culvert velocities
- Much of Indian Creek has a soft bottom with 5 to 9 feet of sloppy ooze made up of fine sand and calcium and magnesium bicarbonate precipitate and fine sand sized particles of slag
- Most of Indian Creek channel is 50 to 75 feet wide, much too wide for the 80 cfs bankfull flow it needs to carry. This has encouraged the deposition of the calcium bicarbonate precipitate
- Indian Creek in its present state and in the suggested design state exhibits bottom slope configurations typical of a wetland stream where, even though it has pools and riffles in sequence that slope downstream, near the major elevation control points, the slope between the riffle tops slopes upward and in effect floods the channel upstream. This is typical in wetland streams and leads to development of the wetland. These flooded channel sections give Indian Creek its deep water and good fish habitat
- Indian Creek, Wolf Lake, and the Hyde Lake Wetland form a significant warm-water, and, in the autumn, cool-water fishery heavily used by the local community. It is a

significant natural and social resource. All of the existing functions of this system should be retained and improved on during construction and restoration activities

Summary of Restoration Findings

- Dune's Creek in the Indian Dunes State Park provided stream dimension data that is transferred to a newly designed Indian Creek. The New Indian Creek design is based on providing a channel that will carry a bankfull flow of 80 cfs and have a floodplain that will allow 640 cfs to pass to the Calumet River during the 100-year event. The 50-year event is estimated at 320 cfs. Dunes Creek is in a sand landscape, similar to the bottom of Indian Creek. Stream dimension data from Dunes Creek is transferred to a New Indian Creek using ratios for various design criteria using stream width as the basis of scaling
- The peatlands in the Dunes Creek system yield hydrogen ions (acid) that keep Dunes Creek pH in the 7.5 to 8 range. Addition of soil to the floodplain of Indian Creek would also help to lower the pH from the 9.2 to 8 range
- The slag banks of the old Indian Creek and the New Indian Creek are very tough and obviate the need for extensive bank revetment work
- The is little opportunity to rework the existing over-wide Indian Creek into a normal dimension, pattern, and profile because of the deep, very unstable slop in the bottom
- It is recommended to build a New Indian Creek in a new floodplain to the East (North of 126th Street Bridge), to the North (of Hyde Lake Wetland), and to the South (of the long E-W section) on the Schroud Plateau
- Some low, bankfull, rock additions along the sides of the existing Indian Creek (to harden the banks) around the ball field would help clear and deepen the existing channel
- Channel blocks are used to redirect flow from the old to the New Indian Creek, but low level passages would allow water to circulate into the existing reaches of Indian Creek
- If the scour-formed riffle below the 126th Street Bridge is removed, and the mouth of Indian Creek is opened to the Calumet River (at an elevation below the waste pipe of 0.3 feet) at the same time, the water level in Hyde Lake will lower as much as a foot
- A series of rock cross vanes is recommended at the Schroud culvert site, one just above the Carondolet Bridge, and a series at the mouth of Indian Creek where it enters the Calumet River. These rock cross vanes allow fish passage at all flow levels and provide grade control for the bottom of the New Indian Creek that will preserve the existing water levels in Wolf Lake, Hyde Lake Wetland, and the wetland North of the 126th Street Bridge
- A step/pool series around the Corps of Engineer's dam at Wolf Lake would also preserve the Wolf Lake water elevation and allow fish passage at average and low water levels
- Reshaping of the ditch (to a gentle-sided B channel type) between the Old railroad (paralleling Highway O) and the nitrogen pipeline road will prevent the existing G channel type from accelerated in-channel erosion
- Proving soil at least 18 inches deep on the floodplain (floodplain is excavated that much lower to accept it) will provide minimal growth medium for trees, shrubs and herbs

Channel Design for a New Indian Creek

Several aspects of the environment at Indian Creek beg for a departure from the normal approach to new channel design, while most of the 49 considerations for new channel design (Hey and Rosgen 2000) remain an imperative.

Sediment Supply

The fact that Indian Creek has little sediment input might imply the channel could not form the normal riffle and pool sequence of a meandering sand bed channel. That is, it may not be able to hold pools, or develop riffles. Though relatively rare in the existing Indian Creek system, the channel has shown that it can maintain pools dug during sand mining at either end of the N-S section paralleling Highway O to the West. Similarly, it has pools from digging above the Schroud culverts, above the Carondolet Bridge, and at the Southwest corner of the Hegewisch ballfield. A very normal pool riffle sequence exists at the end of Indian Creek in the last 400 feet before it enters the Calumet River.

Many examples of pool and riffle sequences in sediment limited situations exist on natural streams below dams constructed a century or more ago. One is in Grand Rapids, MN on the Mississippi River where the river is about 200 feet wide below a series of two dams that transmit virtually no sediment. It also is a sand and gravel bed F5c and C5c channel type and has a normal pool/riffle sequence. Two other examples are below the Stronach Dam on the Little Manistee River and below the Hodenpyl Dam on the Manistee River in West central Michigan; both have normal pool/riffle sequences below the dams, sometimes in straight sections and sometimes in meandering sections.

Most of the Indian Creek bottom is fine sand. However, the riffles near the outlet of Wolf Lake, below the Highway O and Schroud culverts, and throughout the last 400 feet of the channel, are composed of gravel and small cobble. In predominately sand bed streams, with little other coarse sediment sources, a new channel is constructed with an appropriate pool/riffle sequence and the riffles are maintained by adding the appropriate coarse sediment to the riffle faces. The size of the sediment must be large enough to remain in place during bankfull flow and the associated higher velocities --- just the opposite of providing for bottom sediment movement during bankfull flow in many normal streams with significant sediment sources.

Bank Stability

Another significant difference at Indian Creek is the strength of the slag terrace deposits that form the bank for much of the channel (in the wetlands the sand bottom merely feathers out to the wetland surface). The slag deposits have largely resisted the meandering tendencies of sand bottom channels. There is however, a very slight pattern of meandering apparent along the sides of the straight sections. The presence of the slag deposits obviates the need for bank revetments (root wads, heavy shrub vegetation, or even rip rap) and in-channel flow-forming structures (J-hooks, rock vanes, etc.). Leave about 15 feet of the slag along each side of the new channel, and there is little need for these other bank stability measures. Add about 6 inches of soil to the slag at the stream edge. Fifteen feet away from the bank edge the slag should be excavated at least 18 inches below the floodplain elevation and soil added to provide a reasonable environment for trees, shrubs, and grasses. The organic matter in the soil will also provide a hydrogen ion (acid) source to waters percolating into the underlying slag. By comparison, between Dunes Creek and Indian Creek, this may reduce the pH of water entering the channel from 9 to 8.5 or 8.0.

