

CHAPTER 8

DRAIN CONSTRUCTION PROCEDURES

Prepared By:

Jim Smalligan, Chairperson

Larry Protasiewicz

Jeff Friedle

8:1 DESIGN CONSIDERATIONS

8:1.1 Overview

Hydrology is the science concerning precipitation and the resulting storm water runoff, interception, infiltration, and stream flows. These natural phenomena are modeled to predict the potential for flooding, as well as the impact of development and land use on our water resources.

Hydraulics is that branch of engineering that calculates how fluid flows through channels, pipes, or over the landscape. Velocity, as well as depth and width of flow, can be calculated. Hydraulic design uses the design flow and volume determined by hydrologic calculations to design and evaluate proposed design alternatives. A design storm is chosen as the basis of a design. Consideration is given to the land use being enhanced or protected when picking a design storm. Economics, longevity, risk, environmental considerations (e.g., habitat protection or restoration), and aesthetics are also used to evaluate proposed alternatives. Secondary design flows (low and high) are also considered when evaluating proposed alternatives.

8:1.2 Considerations

(1) Design Storm

Engineers refer to design storms based on the statistical probability of their occurrence. For example, the 100-year storm has a 1 in 100 or 1% probability of being equaled or exceeded each year. The total rainfall amount varies based on the frequency (probability) of the design storm.

(2) Hydrographs

A hydrograph is a plot of the rate of runoff that occurs in a drainage area over time. There is a unique hydrograph for every rainfall event. Different storm water management techniques can alter the shape of a hydrograph in a drainage area for the same design storm. Detention reduces the peak rate of runoff while extending the time over which the runoff occurs.

(3) Time of Concentration

The periods of time that it takes storm water to reach the outlet of a drainage area is referred to as the time of concentration. Small subcatchments with impervious surfaces have a short time of concentration and will realize their highest flow rates during brief, intense thunderstorms. A large undeveloped watershed will realize peak runoff after a long continuous rain over many hours or days.

(4) Infiltration

The ability of the soil in a watershed to infiltrate storm water influences the volume of surface water runoff and the peak rate of flow. Soil that is already saturated from snowmelt or a previous rain will have less infiltration and a higher rate of runoff. Frozen ground will impede infiltration and result in runoff from normally permeable soil at a rate similar to impervious surfaces.

(5) Interception

Another water loss that reduces the rate and volume of runoff is interception. Trees, shrubs, and plants retain precipitation, resulting in evaporation or evapotranspiration instead of surface water runoff. Small depressions in uneven ground store water, which then infiltrates or evaporates. These water losses reduce the peak rate and total volume of runoff from a drainage area.

(6) Land Use and Topography

Land use has a large effect on the type of drainage system and the choice of the design storm. Land use affects the peak flow rate as well as the total volume of flow. The economic impact of flood damage to the land and improvements are considered. Generally speaking, protecting a farmland and increasing yield will have less total value per acre than protecting homes, commercial, or industrial properties. The risk of the loss of life, disruption of transportation, or threat of pollution may support a larger expenditure per acre and a larger design storm. The topography of the area will also influence the choice of the design storm. Rolling terrain will usually result in more depression storage and localized flooding whereas flat regions such as the Saginaw Bay area would have extensive flooding and can therefore afford a higher level of protection.

(7) Design Approach

Alternatives should consider a variety of solutions. Structural (channel improvement, detention, berms and dikes, pumps . . .), nonstructural (floodplain protection, land acquisition, less intensive land use . . .), or a combination, should be considered. Acquisition of structures or flood proofing structures in the floodplain may be less expensive in the long run than building a bigger conveyance facility. Regional detention may reduce or avoid the need to increase conveyance.

Decisions need to be made regarding open drains as opposed to enclosed systems. The advantage of the open system is mainly lower cost. Open drain systems use more of the landscape for easements and the facility. There are significant environmental impacts associated with enclosing a stream.

(8) Storm Water Runoff

The hydraulic design seeks to manage the storm water runoff. There are two components to the runoff to consider: the rate at which water runs off the land, and the total volume of the runoff. As land is more intensely used, the amount of impervious surface is increased. This increase in impervious surface tends to increase the peak flow rate as well as the total volume of storm water runoff in the watershed. Historically, people reacted to the increase in peak rate, and provided a bigger channel or pipe. This reaction transferred the problem downstream. In an attempt to make development more responsible for “its” water, a philosophy developed that development would be limited to discharging at the pre-developed rate. This approach still ignores the increased volume of runoff. The increased volume of runoff can accelerate natural erosion processes by increasing the frequency and duration of erosive flows. There may be areas in the watershed where it is best to detain the peak runoff and release the increased volume into the drain over a longer period of time. There may also be locations in the watershed where it is best to not detain the runoff, but instead increase the floodplain storage.

8:1.3 Design Parameters

(1) Design Flow

There are some traditional design storm guidelines that engineers have used. A five- to ten-year design storm is commonly used in rural areas. A 10- to 25-year design is typically used in urban and suburban areas. All design alternatives should evaluate two other flows to check the reaction of the proposed system. They are the low and very high flows. The low flow that you would expect to see most of the time should be evaluated. A very high flow is considered to identify the area affected by the storm water in excess of the design flow. For large flows like the 100-year event, this secondary flow path may approximate the 100-year floodplain.

(2) Channel Design

The channel design must accommodate the design storm/flow that was chosen for the project. There are limiting velocities that should not be exceeded, depending on the soil type and soil stability. Bottom width and side slopes can be adjusted to reduce the velocity. Extra consideration must be given to the potential for erosion due to increased velocity and turbulence at curves, confluences with tributary channels, and entrances and exits of culverts or bridges. The channel design should also be checked at low flow to determine whether the flow velocities will be so low as to cause deposition

of sediment. There may be the need to design a low flow channel within the larger channel to provide a minimum velocity at low flow. The channel should also be checked at high flow to identify problems such as flooded roads and the potential for erosion.

Environmental considerations include use of vegetation for channel stability, using trees to provide shade that limits the growth of aquatic vegetation, and maintaining or providing wildlife habitat.

(3) Enclosed Drains

Enclosed drains for agricultural applications differ from enclosed drains for urban/suburban applications. Many enclosed agricultural drains have no surface inlets; all of the flow comes from water that has percolated through the soil profile. The soil profile acts as a large detention facility. The water is stored and slowed down on its way to the drain. Consequently, agricultural drains tend to be a smaller diameter for a given land area than urban/suburban drains. The agricultural drain is designed to remove a certain depth of water from the drainage area over a relatively long period of time (up to 24 hours), where the urban drain is designed to remove a larger volume of water in a short time period. Urban drains have numerous surface inlets and are designed to remove water quickly from road surfaces and, as a result, are often much larger and more expensive than agricultural drains.

8:1.4 Computer Models

Computer models are often applied in design to present a mathematical approximation of hydrologic, hydraulic, and water quality conditions. The accuracy of the model depends on the input data and how correctly the model represents the hydrologic processes in the watershed. Calibration of the input data using observed conditions is an important step in model development.

The following computer models are commonly applied in drainage studies and design:

(1) Rainfall Runoff and Routing Models (Single-Event Models)

HEC-1 is a computer model developed for the United States Army Corps of Engineers (COE). This program develops discharge hydrographs and allows a wide variety of options for specifying precipitation, losses, and routing.

TR-20 is the United States Soil Conservation Service (Natural Resource Conservation Service) model to develop discharge hydrographs based on land use and soil type. Computed flows are routed through channel reaches or reservoirs.

(2) Rational Method

The rational method is not a computer model, but instead provides a simplified calculation of the peak discharge from a subcatchment based on area, rainfall intensity, and a runoff coefficient (ratio of runoff to rainfall). The rational method should only be applied as a planning tool for small subcatchments.

(3) Flood - Hydraulics Models

HEC-2/HEC RAS was developed for the U.S. Army Corps of Engineers (COE) to compute steady state water surface profiles. The program analyzes flow through channel sections with complex geometry such as rivers and streams as well as bridges and culverts.

(4) Water Quality Models

Storm Water Management Model (SWMM) was developed for the United States Environmental Protection Agency (EPA). It was originally developed as a single-event model to simulate urban storm water runoff quantity and water quality. It has been adapted to continuous simulation applications. The various program “blocks” include discharge hydrographs, pollutographs, and various routing modules.

8:2 CONTRACT DOCUMENTS

8:2.1 Contract Documents

The legally enforceable requirements.

(1) Contract Forms

Agreement: Defines the relationships and obligations between the signatories and incorporates, by reference, all of the other documents.

(2) Bonds

Performance Bond and Payment Bond: These are like insurance. The contractor pays a bonding company to guarantee to the owner that the work will be completed and that all contractors' bills will be paid if the contractor defaults. Cost is 1% to 2% of the construction cost.

Bid Bond (Bid Security): A guarantee from the bidder that he will enter into an agreement with the owner. If the bidder backs out, the bid security is forfeited. The bidder can either pay a bonding company or issue a cashier's check to the owner. The amount is usually 5% of the bid, which will cover the extra cost of awarding to the next lowest bidder or re-bidding costs.

(3) Definitions

Contract Conditions: Defines the basic rights, responsibilities, and relationships of the parties involved.

General Conditions: General clauses that establish how the project is to be administered.

Supplementary Conditions: Modifies or supplements the General Conditions.

Specifications: Define the qualitative requirements for products, materials, and workmanship.

Drawings: Graphic representation of the work to be done. Show the relationship of materials to each other.

(4) Bidding Documents

Attract qualified bidders and explain the procedures that they are to follow in preparing and submitting bids.

(5) Bidding Requirements

- Advertisement for Bids
- Instructions to Bidders
- Information Available to Bidders: Geotechnical Data (Soil Borings)
- Bid Forms

Lump Sum or Unit Price Contracts: A Lump Sum Contract is one where a bidder bids a single lump sum to perform all work described by the drawings and specifications. A Unit Price Contract is one where the bidder is given the quantities of all materials, and the contractor submits a price-per-unit amount.