The Wetland Stream System

The bottom elevation in Indian Creek exhibits a longitudinal profile frequently found in wetland streams throughout the northern Lake States. The longitudinal profile of most streams shows a line connecting the tops of the riffles will form a downhill slope consistent with the overall water slope at high flow and the overall slope of the stream bank.

Wetland streams partly depart from this configuration with regard to their bottom profile. Consider a stream flowing downhill through an upland forest area then entering a wide and long wetland section with organic soils over sands and then exiting the wetland to again flow through mineral soil in an upland forest. The bottom profile in the forest area will exhibit the normal slope between riffle tops. When the stream enters the wetland the bottom profile will continue to exhibit a riffle pool sequence, with coarse material on the riffles and sand in the pools. However, the slope between the tops of the riffles will flatten just as the overall slope of the wetland has flattened, but still sloping downhill overall. Near the end of the wetland before the stream enters the next section of upland forest, the slope between the riffle tops will become positive! *The stream bottom will run uphill!* That is the pattern exhibited in the Indian Creek longitudinal profile.

The upland-forest, sedge-wetland example above commonly occurs when receding glacial moraines dam a scoured section of glacial valley and a wetland develops behind the small moraine. In the south-shore, dune/wetland, system below Lake Michigan, the dunes dam streams flowing between dunes. Streams normally develop parallel to the dunes, but with extreme events, streams perpendicular to the dunes can form. An example is a large flood, in excess of the 100-year event, reshaping or re-routing stream *valleys*. This may have occurred naturally in the Indian Creek area, but certainly occurred with channel construction in the last 150 years. The “dams” formed by the old dunes are the grade level control points for water levels in Indian Creek and its wetlands. The original rail lines probably mark where these dunes retarded Indian Creek flow.

I based the design of longitudinal stream profiles for Indian Creek on the natural wetland streams that run deep coming into the wetland then run uphill at the wetland exit. In effect, Indian Creek and many wetland streams are “flooded channels.”

Why Not Use the Existing Channel?

Could we build a new channel inside the existing one? It is very unlikely equipment can operate inside the existing channel although this is preferred for many channel restoration projects. One or two of the stream cross sections shown earlier in the channel survey section alluded to the presence of a very unstable mixture of fine sand and calcium, magnesium bicarbonate deposits on the channel bottom. These will not support a floating person let alone heavy equipment. The deposits range from 5 to 9 feet deep below the channel bottom and represent the filling-in of a very much over-wide and over-deep trapezoidal channel originally dug primarily for sand mining purposes. Figure 15 illustrates a series of these cross sections taken during the July 11 survey by simply pushing the target pole into the bottom of the stream.

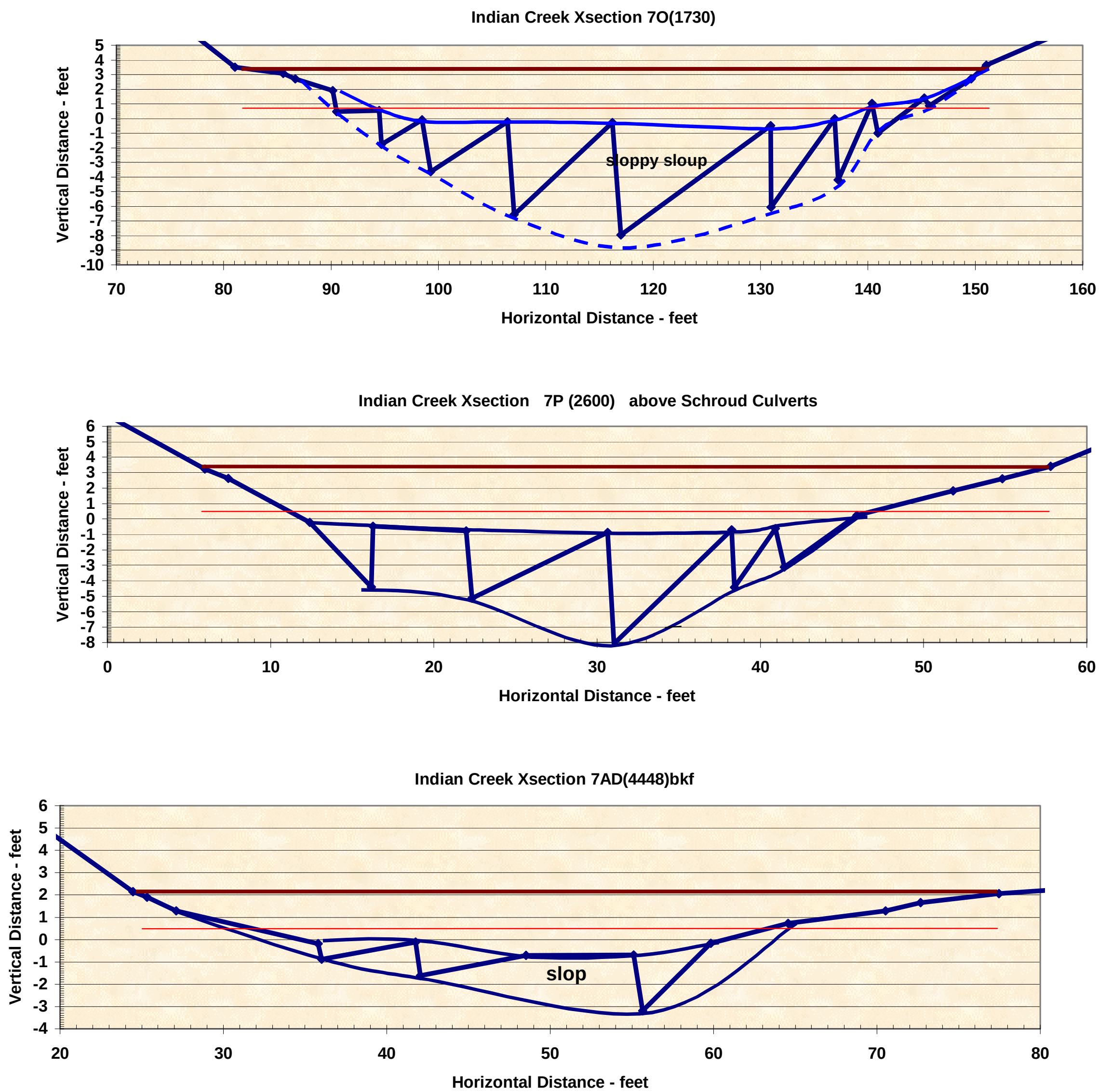


Figure 15. Examples of stream cross-section on Indian Creek showing the depth of very sloppy fine sand and bicarbonate mixtures below the channel bottom.