Cash Allowances: Dollar amounts that the bidder is told to include in the bid for work or materials. Concrete and soil testing is often included by specifying a “testing allowance.” Actual costs are later adjusted by a change order.

Change Orders: Documents that provide a format to handle contract changes affecting contract price or contract time.

Bulletins: A bulletin is issued to request the contractor to submit changes in cost for proposed changes in the Contract Documents. A bulletin is not a Change Order and does not authorize the contractor to proceed with the change in work.

Field Order or Work Change Directive: A Field Order or Work Change Directive is issued

to the contractor to order a change in the work in response to a change in conditions or in an emergency. It documents that a subsequent Change Order will be negotiated to adjust the contract price and/or contract time.

8:2.2 Insurances

Builder's Risk Insurance (Property Insurance): Similar to your homeowners' insurance. Can be "Completed Value" type (Best) or "Reporting" type (not good-must report value regularly). "All Risk" type is better than "Named Peril" type and covers everything including fire, theft, wind, hail, riot, vandalism, earthquake, and flood (not boiler explosion).

XCU Exclusion: Excludes explosion, collapse, and underground damage on general liability insurance.

Boiler Insurance: Covers damage to other things than due to a boiler (or other equipment) exploding or causing damage. ***Must specify equipment required to be covered.***

Business Automobile Coverage: Necessary for owned, non-owned, rented, and hired vehicles.

Contractor's General Property and Equipment Insurance: Builders' risk only covers construction; necessary to cover tools and equipment used to build the project, or contractor assumes the risk of losing them.

Owner's Protective Liability Insurance: A special liability policy that the contractor buys listing the owner as named insured. The name insured will typically include the drainage district, drain commissioner, governmental units and consultants.

Completed Operations: A form of liability insurance that provides coverage for bodily injury and property damage arising out of the operations that have been completed or abandoned, ***provided the accident occurs away from the premises*** owned or rented by the insured. Operations will be deemed completed at the earliest of the following times:

- a) When all operations to be performed by or on behalf of the insured under the contract have been completed.
- b) When all operations to be performed by or on behalf of the insured at the site of the operations have been completed.
- c) When the portion of the work out of which the injury or damage arises has been put to its intended use by other than the contractor or subcontractor.

Contractual Liability: Liability assumed under any contract or agreement over and above that liability that may be imposed by law.

Professional Liability Insurance: This is an insurance policy for design professionals. Often referred to as an “Errors and Omissions Policy.”

Named Insured: Specifically designated as the insured parties (e.g., owner, engineer, governmental units).

Umbrella Policy: An umbrella policy does not provide the primary insurance coverage but instead provides additional coverage after the primary coverage is exhausted. It will typically apply to a number of types of coverage (e.g. general liability, automobile, etc.)

8:3 CONSTRUCTION

(1) Pre-construction Meeting

The pre-construction meeting is intended to get the project off to a good start by opening communication between the owner, contractor, engineer, and indirectly with subcontractors, utility companies, reviewing or inspecting agencies, and other interested parties. The pre-construction meeting addresses schedule, payment procedures, coordination, utilities, regulatory requirements, contractor responsibilities, easements, and submittals. It is important that the engineer or owner take complete and accurate minutes of the pre-construction meeting and distribute these minutes to all attendees.

(2) Engineers’ Duties and Responsibilities under Conditions of the Contract:

- Act as owner’s representative for matters concerning the work.
- Routinely visit the construction site to observe and evaluate progress.
- Validate progress of the work for the purpose of authorizing progress payments.
- Initiate and prepare change orders.
- Exercise approval and disapproval authority on submittals.
- Reject defective work.
- Determine dates of substantial and final completion.

(3) Shop Drawings

Shop drawings are prepared by the contractor to illustrate and detail material and equipment. The shop drawings are submitted by the contractor for review and approval by the engineer.

(4) Retainage

Act 524, P.A. of 1980 (the Act) provides that most public agencies, including most special assessment districts, shall deposit construction contract retained fund money withheld from progress payments to the contractor into an interest-bearing account. The retained fund account money shall not be commingled with other money of the public agency. The retainage may equal 10% of the completed work, not to exceed 5% of the total contract amount.

The Act exempts the following contracts or payments that a public agency may negotiate:

- a) Contracts with a value of less than \$30,000.
- b) Contracts that provide for three or fewer payments.

The Act further provides that interest earned on the deposits of the retained funds money shall be paid to the contractor when the final progress payment is tendered or forfeited to the public agency for specific reasons stated in the Act.

8:4 QUALIFICATIONS-BASED SELECTION (QBS)

QBS is a fair and rational procedure that facilitates the selection of a design professional on the basis of qualifications and competence in relation to the scope and needs of a particular project. In most instances, the QBS process should include all or some of the following steps:

1. The owner identifies that the general schedule is established.
2. The selection schedule is established.
3. A list of design professional firms is compiled.
4. Qualification documents are requested.
5. Qualification documents are evaluated.
6. A shortlist of firms to be interviewed is composed.
7. A briefing is held.
8. Interviews are conducted.
9. Firms are ranked for selection.
10. Detailed scope of work negotiated with the top-ranked firm.
11. A contract is negotiated with the top-ranked firm. If an agreement cannot be reached, those negotiations are ended and negotiations are begun with the second-ranked firm, and so on down the line, until agreement is reached and a firm is selected.
12. All firms involved receive post selection communications, and the process is evaluated.

APPENDIX

Document List

1. Agenda for Pre-construction Meeting
2. Checklist for Preliminary Developments
3. Checklist for Final Plats
4. Flow Chart – Subdivision Control Act
5. Table Regarding Land Divisions
6. Sample Plat

**AGENDA
FOR
PRECONSTRUCTION MEETING**

Project:

Date:

Place:

Attendance: (see attached)

Contractor:

Contractor's supervisor:

Project engineer:

Inspector:

Emergency Telephone Numbers:

PERMITS

Permits will be required as follows:

A Soil Erosion and Sedimentation Control Permit:

<u>Required</u>	<u>Issued</u>
<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
<input type="checkbox"/> No	<input type="checkbox"/> No

A discussion was held regarding the applicable Soil Erosion Ordinance and the contractor's responsibility thereunder. These ordinances generally require that private property owners secure a permit for any fill placed on their property. Erosion controls must be instituted, as necessary. The filled property must be restored with ground cover. Contractors are hereby warned of these requirements.

MDOT	<u>Required</u>	<u>Issued</u>
	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
	<input type="checkbox"/> No	<input type="checkbox"/> No

Railroad	<u>Required</u>	<u>Issued</u>
	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
	<input type="checkbox"/> No	<input type="checkbox"/> No

County Road Commission	<u>Required</u>	<u>Issued</u>
	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
	<input type="checkbox"/> No	<input type="checkbox"/> No

County Drain Commissioner	<u>Required</u>	<u>Issued</u>
	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
	<input type="checkbox"/> No	<input type="checkbox"/> No

Generally work will not start until the required permits are in hand.

SCHEDULE

Anticipated starting date:

Location:

Progress Schedule:

Completion Date:

and contractor's comments thereto:

Liquid Damages

UTILITIES

The contractor was reminded of the requirements to notify MISS DIG and confirm this notification in writing to the project engineer.

Public Utilities - Review of Issues

Power Company - Attended [] Yes [] No

Telephone Company - Attended [] Yes [] No

Gas Company - Attended [] Yes [] No

Cablevision - Attended [] Yes [] No

Other:

MAINTAINING TRAFFIC

Discussion concerning construction safety, protection of the public, and provisions for adequate warning lights and barricades. Contractor shall provide access for fire and emergency vehicles at all times. Any signing, lights, and barricades shall conform to the Michigan Manual of Uniform Traffic Control Devices.

Traffic detour routes are as follows:

The contractor shall notify the project engineer at least 48 hours before closing any street and will notify police, fire and other necessary agencies:

STAKING

Construction staking will be done by _____.

The contractor should make requests for stakes at least 72 hours before they are required.

Telephone No.: _____

PAYMENT

Any extra work or changes in the work must be reviewed with the project engineer before they are performed, in order to be considered for payment. Any changes in the work, not provided for in the Specifications which are different in design or cost, will be made by Change Order only.

Partial payments are to be prepared by the project engineer and approved by on a monthly basis.

CHECKLIST FOR PRELIMINARY DEVELOPMENTS

Development Name: _____ _____	Date: _____ Reviewed By: _____
Developer/Owner: _____	
Developer's Engineer: _____	
Contact Person: _____ Telephone: _____	
Reviewing Agency: _____	
Contact Person: _____ Telephone: _____	

	<u>Provided/ Satisfactory</u>	<u>Comments</u>
General		
1. Development name. _____	_____	
2. Description of location (including section and fractional portion thereof, town or city and County, Michigan). _____	_____	
3. Location map. _____	_____	
4. Name, address, and telephone number of proprietor. _____	_____	
5. Name, address, and telephone number or engineer or surveyor. _____	_____	
6. North arrow and scale (not more than 1"=100') _____	_____	
Legend		
7. Development boundary. _____	_____	
8. Identification of all joining parcels (for subdivisions Show lot number, subdivision name, liber, and page Numbers; for metes and bounds parcels show Permanent parcel number) _____	_____	

9. Overall property description metes and bounds
(with ties to government corner). _____

10. Lot dimensions (scaled or computed). _____

11. Lot Numbers. _____

12. Building setback lines. _____

	<u>Provided/ Satisfactory</u>	<u>Comments</u>
13. Existing buildings (label those under construction with address). _____	_____	
14. Existing roads (with name, ROW width, and type of surface). _____	_____	
15. Proposed roads (with name, ROW width, and type of surface). _____	_____	
16. Existing contours (no greater than a 2' interval inside the plat; no greater than a 5' interval outside the plat). _____	_____	
17. Proposed contours. _____	_____	
18. Typical lot grading plan (detail, statement, or drainage arrows). _____	_____	
19. Available soils data, soil boring logs, and locations (including ground elevation and water table information). _____	_____	
Drainage		
20. Offsite watershed areas (with boundaries and acreage to be shown on location map). _____	_____	
21. All existing drainage courses and structures (with proper labeling as to type, size, and invert elevations). _____	_____	
22. County drains (permission required connect). _____	_____	
23. Proposed drainage systems (clearly identify all open and enclosed portions). _____	_____	