Design Flow Estimates

Bankfull flow is the critical channel design variable needed to derive all other aspects of channel dimension, pattern, and profile. We used Haestad Flowmaster (v6) (Haestad Methods 1999) to estimate flow at the bankfull elevation in 16 cross sections or a modification of the cross sections to allow for a new floodplain. Bankfull flow was then used to size the channel cross section as influenced by the designed channel sinuosity (thus its length and slope) and new estimates of channel roughness (.035). Bankfull flow was estimated at 80 cfs, somewhat above gauging estimates of bankfull flow (measured just a foot below bankfull and extrapolated). Ratios of discharge at a given recurrence interval (1.5-, 5-, 10-, 25-, and 50-years) to the bankfull discharge were used to estimate the flow for these events. I used ratios from Leopold (1994) for C channel types in the Eastern United States. I doubled of the 50-year flow to estimate the 100-year event (or 8 times the bankfull flow). The 50-year flow estimate is 320 cfs and the 100-year flow estimate is 640 cfs using ratios of an average bankfull flow of 80 cfs (see Table 5).

Table 5. Estimates of bankfull flow on Indian Creek and measured flow (or extrapolation a short distance to other cross-sections) compared to modeled channel flow using the Haestad Methods implementation of the Manning's equation.

Section	Bankfull	100-yr Flood	Bankfull	Estimated flow at the gaging time	Measured flow at the gaging time	Gage	Width at Bankfull
	cfs	cfs	slope	cfs	cfs	slope	
B (0)	60	643	0.001	34.5	33.4	0.001	22
C (59)	60	656	0.001	23	33.4	0.001	31
WhtBrdg70	86	650	0.0007	43	33.4	0.001	34
J (956)	65		0.0003	28	28	0.0003	42
M (1095)	81		0.0007	27	25	0.0007	34
O (1730)	86	709	0.0007	36	25	0.00007	70
7T (2760)	95	440	0.001	34	29	0.001	30
7V (2804)	84	499	0.0015	28	29	0.0015	34
7Z (3798)	105	669	0.0007	32	27	0.0007	60
7AA (4314)	105	532	0.0007	39	28	0.0007	41
7AB (4399)	73	346	0.0007	36	28	0.0007	25
7AB (4399)	74	648	0.0007	36	28	0.0007	25
7AC (4442)	66	371	0.001	35	28	0.001	24
7AI (6222)	50	378	0.0012	18	20	0.001	21
7AI (6222)	50	647	0.0012	18	20	0.001	21
Representative	**81**	**650**	**0.0007**				**25 to 40**
Design 100-yr	**80**	**640**	**0.0007**				**28**
Design 50-yr		**320**					

The yellow cells under the 100-yr Flood cfs column in Table 5 indicate sites where existing channel capacity without a floodplain would be able to pass about the 50-year event, but would back water up at higher events. For Sections 7T and 7V this would occur at the Schroud culverts. Installation of a step/pool series of rock cross vanes at this location would control water levels above this site to maintain existing low-water fishing conditions and allow a greater passage of water during floods. Incorporation of a floodplain above the Schroud culverts would allow the temporary storage and passage of the 100-year event.

Section 7AB is at the existing 126th Street Bridge. The bridge opening would allow the passage of the 50-year event, but would detain higher flows. Incorporation of a floodplain cross section in addition to a box culvert would allow the passage of the 100-year event. A floodplain profile extending all the way to the Calumet River would ensure unrestricted flood flow.

Section 7AI is near the Calumet River where the existing narrow channel with high terraces on each side will also allow the 50-year event to pass, but incorporation of a floodplain with a new outlet to the Calumet River would allow the passage of the 100-year event.

There also needs to be a low-water-level control at the confluence of Indian Creek with the Calumet River to insure the newly constructed wetland floodplain stays wet. The specific ratios and the elevations these flows represent are given in Table 6.

Table 6. Design flow and design flood elevations for various flood events in a new channel designed to carry a bankfull flow of 80 cfs in Indian Creek. Q/Qbkf ratios are taken from Leopold (1994).

C Channel Type		**West of the first bend beyond Nitr. Road**	**West of Carondolet Bridge**	**North of 126th Street Bridge**		**Indian Creek Design Discharge**
Frequency of flow	**mean d/ mean d bkf**	**Elevation ft**	**Elevation ft**	**Elevation ft**	**Q/ Qbkf**	**cfs**
[100 yr]	[2x50yr]	7.4	6	5	[8.4]	672
50 yr	1.75	5.7	4.4	3.4	4.20	336
25 yr	1.5	5.2	3.8	2.8	3.30	264
10 yr	1.25	4.6	3.2	2.2	2.10	168
5 yr	1.15	4.35	2.95	1.95	1.50	120
1 yr	1	4	2.6	1.6	1.00	80
110 days	0.3	2	0.6	-0.6	0.17	16
37 days	0.15	1.6	0.2	-1.8	0.02	2

Figure 16 (A3) shows the elevations represented by these high flow estimates for the longitudinal Indian Creek section along with the 100-year flood estimate for the HEC-II model presented by SDI.

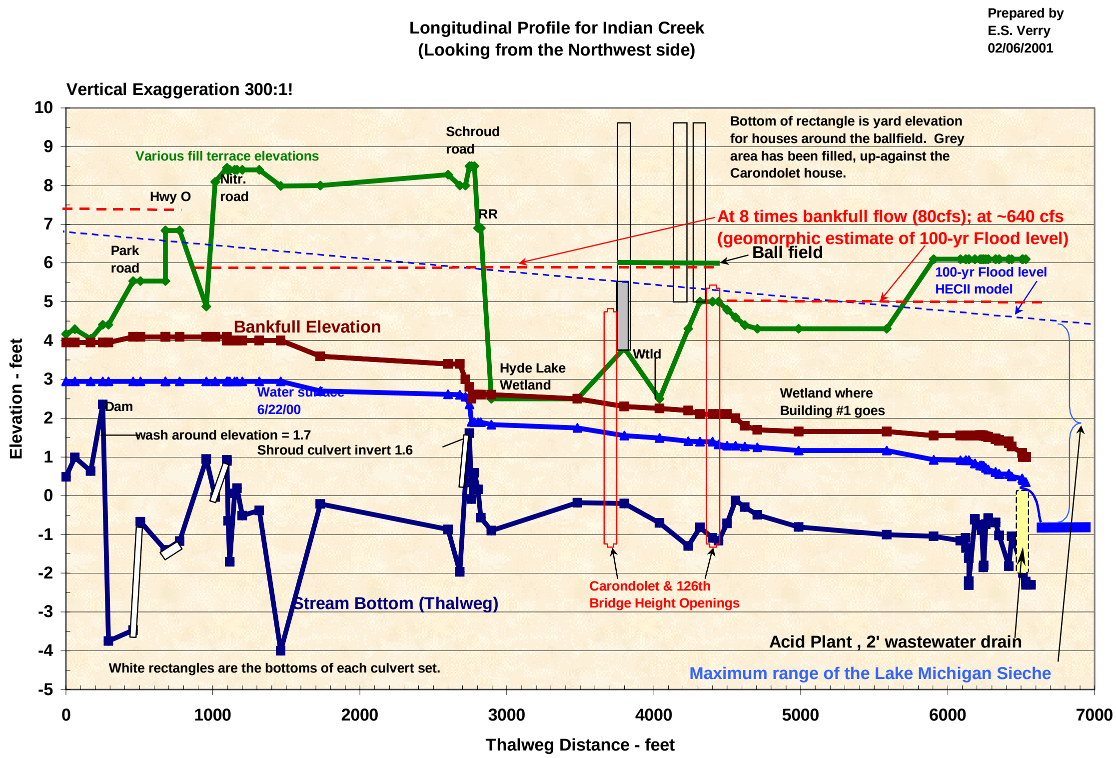


Figure 16. Estimates of the elevation of the 100-year flood event based on bankfull ratios and the HECII model.

I have my doubts about the 7.4-foot elevation of Wolf Lake, as water at that elevation would begin spilling over the highways to the North and East of Wolf Lake and the high elevation would induce more groundwater flow beneath these highways into Lake Michigan. However, the 6-foot elevation is quite believable. There is a general agreement between the bankfull ratio and HECII model results and in either case the houses to the South and West of the Hegewisch ballfield would get 6 inches to a foot of water above their yard elevations at the foundation wall. Anecdotal accounts of the floods in the early 1950s place the water level at the Carondolet Bridge at 4.5 feet. This event induced the placement of clay against the foundation of the house to the Southwest of the Carondolet Bridge to an elevation of 5.5 feet.

Figure 17 shows suggested floodplain cross-sections under the new 126th Street Bridge and carrying through to the Calumet River.

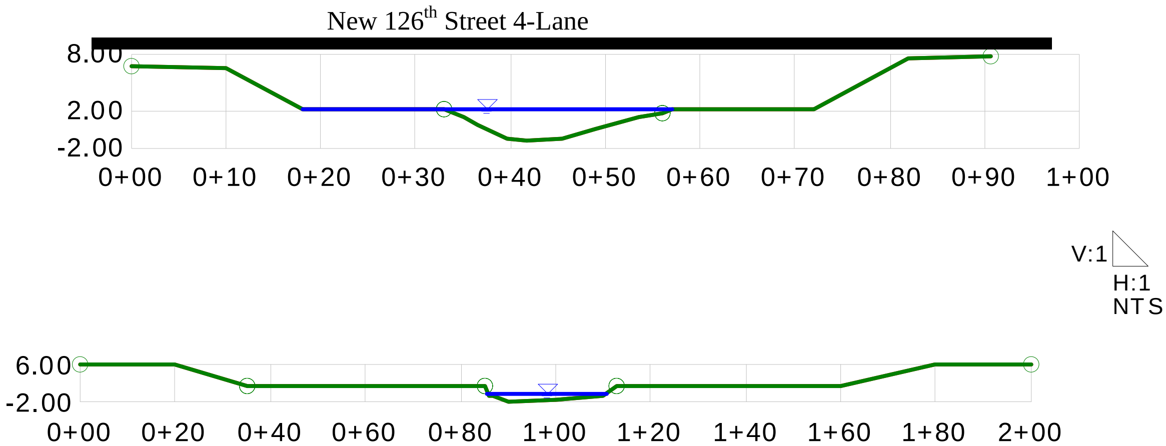


Figure17. Floodplain cross-sections under the new 126th Street Bridge (top) and at the confluence of Indian Creek with the Calumet River (bottom). Note difference in scales.

Bankfull flow and channel type C dimensions dictated the size of a restored Indian Creek. These dimensions will induce normal secondary flow cells in the channel that will maintain new riffle and pool dimensions. It should also help to clear new deposits of the calcium bicarbonate (heavy amounts have accumulated in the existing over-wide and over-deep channel originally dug). The bicarbonate will continue to coat much of the stream substrate.

Channel Cross Sections for a Restored Indian Creek

The riffle and pool cross sections associated with the design bankfull discharge of 80 cfs and an overall stream slope of 0.0007 in the Schroud section are shown in Fig. 18, A4.

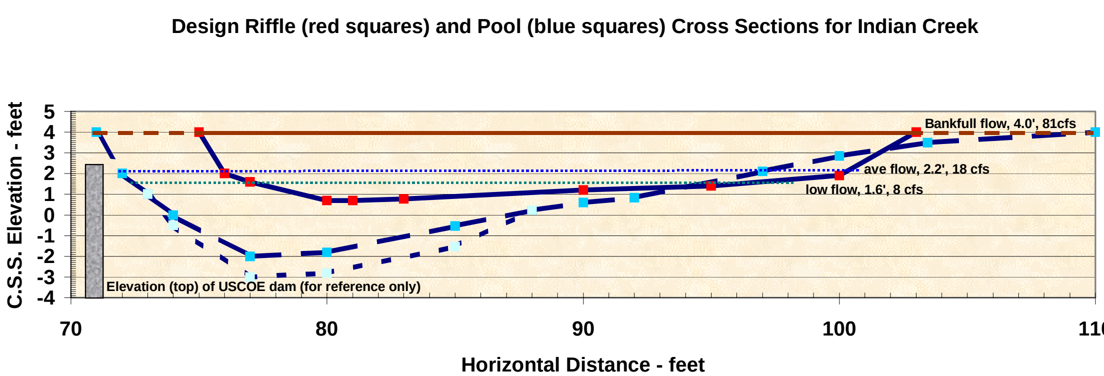


Figure 18. The riffle (upper line) and pool (two lower lines) cross-sections for a new Indian Creek channel located just west of the nitrogen pipeline where the new floodplain elevation would be 4.0 feet. Horizontal lines indicate bankfull, average, and low flow water levels and discharges. Figure 18 shows the COE dam near the outlet of Wolf Lake because many people reference water levels to its top.

The riffle cross section is 28 feet wide, and the pool cross section is 28* (1.4) or about 40 feet wide. Variation in the pool width between 32 and 40 feet as the pool goes around a stream bend is needed to feather into the riffle cross section width of 28 feet and also desirable from an aesthetic viewpoint. The riffle cross section should be kept at 28 feet, but could also show variation up to 32 feet. Note the variation in pool depth that will provide variable habitat niches for different sized fish.