24. Floodplain contour (existing or proposed). _____

25. Existing wetlands. _____

26. Proposed storm water detention/infiltration
basins. _____

Stormwater Design

27. Calculations. _____

28. Inlet capacity/spacing. _____

	<u>Provided/ Satisfactory</u>	<u>Comments</u>
29. Adequate size/slopes. _____	_____	
30. Pipe material. _____	_____	
31. Submergence. _____	_____	
32. Outlet erosion control. _____	_____	
33. HWL in relation to low TOC elevation. _____	_____	
<u>Detention/Infiltration Basins</u>		
34. Required volume/release rate. _____	_____	
35. Adequate volume provided. _____	_____	
36. Side slopes. _____	_____	
37. Overflow spillway. _____	_____	
38. Hydraulic calcs. for transfer or outlet pipe. _____	_____	
39. Minimum basement floor elevations established. _____	_____	
40. Ensure proper siting. _____	_____	
Easements		
41. Utility easements (with dimensions and type of utility). _____	_____	
42. Existing and proposed drainage easements. _____	_____	
43. Offsite drain easements or rights-of-way. _____	_____	

Maintenance

44. Identification of agency proposed to assume ownership of the drainage system (including the detention and/or infiltration basins). _____

Fees

45. Development fee. _____

CHECKLIST FOR FINAL PLATS

SUBDIVISION NAME: _____ DEVELOPER:

LOCATION: _____ REVIEWED BY:

Initial Reviews

Date(s) Completed

- 1. Preliminary plat including (site plan, grading & drainage plan, and engineering calculations):
 Submitted _____
 Approved _____
- 2. Plat review fees are paid. _____
- 3. Construction drawings:
 Submitted _____
 Approved _____

Prior to Construction

- 4. Evidence of contractor’s insurance coverage. _____
- 5. Copy of signed construction contract. _____
- 6. Inspection deposits received. _____
- 7. Soil erosion and sedimentation control permit (Part 91 Act 451, P.A. 1972) received. _____
- 8. “Flooding” easement agreement submitted. _____

Prior to Final Plat Approval

9. Certification that county drains and storm water system have been improved in accordance with approved construction drawings. _____

-or-

The proprietor has entered into an agreement with the Commissioner or government body and has posted surety for faithful performance of the agreement. _____

10. Recordable release of rights-of-way are provided in the name of the drainage district. _____

Date(s) Completed

11. Approval has been given for any improvements required to existing county drains and permit fees are paid.

12. A drainage district has been established (adjusted), legal descriptions and a maintenance agreement are provided.

-or-

A letter of commitment from the local municipality, governmental agency, or association has been executed.

13. Copies of restrictive covenants have been provided.

Upon Completion of Construction

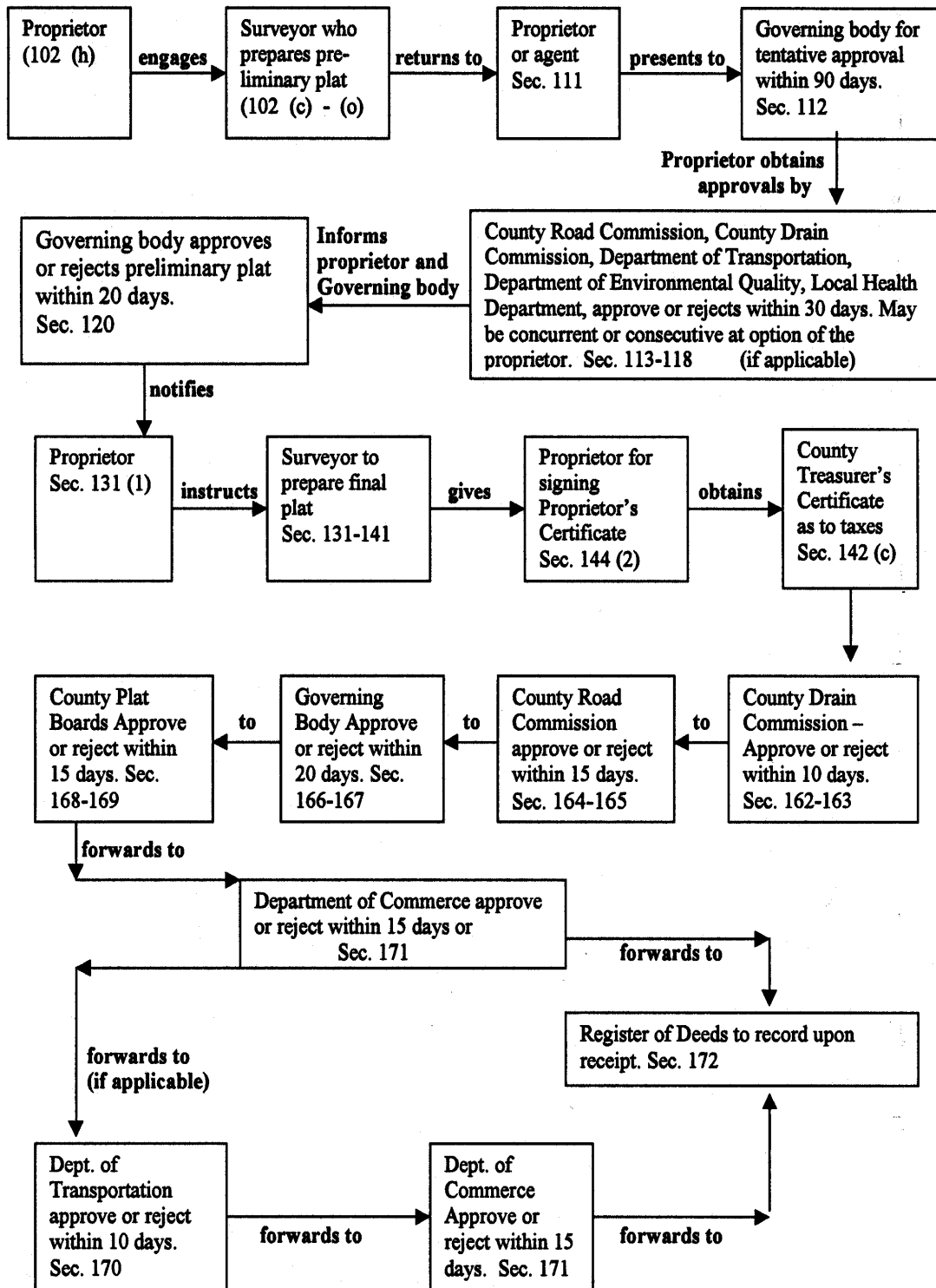
14. Guarantee for repairs of any defects in the work for a period of one year is provided