Plan Views for a Restored Indian Creek

Construction of a new, resized channel is suggested for three areas of Indian Creek: north of the 126th Street Bridge, north of the Hyde Lake Wetland, and south of the existing channel on the Schroud property. These designs incorporate channel blocks to divert water from the existing Indian Creek channel but some of them also incorporate elevation dips in the blocks to allow fish access to the old Indian Creek channel and the Hyde Lake Wetland. Figures 19-21, A5-A7, show the plan views for a restored Indian Creek.

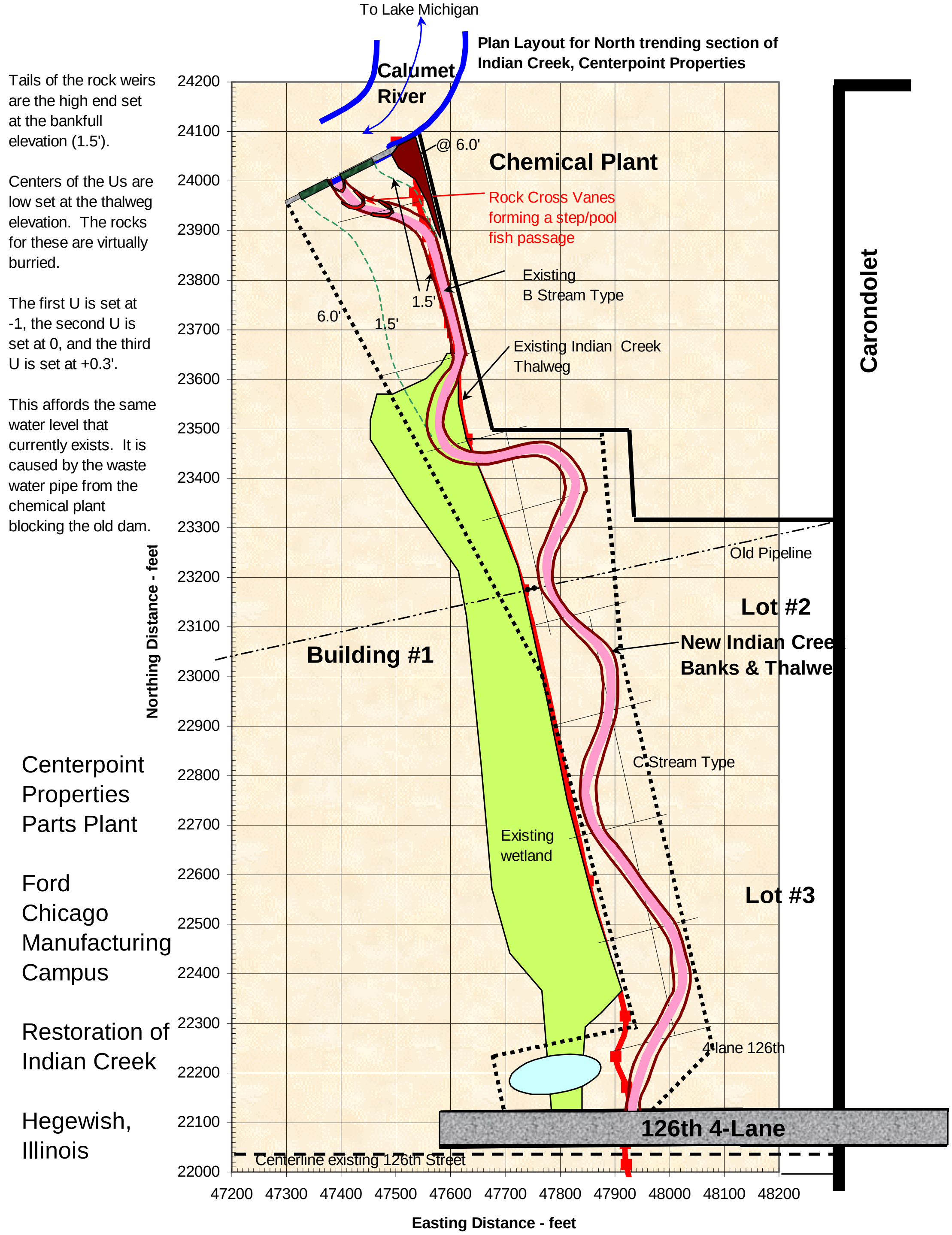


Figure 19. Plan view for the reconstruction of Indian Creek (rose) in a new floodplain north of the 126th Street Bridge. The old Indian Creek Channel (red) and the existing wetland (green) will be filled and become part of the base for building No. 1 in the Manufacturing Campus. If the old concrete dam at the mouth of the existing Indian Creek were removed, the curve at the mouth of the new Indian Creek could be eliminated. Rock cross vanes are still required to control wetland water levels.

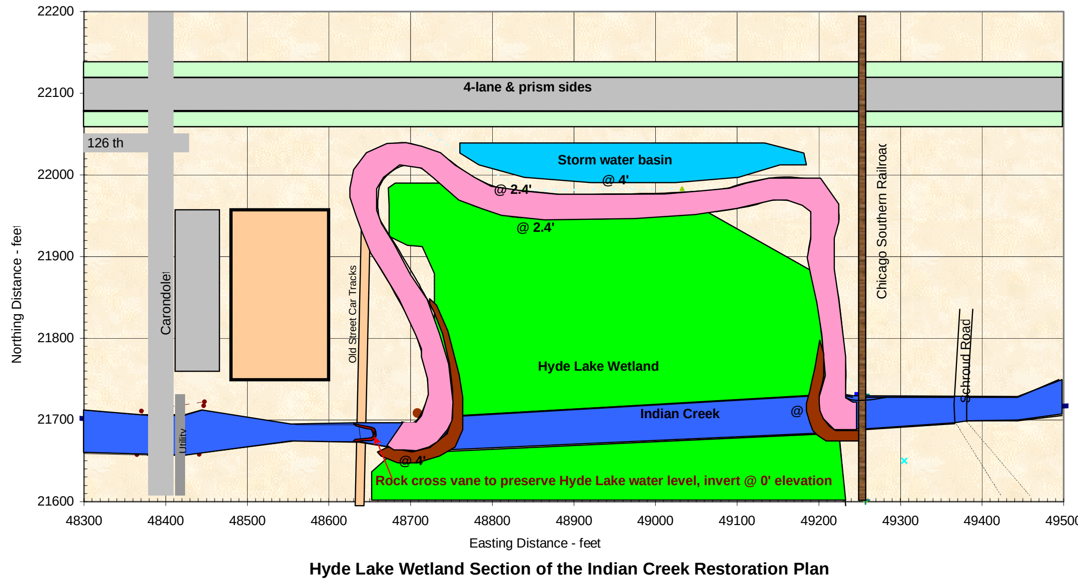


Figure 20. Hyde Lake Wetland Section of the Indian Creek restoration plan. The new channel is shown in rose, and channel blocks in brown. The bankfull elevation of the new channel is 2.4 feet consistent with the existing wetland. The channel blocks are at a 4.0-foot elevation, however, water will freely circulate into the wetland at the 2.4' elevation.

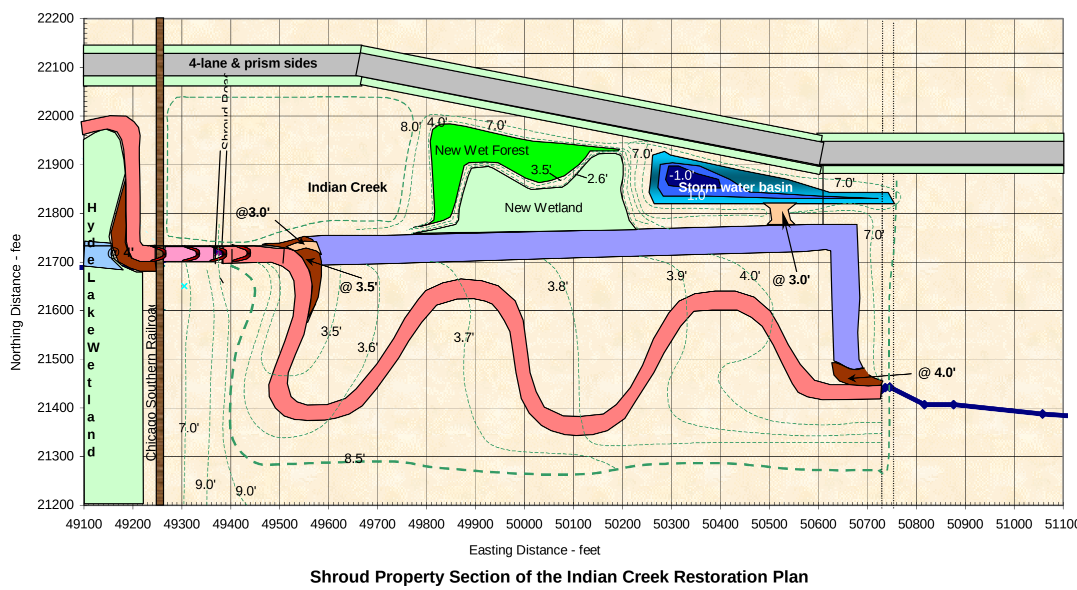


Figure 21. The Schroud property section of the Indian Creek restoration plan. The new channel is shown in rose. Brown areas are channel blocks constructed of slag draped with geotextile and capped with large (3 foot) rock. Lighter brown areas are average flow connections to the existing Indian Creek channel and the new wetland on its north bank. Red crescents are rock cross vanes for grade control. There is a 1.5 to 1.6' drop across all the vanes. See Fig. A15 for the cross vane specifications.

Note the presentation of the figure scales in Figs.19-21 is slightly different. In Fig. 21 the first grade control rock cross vane is beneath the Chicago and Southern Railroad Bridge and will serve to protect the foundation structure for the bridge as well as begin the lower section of the step/pool sequence. See Fig. A15 for a drawing of a rock cross vane.

Channel Longitudinal Sections for a Restored Indian Creek

The longitudinal section for the Schroud property section of the new Indian Creek is shown in Fig. 22, A8.

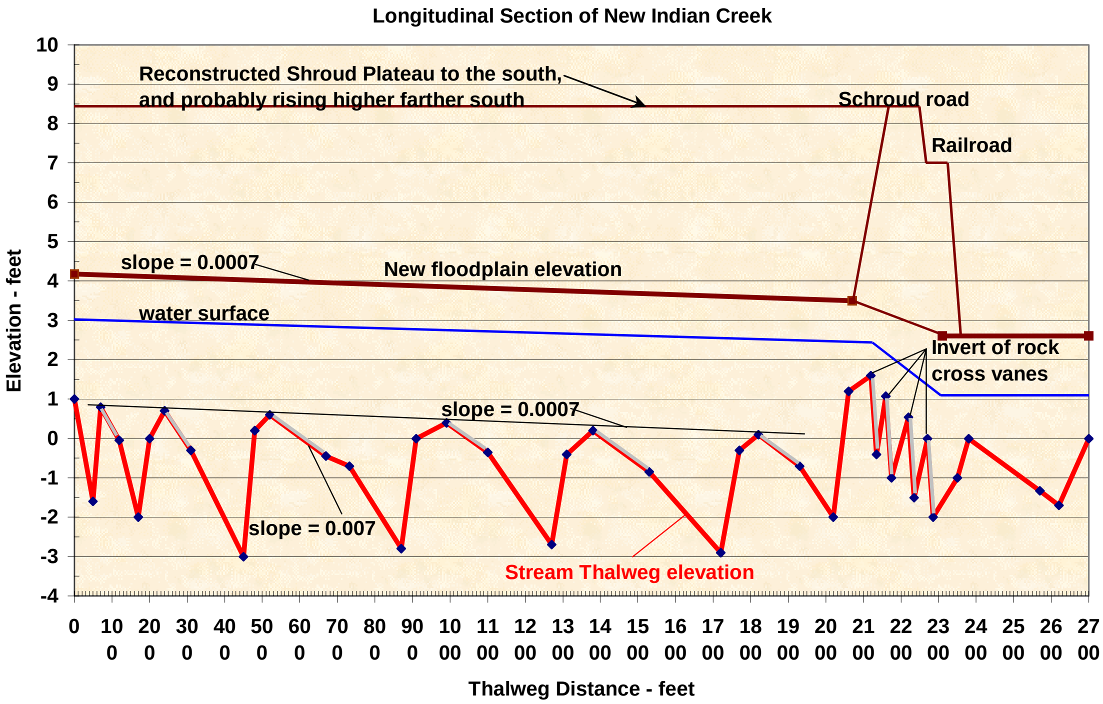


Figure 22. The longitudinal section for the Schroud property section of the new Indian Creek. Horizontal distance is the thalweg distance along the new stream shown in Fig. 21. It begins at the outlet of the nitrogen pipeline culverts on the left (0) and extends to the downstream edge of the Chicago Southern railroad bridge on the right (2700 feet). The brown line is the newly constructed floodplain (and bankfull) elevation. The red line is the thalweg bottom of the stream. The gray lines are added rock (4 to 6 inches deep) to the riffle sections. Rock size is 15 to 100 mm (1/2 to 4 inches) in diameter.