15. Construction record drawings are provided.

16. Engineer's certificate is provided.

17. Maintenance deposit is provided.

SUBDIVISION CONTROL ACT FLOW CHART
ACT 288 OF 1967 – EFFECTIVE JANUARY 1, 1968



SB112, AS PASSED 12-13-96

for Parent parcels or tracts "lawfully in existence" on effective date
 nital Split Rights for:

Redivision Rights for:

Number of allowable splits under current law	Parent Parcel Size	Number of allowable divisions under SB 112- section 108	Number of allowable divisions with bonus- section 108	40% of parent parcel acreage	Average size of divisions	60% of parent parcel as a remainder (can be used for current use or future development)	Size of property for further partitioning	Number of allowable divisions	Number of allowable splits under current law
5	20 acres	5	7	8 acres	1.14 acres	12 acres	10 acres or less	2	4
6	30 acres	6	8	12 acres	1.5 acres	18 acres	20 acres	3	5
7	40 acres	7	9	16 acres	1.78 acres	24 acres	30 acres	4	6
8	50 acres	8	10	20 acres	2.00 acres	30 acres	40 acres	5	7
9	60 acres	9	11	24 acres	2.18 acres	36 acres	50 acres	6	8
10	70 acres	10	12	28 acres	2.33 acres	42 acres	60 acres	7	9
11	80 acres	11	13	32 acres	2.46 acres	48 acres	70 acres	7 or 8 if all exemptions are used in 40% of the parcel	10

12	90 acres	12	14	36 acres	2.57 acres	54 acres	80 acres	7 or 9 if all exemptions are used in 40% of the parcel	11
13	100 acres	13	15	40 acres	2.67 acres	60 acres	90 acres and above	7 or 10 if all exemptions are used in 40% of the parcel	12
14	110 acres	14	16	44 acres	2.75 acres	66 acres	110 acres	7 or 10*	13
15	120 acres	15	17	48 acres	2.82 acres	72 acres	120 acres	7 or 10*	14
16	160 acres	16	18	64 acres	3.56 acres	96 acres	160 acres	7 or 10*	15
17	200 acres	17	19	80 acres	4.21 acres	120 acres	200 acres	7 or 10*	16
18	240 acres	18	20	96 acres	4.80 acres	144 acres	240 acres	7 or 10*	17
19	280 acres	19	21	112 acres	5.33 acres	168 acres	280 acres	7 or 10*	18
20	320 acres	20	22	128 acres	5.82 acres	192 acres	320 acres	7 or 10*	19
21	360 acres	21	23	144 acres	6.26 acres	216 acres	360 acres	7 or 10*	20
22	400 acres	22	24	160 acres	6.67 acres	240 acres	400 acres	7 or 10*	21
23	440 acres	23	25	176 acres	7.04 acres	264 acres	440 acres	7 or 10*	22
24	480 acres	24	26	192 acres	7.38 acres	288 acres	480 acres	7 or 10*	23
25	520 acres	25	27	208 acres	7.70 acres	312 acres	520 acres	7 or 10*	24