The addition of rock to the riffle surfaces will serve to armor them against movement during high flows. We calculated the critical shear stress using the Shields equation as 62.4 times the hydraulic radius of the channel (2.28 ft.) times the over-all slope (0.0007) to yield 0.1lbs/sq. ft. of shear stress at the bankfull flow condition. From the Shields diagram (Leopold, Wolman and Miller 1964) the particle size associated with a critical shear stress of 0.1 is 7 mm. However, the Shield's diagram typically underestimates the particle size diameter in its mid range by 100% (Hey and Rosgen 2000) so the design particle size that will remain on the riffle section is selected at 15 mm or greater.

We recommend a range of rock diameters from 15 to 100 mm (1/2 to 4 inches) on the riffle surfaces because we measured slag conglomerate up to 250 mm in diameter at the outlet of Wolf Lake. Some people recommend an underlay of geotextile on the riffle section; however, I do not recommend this because it interferes with burrowing invertebrates, and experience with and without it on a fine sand bed stream (Pokegama Creek south of Grand Rapids, MN; a joint MNDOT, MNDNR, FS stream restoration) indicates it is not needed.

Note the elevation of the top rock cross vane invert is at 1.6 feet. It is the same elevation as the invert of the existing Schroud culvert (inside bottom of the culvert circle). In effect, this design perpetuates a flooded channel that provides deep-water habitat to the fish community between the Schroud culverts and Wolf Lake. Lowering this elevation would yield very low water levels that, in my opinion, would evoke strong opposition from a large number of people who fish the Wm. Powers Conservation Area (lake and stream) and the upper East-West section of the current Indian Creek. Note the uphill stream bottom at the end of the longitudinal section in Fig. 22. This mimics the flooded channel bottoms in natural wetland stream systems.

The multiple rock cross vanes form a step/pool series from the new Indian Creek channel down to the Hyde Lake Wetland that will maintain the current water level regime above and below the vanes and provide for spawning and average flow fish passage. It will also make it very hard to block the flow at this point as some folks wanting to spear spawning salmon have done in the past. Figure 23, A9 shows a more detailed view at the pool/step cross vane area.

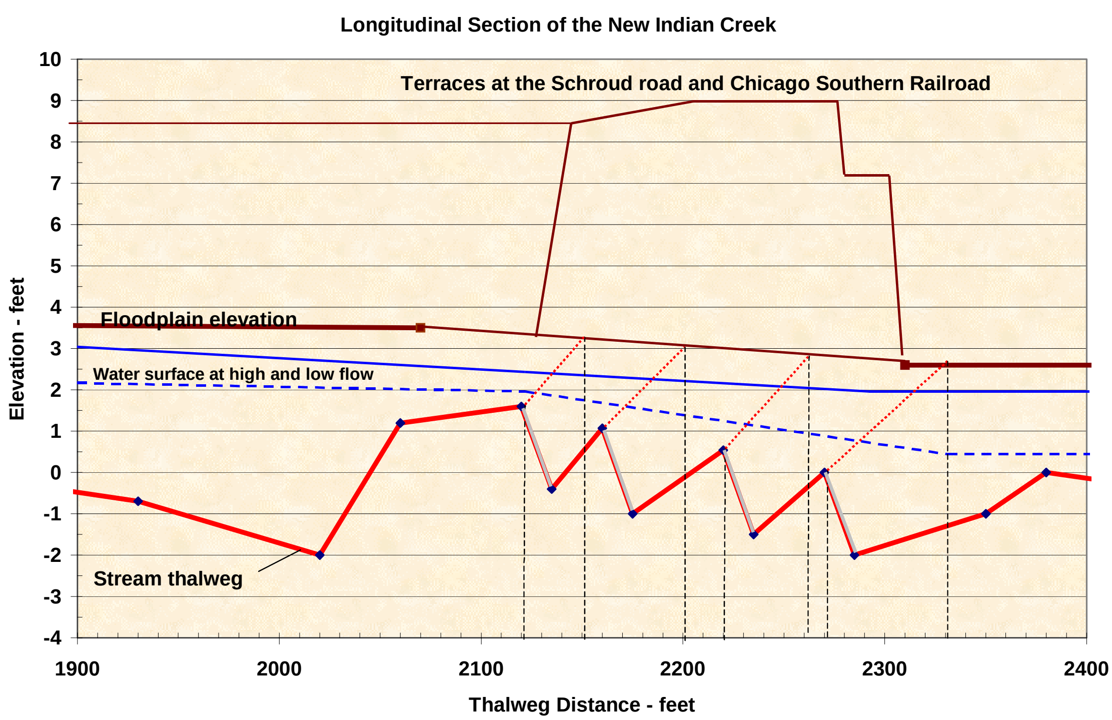
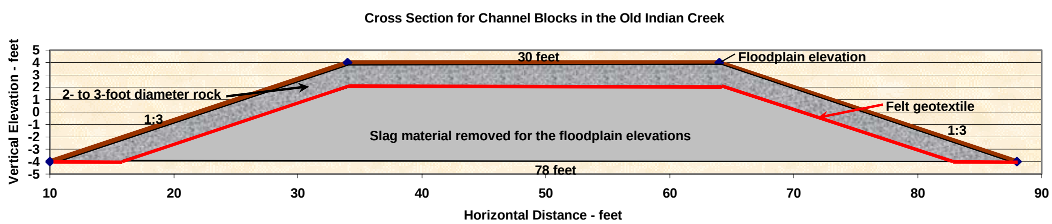


Figure 23. Elevation detail for the rock cross-vanes at the Schroud road, Chicago Southern railroad site. Gray areas are 3 to 4 inch rock in the plunge pool inside the vanes. Vertical dashed lines are for distance measurement. The diagonal dashed red lines are the rising legs (tails) of the rock cross vanes from their inverts to the bankfull elevation.

Fig. 24, A10 (top) shows a cross-section of the channel block just below the nitrogen pipeline. Figure 24, A11 (bottom) shows a longitudinal section of the channel block just above the Schroud culvert location. Note all of the channel blocks are level across their top except for the one above the Schroud culvert site. At the Schroud culvert site there is a dip in the surface to allow low (and high) water exchange into the old section of Indian Creek and the newly created wetland on its north side. The plan views in Figs. 19-21 show the height of the various channel blocks. There are five channel blocks in all.



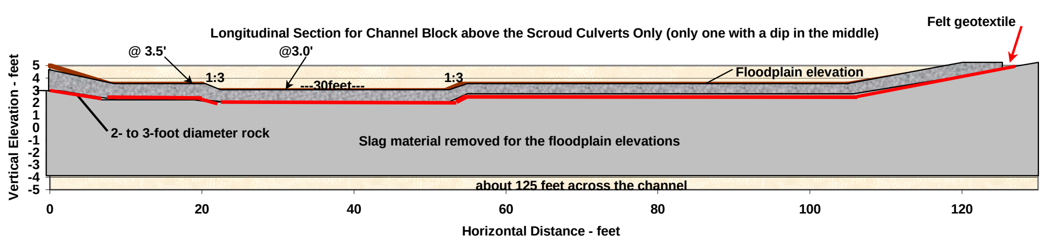
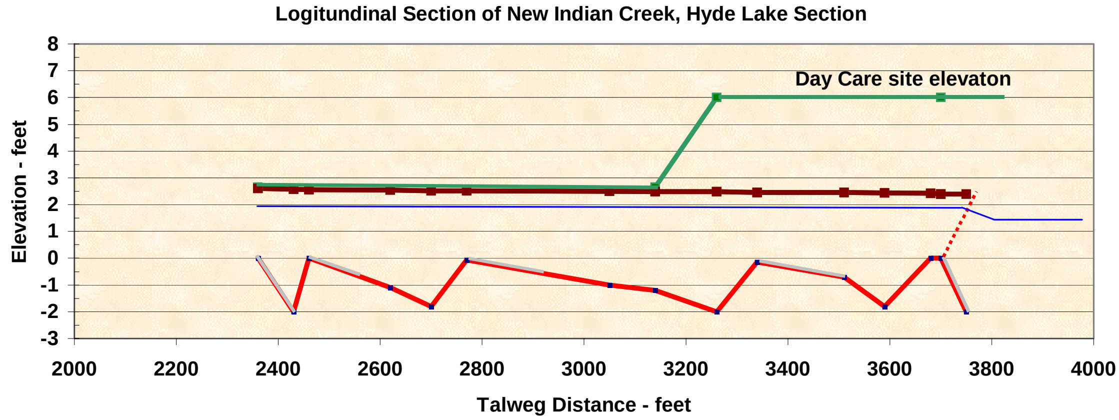


Figure 24. Cross-section (top) and longitudinal section (bottom) for two of the five channel blocks recommended. The top cross section is located just west of Highway O and is straight across at the top at an elevation of 4’. The pool at that location is about a –4’ elevation deep. The longitudinal section (bottom) is for the block just above the Schroud culverts and it has a different top (floodplain elevation and a dip to allow low water circulation with the old Indian Creek channel. See plan views for top elevations of other channel blocks.

These channel blocks will overtop during floods (flow above the floodplain) and allow the old part of Indian Creek and the newly constructed wetland to function as a floodplain. Large rock, underlain by a felt geotextile will prevent headcutting of the channel block. When a floodplain overtops there is always the possibility the overflowing water *on the downstream edge* of the block will start a headcut that works its way upstream through the block and finally breaches the entire block. Thus, the large rocks *on both sides* of the block are important to prevent breaching. Round glacial rock from the Kankakee moraine to the south would look well, but flat rock in the center of the block would help people walking there.

Fig. 25 (A12 and A13) shows the longitudinal stream profiles for the Hyde Lake Wetland and the Building One Wetland sections of the new Indian Creek.



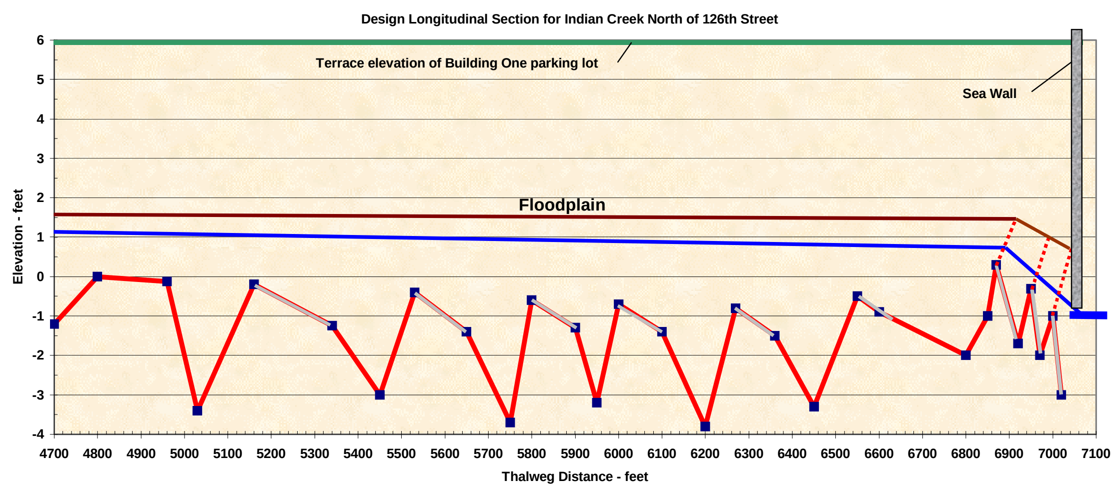


Figure 25. Stream longitudinal profiles for the Hyde Lake Wetland section (top) and the Building One Wetland section (bottom). Rocked, riffle areas are shown in gray, and the location of rock cross vanes are indicated with upward slanting, dashed, red lines. The sea wall in the bottom figure is at the confluence with the Calumet River and will be removed and replaced with riprap in the new floodplain area.

The rock cross vane at the old trestle site just above the Carondolet Bridge and just below the Hyde Lake Wetland is suggested as a starting point for any construction in the Indian Creek area. The riffle formed by the scour deposit below the 126th Street Bridge controls the water level in Hyde Lake Wetland. The wastewater pipe from the sulfuric acid plant entering the old dam at the confluence with the Calumet River also controls the Hyde Lake Wetland water level.

Removing both of the control points during construction would lower the water level in Hyde Lake Wetland as much as a foot! Alternately, temporary cofferdams at the 0 elevation would maintain the Hyde Lake Wetland water level until permanent rock cross- vanes at the mouth of Indian Creek were completed. However, the cofferdam would be subject to washout when large storms occurred.

Rock cross vane grade controls at the Schroud culvert site, the old trestle site above Carondolet Bridge, and at the confluence with the Calumet River will set the groundwater regime for the entire Indian Creek stream course, Wolf Lake, and surrounding areas. The design elevations selected will maintain the existing deep water above the Schroud culverts, protect the water levels in Hyde Lake Wetland, and allow water to pass quickly around the Hegewisch ballfield into the Building One Wetland where the rock vanes at the confluence with the Calumet River will allow a new wetland to develop.