59	560 acres	26	28	224 acres	8.00 acres	336 acres	560 acres	7 or 10*	59
63	600 acres	27	29	240 acres	8.28 acres	360 acres	600 acres	7 or 10*	63
83	800 acres	32	34	320 acres	9.41 acres	480 acres	800 acres	7 or 10*	83
103	1000 acres	37	39	400 acres	10.26 acres	600 acres	1000 acres	7 or 10*	103
123	1200 acres	42	44	480 acres	10.91 acres	720 acres	1200 acres	7 or 10*	123

* 7 exemptions or 10 exemptions if all exemptions are used in 40% of the parcel

Regarding Initial Splits:

- * For the first time ever, local units of government have the ability to review adequately exempt divisions
- * For the first time, a farmland disclosure statement is placed on all deeds for parcels of unplatted land
- * Parent parcels of 10 acres or smaller are allowed four (4) exemptions with no bonus provision
- * The bonus provision encourages divisions to be used within 40% of the parent parcel, leaving a remainder of land for current use and/or future development
- * This proposal encourages preservation of farm land, forestry and open space
- * This is an incentive proposal versus a mandated formula, therefore guaranteeing personal property rights

Regarding Redivision Rights:

- * The redivision provision was added in the House version of SB 112 and amended in the Senate
- * Redivision rights also encourage divisions to be used within 40% of the parcel, leaving a remainder of land for current use and/or future development
- * Redivision rights also encourage the preservation of farm land, forestry and open space through the 60% remainder provision
- * Redivision rights also take into account personal property rights

Worksheet to determine permissible number of splits

A division, together with any previous division of the same parent parcel or parent tract, shall result in a total number of parcels which does not exceed the following calculation.

TOTAL ACREAGE IN PARENT PARCEL OR TRACT: _____
60% OF PARCEL/TRACT: _____

Original formula for counted divisions:

For the first 10 acres or fraction thereof in the parent parcel or tract, 4 parcels

4 SPLITS
REMAINING WHOLE 10
ACRE PARCELS: _____

For each whole 10 acres in excess of the first 10 acres in the parent parcel or parent tract, 1 additional parcel, for up to a maximum of 11 additional parcels (bonus formula may apply below)

_____ SPLITS
Remaining Whole 40 Acre Parcels
In Excess of the First 120
Acres: _____

For each whole 40 acres in excess of the first 120 acres in the parent parcel or parent tract, 1 additional parcel.

_____ SPLITS

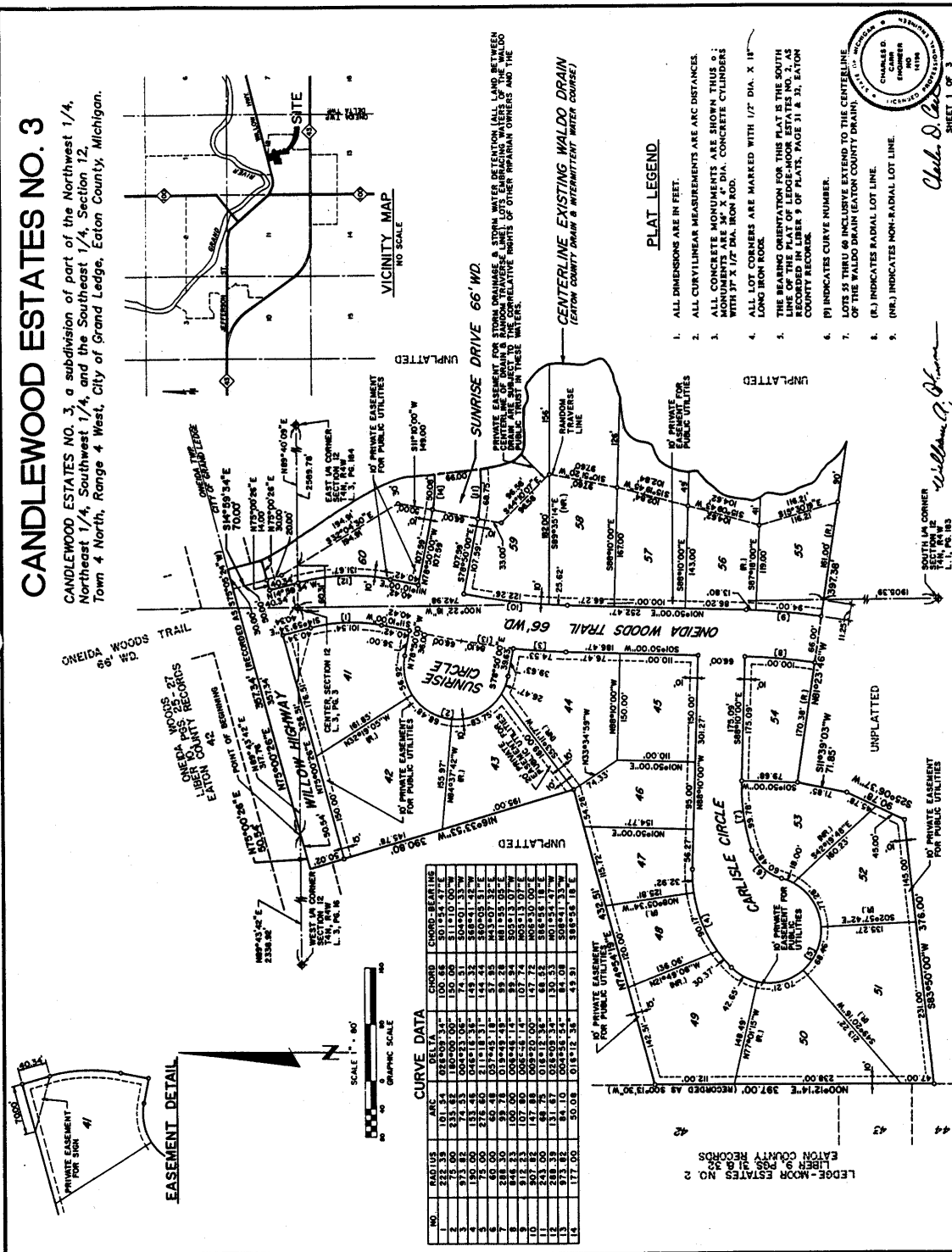
Bonus formula for counted divisions:

For a parent parcel or parent tract of not less than 20 acres, the division may result in a total of 2 parcels in addition to those permitted above if either no new driveway access is created or required for any of the parcels, or if one of the resulting parcels under the original formula and this bonus provision comprises not less than 60% of the area of the parent parcel or tract.

No new access _____
60% resulting parcel _____

_____ 2 SPLITS
_____ NO SPLITS

TOTAL COUNTED DIVISIONS _____



CANDLEWOOD ESTATES NO. 3

CANDLEWOOD ESTATES NO. 3, a subdivision of part of the Northwest 1/4, Northeast 1/4, Southwest 1/4, and the Southeast 1/4, Section 12, Town 4 North, Range 4 West, City of Grand Ledge, Eaton County, Michigan.

CERTIFICATE OF MUNICIPAL APPROVAL

I certify that this plan was approved by the City Council of the City of Grand Ledge at a public hearing held on the 20th day of August, 1957, and was approved and found to be in compliance with Act 281, P.A. of 1947. That priority has been passed to insure the installation of public sewer and public water services.

Franklin Robinson
City of Grand Ledge

COURT PLAT BOARD CERTIFICATE

This plat has been reviewed and is approved by the Eaton County Plat Board on the 20th day of August, 1957, as being in compliance with all of the provisions of Act 281, P.A. 1947, and the plat board's applicable rules and regulations.

Edward M. Myers
Chairman, Board of Commissioners

Alvin Starr
County Treasurer

Linda M. Trischel
Register of Deeds and County Clerk

COURT TREASURER'S CERTIFICATE

The records in my office show no unpaid taxes or special assessments for the five years preceding 11-11-57, involving the lands included in this plat.

Alvin Starr
Eaton County Treasurer

COURT DRAIN COMMISSIONER'S CERTIFICATE

Approved on Feb. 9, 1957, in compliance with Section 195 of Act 281, P.A. 1947 and the applicable rules and regulations published by my office in the County of Eaton.

Edith Chapman
Eaton County Drain Commissioner

CERTIFICATE OF PLANNING COMMISSION

I certify that this plat was approved by the Planning Commission of the City of Grand Ledge at a meeting held 12 December, 1957.

John A. Warkley
John A. Warkley - Chairman

RECORDING CERTIFICATE

This plat was received for record on the _____ day of _____, 19____ at _____, and recorded in Liber _____ of plats on Page(s) _____
State of Michigan }
Eaton County }

Linda M. Trischel, Register of Deeds



QUESTIONS & ANSWERS

1. **When are Contract Documents required?**

- A. Some type of an agreement to document the scope of work and compensation should be provided for all work. A purchase order or agreement to complete maintenance on a time and material basis may be appropriate for routine maintenance, although insurance coverage should still be verified. Contract Documents provide important safeguards for all parties under most types of drain work.

2. **What does a rainfall with a 100-year rainfall frequency mean?**

- A. Rainfall frequency is a statistical term to define the probability that over a long period of record an amount of rainfall will be equaled or exceeded at a certain frequency (i.e., a 100-year frequency). Confusion often occurs because there are different volumes of rainfall for different rainfall durations. A 15-minute duration may be the critical time of concentration for a small parking lot, whereas a 24-hour duration is necessary to cause flooding in a large river basin. Often, when people speak of having had numerous 100-year rainfall events within the past several years, they are remembering storms with different durations, none of which may have been the critical time of concentration at the area of concern.

3. **How do we know which type of computer model should be used?**

- A. Simple approaches such as the rational formula or SCS TR-55 are useful planning tools to provide an order of magnitude runoff value. A more sophisticated model such as TR-20, SWMM, HEC-1, OR HEC RAS should be developed for most design applications to provide greater accuracy.

4. **How do soil conditions impact the rate of storm water runoff?**

- A. During the first part of a storm, rain is intercepted by vegetation, stored in depressions, and infiltrates into the soil. Runoff occurs when the rainfall intensity exceeds these initial losses. Saturated soil or frozen ground conditions will reduce the rate of infiltration and increase runoff. These initial losses become less important in watersheds with relatively impervious soil or ground cover and during major floods.